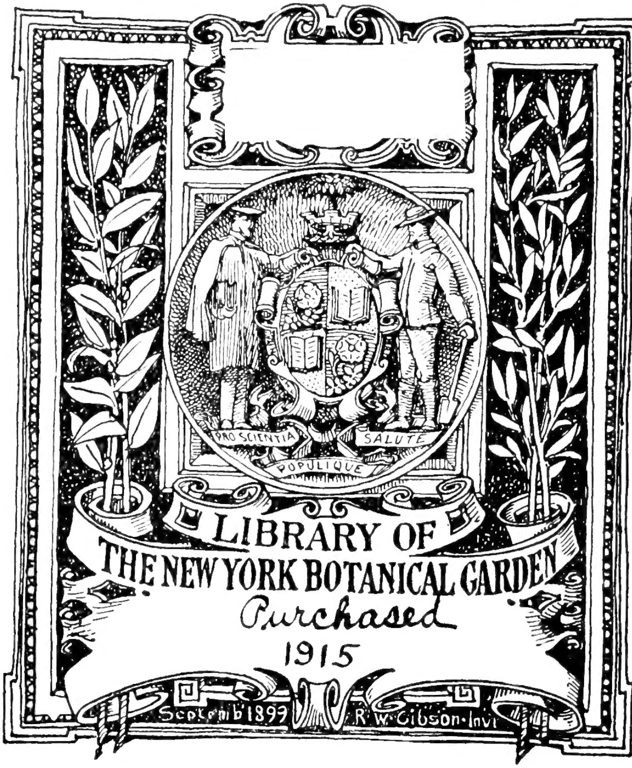
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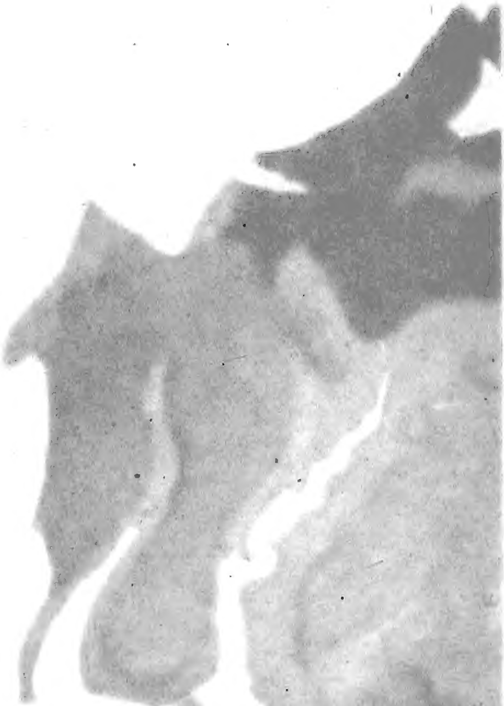

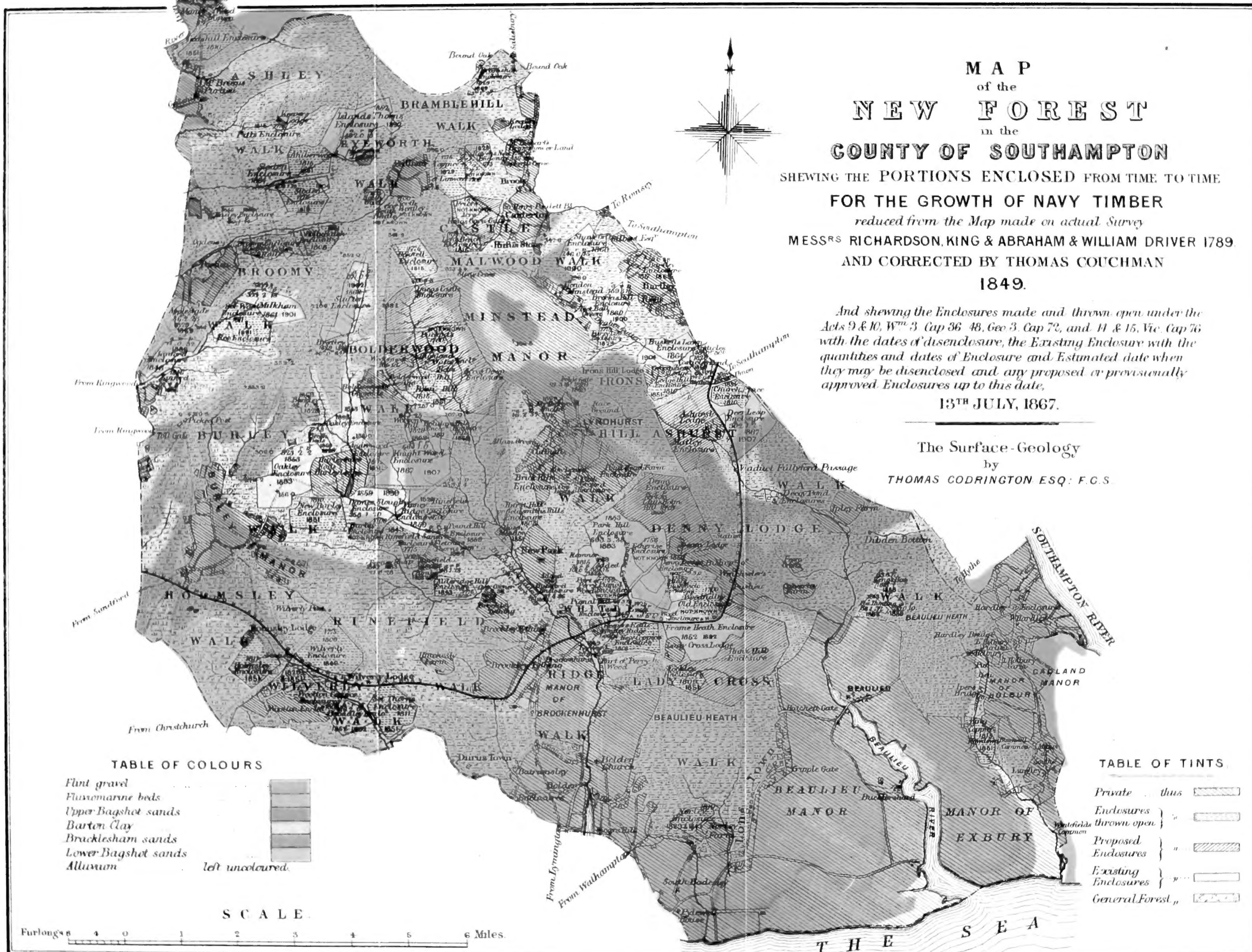


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THE

# JOURNAL

OF THE

# ROYAL AGRICULTURAL SOCIETY

# OF ENGLAND.

SECOND SERIES.

VOLUME THE SEVENTH.

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PRACTICE WITH SCIENCE.

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JOHN MURRAY, ALBEMARLE STREET.
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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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# CONTENTS OF VOL. VII.

## SECOND SERIES.



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## APPENDIX.



## DIRECTIONS TO THE BINDER.

Plan of Breton's Sewage Farm, Romford .. .. .. .. .. .. to face page 401

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

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

## ERRATA IN No. XIII. (Second Series). Vol. vii., Part I.

Page 13. Title of Fig. 5 dele "*by Horse or other power.*"

Page 21. Line 11 from bottom, *for* "ordinary" *read* Millar.

Page 22. Line 4 from bottom, *after* "quarts" *insert* "daily;" and *after* "The pipe at A," *insert* "(Fig. 15)."

Page 30. Lines 14 to 18 should read, "Fig. 26 represents a perspective view of a cheese made according to this improvement. It rests upon a table with scale-board (E), and with knife (F) for cutting into different weights, according to the measurement on the scale E."

Page 152. Lines 24 and 34, *for* "sit out" *read* renew.

# CONTENTS OF PART I., VOL. VII.

## SECOND SERIES.

## APPENDIX.



## DIRECTIONS TO THE BINDER.

Map of the New Forest .. .. .. .. .. .. .. .. .. to face page 239.

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

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

# VITAL STATISTICS:—POPULATION; BIRTHS; DEATHS; EMIGRATION; METEOROLOGY; IMPORTATIONS OF GRAIN; SALES OF BRITISH WHEAT; PRICES OF CORN AND OTHER PRODUCE; AND PAUPERISM, &c.

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

Population of the United Kingdom, estimated to the middle of the year 1870 (exclusive of islands in the British seas):—

| | |
|---|---|
| Males .. .. .. .. .. | 14,805,183 |
| Females .. .. .. .. | 16,033,027 |
| | 30,838,210 |

| | England. | Scotland. | Ireland. |
|---|---|---|---|
| Males .. .. | 10,635,905 | 1,518,640 | 2,650,638 |
| Females .. .. | 11,454,258 | 1,704,197 | 2,874,572 |
| Total .. | 22,090,163 | 3,222,837 | 5,525,210 |

## ENGLAND AND WALES.

### Births and Deaths in the Last Six Months of 1870.

*Summer Quarter (July, August, September)*.—Births registered were 192,178. The annual birth-rate of the season to 1000 persons living was 34·5; the average during the ten corresponding summers of 1860-69 was 34·1.

Deaths registered were 124,258. The annual death-rate of the season per 1000 of population was 22·3, or 1·7 over the average, which was 20·6.

The mortality of the quarter experienced by the people inhabiting the chief towns was at the annual rate of 24·0 per 1000 of population, the average being 23·0. In districts that comprise small towns, villages, and open country, it was 20·0, the average being 17·6.

The people married during the quarter at the annual rate of 15·8 per 1000 of population, while the average of ten preceding quarters was 16·4. The summer marriage-rate has declined every year since 1865.

Best potatoes were 6*s.* per cwt. at Waterside Market, Southwark; the prices in the two previous summers having been 7*s.* 4*d.* and 5*s.* 6*d.* per cwt. Beef, by the carcase, was 6*d.* per lb. at the Metropolitan

Market; $4\frac{3}{4}d.$ for inferior, $7\frac{1}{4}d.$ for superior meat. Mutton was dearer; it was on an average $6\frac{5}{8}d.$ per lb.; $5\frac{1}{4}d.$ for inferior, $8d.$ for superior meat. The price of mutton has risen $1d.$ a lb. during the last three summers; beef slightly rose and fell; it is now cheaper than mutton.

During the quarter under review English emigrants, to the number of 30,548, sailed from the ports of the United Kingdom. The emigrants of Scotch birth numbered 7311, and of Irish 16,563. The destination of 52,399 emigrants was the United States; 9656 went to British North America, 5126 to the Australian Colonies, and 1198 to various other places. In comparison with corresponding summer quarters, the tide of emigration has been higher in the last two summers than in any previous summer since 1854.

*Autumn Quarter* (*October, November, December*).—Births registered were 190,026. The annual birth-rate of the season per 1000 of population was 34·0; the average of ten autumns (1860-69) was 33·8.

Deaths registered were 126,049. The annual death-rate of the season per 1000 of population was 22·6; the average of ten autumns (1860-69) was 22·0.

BIRTHS and DEATHS in England in 1870.

| | Births in 1870. | Annual Birth-rate to 1000 persons living (1870). | Average Birth-rate to 1000 persons living (1860-69). |
|---|---|---|---|
| First Quarter: Jan., Feb., March .. | 206,441 | 38·05 | 37·02 |
| Second Quarter: April, May, June .. | 203,484 | 37·00 | 36·52 |
| Third Quarter: July, Aug., Sept. .. | 192,178 | 34·47 | 34·09 |
| Fourth Quarter: Oct., Nov., Dec. .. | 190,026 | 34·00 | 33·82 |
| Year .. .. .. .. .. | 792,129 | 35·86 | 35·38 |

| | Deaths in 1870. | Annual Death-rate to 1000 persons living (1870). | Average Death-rate to 1000 persons living (1860-69). |
|---|---|---|---|
| First Quarter: Jan., Feb., March .. | 143,991 | 26·54 | 25·32 |
| Second Quarter: April, May, June .. | 121,246 | 22·05 | 22·05 |
| Third Quarter: July, Aug., Sept. .. | 124,258 | 22·29 | 20·61 |
| Fourth Quarter: Oct., Nov., Dec. .. | 126,049 | 22·56 | 22·03 |
| Year .. .. .. .. .. | 515,544 | 23·34 | 22·51 |

The natural increase of population by excess of births over deaths was 63,977; and if it were not for the disturbing elements of emigration and immigration, this natural increment would suffice for determining the number of the population at any given time.

The number of emigrants who sailed from British ports, in the last three months of 1870, was 38,460; of these 18,599 were of

English, 3754 of Scotch, and 8641 of Irish origin; 7466 were foreigners. The destination of 13,210 of the English emigrants was the United States; 1063 went to the North American Colonies; 2662 to Australia; and 1664 to other places.

Since the autumn of 1868 beef has risen 11 per cent. in price, and mutton 18 per cent. Best potatoes averaged 70*s.* per ton at the Waterside Market, Southwark, being cheaper by 17*s.* 6*d.* and 35*s.* per ton than in the corresponding quarters of 1869 and 1868.

The public health has not recovered from the depression of the summer; but the mortality in the 20 great cities of the United Kingdom is less than it was in the autumn quarters of the two previous years. In London the mortality-rate was between 2 and 3 in 1000 less than it was in the previous year. The mortality was low in Portsmouth, Wolverhampton, Birmingham, Hull, Sunderland, and Newcastle-upon-Tyne. It was high in Norwich, Bristol, and Leicester; in Liverpool the mortality rose to 38 in 1000. What diseases were fatal in Liverpool? Scarlet fever, fever in its various forms, small-pox, measles, and whooping-cough; besides various forms of violence, to which 196 persons succumbed.

### The United Kingdom in the Year 1870.

In the United Kingdom 1,057,622 births and 680,220, deaths were registered during the year; and the excess of births over deaths, amounting to 377,402, would represent the natural increase of the population, were it not that registration in Ireland is so exceedingly defective as to require a correction of the registered numbers for that division of the Kingdom, the effect of which is to make the natural increase for the year 387,117. The returns of the Emigration Commissioners show that 207,306 emigrants of home origin sailed during the year from ports at which there are emigration officers; deducting these from the natural increase by excess of births, the actual population increment for the year is 179,811, which is at the rate of 493 per day. It must be understood, however, that this result is only approximative, as an indefinite number of persons leave this country every year whose departure is not registered, and in the same way there is an influx from abroad which may or may not balance the outflow. The corrected birth-rate of the year was 36, and the death-rate 23 per 1000 persons living. Emigration fell off by 1087 as compared with the previous year, but the returns for both years were much higher than for any previous year since 1854. Of 256,940 emigrants, 107,926 were of English, 23,471 of Scotch, and 75,909 of Irish origin; 49,634 were of foreign extraction. The destination of 196,075 emigrants was the United States,

A 2

35,295 sailed for the North American Colonies, 17,065 for the Australian Colonies, and 8505 for various other places.

## METEOROLOGY.

*Third Quarter* (*July, August, September*).—The cold and variable weather which set in on June 22nd continued to July 3rd; it changed on the 4th to warm and fine, with light westerly wind. This change of weather exercised a great influence on the growing crops, which up to this time were in a doubtful condition. This period of fine, bright, and warm weather continued up to August 18th, the excess of temperature during these 46 days was more than $3\frac{1}{2}^\circ$ daily. The growing crops ripened, harvest operations began in the southern counties in the third week in July, and extended all over the South and generally into the Midland districts by the end of the month. On the 19th day of August the temperature passed below its average, and it continued generally low till near the end of the quarter; but the weather, however, continued very fine, and frequently nearly cloudless, and this was particularly the case during the last ten days of the quarter. The deficiency of temperature below the average in the 43 days ending September 30th was rather more than $1\frac{1}{2}^\circ$ daily.

The fine and mild weather, particularly towards the end of September, enabled the farmers in the North to secure in good condition nearly all the outstanding crops. At the end of the quarter scarcely any of the corn crops were left standing. Potatoes proved to be generally of good quality. The weather in these three months was as favourable as could be desired for all farming operations, and at the end of the quarter preparations were general for autumn sowing and other autumnal field work.

Upon the whole quarter of 92 days, the period of warm weather having been more above the average than the period of cold was below, there was an excess of temperature on the average of a little less than $1^\circ$ daily.

The mean temperature of the quarter was $60^\circ{\cdot}7$, or $1^\circ{\cdot}2$ above the average of 99 years. In July it was $3^\circ{\cdot}9$ higher than the average; in August $0^\circ{\cdot}4$ higher; and in September $0^\circ{\cdot}8$ lower than the average.

*Wheat was cut* on the 18th of July at Hawarden; on the 19th at Weybridge; on the 20th at Worthing and Taunton; on the 21st at Osborne and Cardington; on the 22nd at Guernsey; on the 23rd at Helston; on the 25th at Little Wratting and Leamington; on the 26th at Portsmouth; on the 27th at Hull; and on the 28th at Boston. On the 1st of August at Llandudno; on the 12th at Miltown; and on the 18th at Culloden.

*Barley was cut* on the 16th of July at Helston; on the 21st at Weybridge; on the 29th at Taunton and Llandudno; and on the 30th at Cardington. On the 13th of August at Culloden; and on the 18th at Guernsey.

*Oats were cut* on the 7th of August at Helston; on the 14th at Taunton; on the 15th at Worthing; on the 21st at Weybridge and Boston; and on the 30th at Cardington. On the 3rd of August at Llandudno: and on the 5th at Miltown and Culloden.

*Fourth Quarter* (*October, November, December*).—During the month of October there were constant alternations of temperature; for two or three days together it was in excess of the average, and for two or three days together in defect. Upon the whole month there was a deficiency averaging $\frac{1}{2}°$ daily. On November 1st a cold period set in and continued till the 19th; the average daily deficiency of temperature for this period amounted to $4\frac{3}{4}°$. This was followed by a period of ten warm days, the daily average excess of temperature being $4\frac{1}{2}°$ nearly. Another very cold period set in on the 30th of November, and continued to December 11th, the deficiency of temperature was on the average of days as large as $7\frac{3}{4}°$. From the 12th of December to the 20th, both days inclusive, the weather was warm; on the 14th, its mean value was 52°·5 or 12° in excess of its average, the mean daily excess for the 9 days was $4\frac{1}{4}°$. A very great change took place on the 21st, when the mean value was 27°·7 or 24°·8 of lower temperature for the whole day than it was a few days previously; snow-falls were frequent and heavy everywhere. On Christmas-day it was lower still, its mean value was as low as 20°·6; the day was painfully cold.

With reference to extreme low temperatures, Mr. Glaisher shows that the day of lowest temperature since 1814 was on January 20, 1838 (10°·7); the next in order of severity were 1816, February 9 (12°·6), and 1841, January 8 (12°·8). Of these days of remarkably low temperature, eleven only have taken place in the last 30 years, six in January, two in February, and three in December, the last two occurring both on Christmas-day, the one in 1860, the other in 1870.

The temperature on December 25, 1870, descended to a very low point; it was the minimum for the month at many stations, but not at all. The lowest reading took place on the 23rd and 24th, at a few places, and on the 25th or 31st, at a greater and nearly an equal number of places.

The cold in the eleven days ending December 31, 1870, was more rigorous than in any period of similar length since February, 1855.

The mean temperature of the quarter under review was 41°·6, or 2°·1 below the average of 99 years. The mean temperature of December was 33°·6, being 5°·6 lower than the average.

METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1870.

| 1870. | Temperature of | | | | | | | | | | Elastic Force of Vapour. | | Weight of Vapour in a Cubic Foot of Air. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air. | | | Evaporation. | | Dew Point. | | Air—Daily Range. | | Water of the Thames. | | | | |
| MONTHS. | Mean. | Diff. from average of 99 years. | Diff. from average of 29 years. | Mean. | Diff. from average of 29 years. | Mean. | Diff. from average of 29 years. | Mean. | Diff. from average of 29 years. | | Mean. | Diff. from average of 29 years. | Mean. | Diff. from average of 29 years. |
| | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | in. | in. | grs. | grs. |
| July .. .. | 65·4 | +3·9 | +3·5 | 59·7 | +2·2 | 55·0 | +1·3 | 22·1 | +1·0 | .. | 0·433 | +0·019 | 4·8 | +0·2 |
| August .. | 61·1 | +0·4 | −0·2 | 56·2 | −1·1 | 52·0 | −1·8 | 19·5 | −0·1 | .. | 0·388 | −0·029 | 4·3 | −0·3 |
| September .. | 55·7 | −0·8 | −1·6 | 53·0 | −1·1 | 50·5 | −0·7 | 20·4 | +1·9 | .. | 0·367 | −0·014 | 4·1 | −0·1 |
| Mean .. | 60·7 | +1·2 | +0·6 | 56·3 | 0·0 | 52·5 | −0·4 | 20·7 | +0·9 | .. | 0·396 | −0·008 | 4·4 | −0·1 |
| | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | in. | in. | grs. | grs. |
| October .. | 49·8 | +0·1 | −0·6 | 47·6 | −0·8 | 45·3 | −0·9 | 15·4 | +0·7 | .. | 0·303 | −0·012 | 3·5 | −0·2 |
| November | 41·5 | −0·9 | −2·3 | 40·2 | −1·3 | 38·5 | −1·2 | 12·4 | +0·7 | .. | 0·233 | −0·016 | 2·7 | −0·1 |
| December .. | 33·6 | −5·6 | −6·9 | 32·3 | −6·7 | 29·8 | −7·4 | 9·1 | −0·4 | .. | 0·166 | −0·058 | 1·9 | −0·7 |
| Mean .. | 41·6 | −2·1 | −3·3 | 40·0 | −2·9 | 37·9 | −3·2 | 12·3 | +0·3 | .. | 0·231 | −0·029 | 2·7 | −0·3 |

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.

METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1870.

| 1870. MONTHS. | Degree of Humidity. | | Reading of Barometer. | | Weight of a Cubic Foot of Air. | | Rain. | | Daily Horizontal movement of the Air. | Reading of Thermometer on Grass. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Number of Nights it was | | | Lowest Reading at Night. | Highest Reading at Night. |
| | Mean. | Diff. from average of 29 years. | Mean. | Diff. from average of 29 years. | Mean. | Diff. from average of 29 years. | Amount. | Diff. from average of 55 years. | | At or below 30°. | Between 30° and 40°. | Above 40°. | | |
| | | | in. | in. | grs. | grs. | in. | in. | Miles. | | | | ° | ° |
| July .. .. | 70 | − 5 | 29·818 | +0·011 | 525 | − 3 | 2·0 | −0·6 | 221 | 0 | 3 | 28 | 36·8 | 60·3 |
| August .. | 73 | − 4 | 29·804 | +0·013 | 529 | 0 | 2·0 | −0·4 | 241 | 0 | 7 | 24 | 31·0 | 60·0 |
| September .. | 83 | + 2 | 29·908 | +0·097 | 537 | + 4 | 1·6 | −0·8 | 228 | 2 | 17 | 11 | 30·0 | 50·5 |
| | | | | | | | Sum | Sum | Mean | Sum | Sum | Sum | Lowest | Highest |
| Mean .. | 75 | − 2 | 29·843 | +0·040 | 530 | 0 | 5·6 | −1·8 | 230 | 2 | 27 | 63 | 30·0 | 60·3 |
| | | | in. | in. | grs. | grs. | in. | in. | Miles | | | | ° | ° |
| October .. | 85 | − 2 | 29·570 | −0·136 | 537 | − 2 | 3·3 | +0·5 | 327 | 4 | 21 | 6 | 24·5 | 46·0 |
| November .. | 90 | + 2 | 29·637 | −0·129 | 548 | 0 | 1·2 | −1·2 | 240 | 16 | 11 | 3 | 22·1 | 41·1 |
| December .. | 86 | − 2 | 29·733 | −0·075 | 559 | + 7 | 3·1 | +1·1 | 242 | 21 | 9 | 1 | 3·8 | 41·8 |
| | | | | | | | Sum | Sum | Mean | Sum | Sum | Sum | Lowest | Highest |
| Mean .. | 87 | − 1 | 29·647 | −0·113 | 548 | + 2 | 7·6 | +0·1 | 270 | 41 | 41 | 10 | 3·8 | 46·0 |

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

Since 1771 the following have been the only instances in which the corresponding temperatures for December have been lower, viz.: 1784, 31°·0; 1788, 29°·0; 1796, 30°·4; 1799, 32°·8; 1840, 33°·3; 1844, 33°·0; and 1846, 32°·9.

The *Aurora Borealis* was seen on the 1st, 2nd, 3rd, 14th, 15th, 17th, 18th, 20th, 21st, 22nd, 23rd, 24th (probably the most magnificent display seen for many years, it was seen at Malta, Italy, Syria, &c.), 25th, 26th, 27th, 28th, and 30th of October; on the 7th, 14th, 17th, 18th, 19th, 21st, 22nd, 23rd, and 25th of November; and on the 15th, 16th, and 17th of December.

## CORN: Importations, Sales, and Prices.

Quantities of Wheat, Wheatmeal and Flour, Barley, Oats, Peas and Beans, Imported into the United Kingdom in the Year 1870; and in each of the Last Six Months of the Year 1870.

| 1870. | Wheat. | Wheatmeal and Flour. | Barley. | Oats. | Peas. | Beans. |
|---|---|---|---|---|---|---|
| | cwts. | cwts. | cwts. | cwts. | cwts. | cwts. |
| In first Six Months | 13,843,124 | 2,476,192 | 3,824,222 | 4,467,633 | 879,425 | 768,002 |
| July .. .. | 2,878,873 | 363,012 | 614,192 | 1,260,195 | 287,164 | 134,211 |
| August .. | 3,056,936 | 378,699 | 568,728 | 1,509,685 | 284,851 | 96,171 |
| September | 3,129,983 | 352,697 | 451,102 | 1,022,580 | 88,820 | 85,291 |
| October .. | 3,060,794 | 449,842 | 669,190 | 745,398 | 77,888 | 134,511 |
| November | 2,511,726 | 360,562 | 475,658 | 812,734 | 81,348 | 152,842 |
| December | 2,544,706 | 434,484 | 640,689 | 1,042,370 | 99,882 | 141,148 |
| In last Six Months | 17,183,018 | 2,339,296 | 3,419,559 | 6,392,962 | 919,953 | 744,174 |
| Year .. | 31,026,142 | 4,815,488 | 7,243,781 | 10,860,595 | 1,799,378 | 1,512,176 |

Note.—The average weights *per quarter* of corn, as adopted in the office of the Inspector-General of Imports and Exports, are as follow:—For wheat, 485⅓ lbs., or 4⅓ cwts.; for barley, 400 lbs., or 3$\frac{4}{7}$ cwts.; for oats, 308 lbs., or 2¾ cwts. Corn has been entered and charged with duty by *weight* instead of *measure* since September, 1864.

Computed Real Value of Corn Imported into the United Kingdom in each of the Four Years, 1867-70.

| | 1867. | 1868. | 1869. | 1870. |
|---|---|---|---|---|
| | £. | £. | £. | £. |
| Wheat .. .. .. .. | 24,985,096 | 22,069,353 | 19,515,758 | 16,340,557 |
| Barley .. .. .. | 2,832,515 | 3,799,527 | 3,379,775 | 2,872,602 |
| Oats .. .. .. .. | 4,319,908 | 3,875,929 | 3,340,494 | 4,393,591 |
| Maize .. .. .. .. | 3,834,734 | 4,838,012 | 5,935,665 | 5,794,838 |
| Other kinds .. .. | 1,778,954 | 1,981,553 | 1,376,087 | 1,402,878 |
| Wheat Flour .. .. | 3,519,577 | 2,832,077 | 3,792,939 | 3,392,317 |
| Other kinds of Flour | 93,350 | 23,839 | 6,640 | .. |
| Total of Corn .. | 41,364,134 | 39,420,290 | 37,347,358 | 34,196,783 |

QUANTITIES of BRITISH WHEAT SOLD in the Towns from which Returns are received under the Act of the 27th and 28th VICTORIA, cap. 87, and their AVERAGE PRICES, in each of the LAST SIX MONTHS of the Years 1865-70.

| | Quantities in Quarters. | | | | | |
|---|---|---|---|---|---|---|
| | 1865. | 1866. | 1867. | 1868. | 1869. | 1870. |
| | quarters. | quarters. | quarters. | quarters. | quarters. | quarters. |
| Seventh month | 222,961 | 127,836 | 109,829 | 106,812 | 166,485 | 171,005 |
| Eighth month | 201,953 | 191,057 | 102,303 | 174,633 | 174,904 | 201,788 |
| Ninth month (five weeks) | 318,893 | 325,056 | 265,668 | 444,296 | 255,286 | 435,398 |
| Tenth month | 304,054 | 320,674 | 349,788 | 284,810 | 256,984 | 340,445 |
| Eleventh month | 295,632 | 284,530 | 265,622 | 268,848 | 220,876 | 298,407 |
| Twelfth month (five weeks) | 391,941 | 332,934 | 301,558 | 307,386 | 244,933 | 352,629 |

| | Average Prices per Quarter. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1865. | | 1866. | | 1867. | | 1868. | | 1869. | | 1870. | |
| | s. | d. | s. | d. | s. | d. | s. | d. | s. | d. | s. | d. |
| Seventh month | 42 | 10 | 54 | 1 | 65 | 1 | 65 | 6 | 49 | 5 | 50 | 9 |
| Eighth month | 43 | 3 | 50 | 7 | 68 | 0 | 57 | 9 | 52 | 1 | 53 | 11 |
| Ninth month (five weeks) | 44 | 0 | 49 | 0 | 63 | 5 | 55 | 1 | 51 | 4 | 47 | 0 |
| Tenth month .. | 41 | 10 | 52 | 4 | 66 | 7 | 53 | 11 | 47 | 8 | 47 | 4 |
| Eleventh month | 45 | 7 | 56 | 6 | 69 | 9 | 52 | 2 | 46 | 8 | 50 | 1 |
| Twelfth month (five weeks) | 46 | 8 | 60 | 3 | 67 | 7 | 50 | 2 | 44 | 2 | 52 | 4 |

AVERAGE PRICES of BRITISH WHEAT, BARLEY, and OATS per Quarter (Imperial Measure) as received from the INSPECTORS and OFFICERS of EXCISE according to the Act of 27th and 28th VICTORIA, cap. 87, in each of the last TWENTY-SIX WEEKS of the Year 1870.

| Week ending | Wheat. | | Barley. | | Oats. | | Week ending | Wheat. | | Barley. | | Oats. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | s. | d. | s. | d. | s. | d. | | s. | d. | s. | d. | s. | d. |
| July 9 .. | 50 | 7 | 30 | 3 | 25 | 8 | October 8 .. | 46 | 5 | 36 | 11 | 21 | 11 |
| July 16 .. | 49 | 8 | 31 | 2 | 25 | 6 | October 15 | 47 | 0 | 36 | 7 | 22 | 5 |
| July 23 .. | 49 | 9 | 31 | 2 | 26 | 11 | October 22 | 47 | 3 | 36 | 5 | 22 | 2 |
| July 30 .. | 52 | 10 | 33 | 5 | 26 | 9 | October 29 | 48 | 6 | 36 | 9 | 22 | 4 |
| August 6 .. | 54 | 11 | 31 | 8 | 28 | 8 | November 5 | 49 | 9 | 36 | 8 | 22 | 7 |
| August 13 .. | 54 | 10 | 32 | 11 | 28 | 0 | November 12 | 50 | 5 | 36 | 11 | 23 | 8 |
| August 20 .. | 54 | 7 | 33 | 5 | 25 | 10 | November 19 | 49 | 10 | 36 | 8 | 23 | 11 |
| August 27 .. | 51 | 3 | 36 | 8 | 24 | 6 | November 26 | 50 | 5 | 36 | 2 | 23 | 7 |
| September 3 | 49 | 1 | 36 | 2 | 25 | 9 | December 3 | 52 | 5 | 36 | 1 | 23 | 10 |
| September 10 | 48 | 1 | 35 | 8 | 23 | 10 | December 10 | 52 | 2 | 35 | 9 | 23 | 7 |
| September 17 | 46 | 6 | 36 | 4 | 23 | 9 | December 17 | 52 | 5 | 35 | 4 | 23 | 4 |
| September 24 | 45 | 4 | 36 | 2 | 20 | 7 | December 24 | 52 | 7 | 34 | 11 | 23 | 6 |
| October 1 .. | 46 | 1 | 36 | 7 | 22 | 8 | December 31 | 52 | 3 | 34 | 11 | 22 | 5 |
| Average of Summer Quarter | 50 | 4 | 33 | 9 | 25 | 3 | Average of Autumn Quarter | 50 | 1 | 36 | 1 | 23 | 0 |

## ACREAGE under each Description of CROP, FALLOW, and GREAT BRITAIN and

| DESCRIPTION of CROPS and LIVE STOCK. | GREAT BRITAIN. | | |
|---|---|---|---|
| | 1868. | 1869. | 1870. |
| **CORN CROPS:—** | Acres. | Acres. | Acres. |
| Wheat .. .. .. .. .. .. .. | 3,652,125 | 3,688,357 | 3,500,543 |
| Barley or Bere .. .. .. .. .. | 2,151,324 | 2,251,480 | 2,371,739 |
| Oats .. .. .. .. .. .. .. | 2,757,053 | 2,782,720 | 2,763,300 |
| Rye .. .. .. .. .. .. .. | 46,896 | 64,099 | 65,166 |
| Beans .. .. .. .. .. .. .. | 529,900 | 575,204 | 530,095 |
| Peas .. .. .. .. .. .. .. | 296,234 | 396,177 | 317,198 |
| TOTAL CORN CROPS .. .. | 9,433,532 | 9,758,037 | 9,548,041 |
| **GREEN CROPS:—** | | | |
| Potatoes .. .. .. .. .. .. | 541,543 | 585,211 | 587,661 |
| Turnips and Swedes .. .. .. .. | 2,165,142 | 2,171,526 | 2,210,911 |
| Mangold .. .. .. .. .. .. | 249,041 | 292,742 | 306,531 |
| Carrots .. .. .. .. .. .. .. | 13,265 | 14,344 | 15,259 |
| Cabbage, Kohl-rabi, and Rape .. .. | 115,083 | 145,251 | 143,930 |
| Vetches, Lucerne, and any other crop (except clover or grass) .. .. .. | 301,792 | 365,993 | 322,438 |
| TOTAL GREEN CROPS.. .. | 3,385,866 | 3,575,067 | 3,586,730 |
| **OTHER CROPS, GRASS, &c.:—** | | | |
| Flax .. .. .. .. .. .. .. .. | 17,543 | 20,923 | 23,957 |
| Hops .. .. .. .. .. .. .. .. | 64,488 | 61,792 | 60,594 |
| Bare fallow or uncropped arable land | 958,221 | 738,836 | 610,517 |
| Clover and artificial and other grasses under rotation .. .. .. .. .. | 3,960,008 | 3,448,726 | 4,504,884 |
| Permanent pasture, meadow, or grass not broken up in rotation (exclusive of heath or mountain land) .. .. | 12,136,036 | 12,735,897 | 12,072,856 |
| **LIVE STOCK:—** | No. | No. | No. |
| Cattle .. .. .. .. .. .. .. | 5,423,981 | 5,313,473 | 5,403,317 |
| Sheep .. .. .. .. .. .. .. | 30,711,396 | 29,538,141 | 28,397,589 |
| Pigs .. .. .. .. .. .. .. | 2,308,539 | 1,930,452 | 2,171,138 |
| Total number of horses used for agriculture, unbroken horses, and mares kept solely for breeding .. .. .. .. .. | .. | .. | 1,266,709 |

Grass, and Number of Cattle, Sheep, and Pigs, in Ireland in 1868-9-70.

| Ireland. | | | United Kingdom, including the Islands. | | |
|---|---|---|---|---|---|
| 1868. | 1869. | 1870. | 1868. | 1869. | 1870. |
| Acres. | Acres. | Acres. | Acres. | Acres. | Acres. |
| 286,790 | 281,117 | 260,914 | 3,951,018 | 3,981,989 | 3,773,663 |
| 188,252 | 223,338 | 243,435 | 2,348,068 | 2,483,277 | 2,623,752 |
| 1,699,919 | 1,684,788 | 1,648,764 | 4,469,387 | 4,480,125 | 4,424,536 |
| 7,854 | 8,770 | 9,281 | 54,827 | 72,986 | 74,527 |
| 8,813 | 8,833 | 9,644 | 538,943 | 584,251 | 539,968 |
| 1,157 | 1,124 | 1,071 | 297,612 | 397,483 | 318,607 |
| 2,192,785 | 2,207,970 | 2,173,109 | 11,659,855 | 12,000,111 | 11,755,053 |
| 1,034,853 | 1,041,837 | 1,043,788 | 1,584,213 | 1,635,347 | 1,639,296 |
| 320,066 | 321,880 | 339,059 | 2,495,536 | 2,502,512 | 2,559,629 |
| 19,067 | 21,029 | 25,220 | 268,780 | 314,421 | 332,409 |
| 3,789 | 3,702 | 3,940 | 17,815 | 18,831 | 19,925 |
| 42,268 | 42,237 | 45,266 | 157,525 | 187,667 | 189,344 |
| 36,264 | 38,210 | 41,446 | 341,188 | 407,155 | 366,532 |
| 1,456,307 | 1,468,895 | 1,498,719 | 4,865,057 | 5,065,933 | 5,107,135 |
| 206,446 | 229,178 | 194,893 | 223,997 | 250,112 | 218,870 |
| .. | .. | .. | 64,488 | 61,792 | 60,594 |
| 24,017 | 20,981 | 19,054 | 984,246 | 761,369 | 630,294 |
| 1,691,797 | 1,669,800 | 1,775,835 | 5,690,318 | 5,149,552 | 6,320,126 |
| 10,003,918 | 10,046,877 | 9,990,968 | 22,164,584 | 22,811,284 | 22,085,295 |
| No. | No. | No. | No. | No. | No. |
| 3,620,352 | 3,727,794 | 3,796,380 | 9,083,416 | 9,078,282 | 9,235,052 |
| 4,822,444 | 4,648,158 | 4,333,984 | 35,607,812 | 34,250,272 | 32,786,783 |
| 862,443 | 1,079,793 | 1,459,332 | 3,189,167 | 3,028,394 | 3,650,730 |
| .. | .. | 531,306 | .. | .. | 1,808,040 |

Quantities of Wheat, Barley, Oats, Peas, Beans, Indian Corn or Maize, Wheatmeal and Flour, Imported in the Three Years 1868-9-70; also the Countries from which the Wheat, Wheatmeal, and Flour were obtained.

| | 1868. | 1869. | 1870. |
|---|---|---|---|
| Wheat from— | cwts. | cwts. | cwts. |
| Russia | 10,053,617 | 9,158,331 | 10,269,198 |
| Denmark | 654,419 | 549,811 | 327,919 |
| Prussia | 4,584,742 | 4,635,111 | 2,659,059 |
| Schleswig, Holstein, and Lauenburg | 45,412 | 57,454 | 24,176 |
| Mecklenburg | 647,205 | 690,147 | 457,205 |
| Hanse Towns | 756,654 | 736,134 | 287,982 |
| France | 56,414 | 468,274 | 253,644 |
| Illyria, Croatia, and Dalmatia | 1,004,701 | 1,030,563 | 60,472 |
| Turkey and Wallachia and Moldavia | 3,049,088 | 2,354,017 | 436,848 |
| Egypt | 3,219,536 | 1,004,479 | 104,950 |
| United States | 5,908,149 | 13,181,507 | 12,372,176 |
| Chili | 1,309,575 | 567,107 | 599,337 |
| British North America | 557,443 | 2,723,053 | 2,876,530 |
| Other countries | 792,813 | 539,840 | 296,646 |
| Total Wheat | 32,639,768 | 37,695,828 | 31,026,142 |
| Barley | 7,476,224 | 8,053,660 | 7,243,781 |
| Oats | 8,112,563 | 7,916,870 | 10,860,595 |
| Peas | 1,116,246 | 1,054,387 | 1,799,378 |
| Beans | 2,647,390 | 1,897,230 | 1,512,176 |
| Indian Corn, or Maize | 11,472,226 | 17,664,113 | 16,769,207 |
| Wheatmeal and Flour from— | | | |
| Hanse Towns | 615,756 | 647,430 | 671,690 |
| France | 632,359 | 1,348,061 | 645,181 |
| United States | 676,192 | 1,711,000 | 2,154,751 |
| British North America | 192,850 | 538,766 | 451,463 |
| Other countries | 975,865 | 1,156,298 | 892,403 |
| Total Wheatmeal and Flour | 3,093,022 | 5,401,555 | 4,815,488 |

## Computed Real Value of Corn Imported in the Year 1870.

The value of wheat imported in the year 1870 was 16,340,557*l.*, which is 3,175,201*l.* below the value of the quantity imported in the year 1869, and 5,728,796*l.* below the value in 1868, when it was 22,069,353*l.*

The value of wheat-meal and flour was 3,392,317*l.*, which is 400,622*l.* below the value imported in the year 1869, but 560,240*l.* more than that of 1868.

The value of barley imported in the year 1870 was 2,872,602*l.*, against 3,379,775*l.* in 1869, and 3,799,527*l.* in 1868.

The value of oats was 4,393,591*l.*, against 3,340,494*l.* in 1869, and 3,875,929*l.* in 1868.

'he AVERAGE PRICES of Consols, of Wheat, of Meat, and of Potatoes; also the AVERAGE NUMBER of PAUPERS relieved on the *last day* of each Week; and the MEAN TEMPERATURE, in each of the Twelve Quarters ending December 31st, 1870.

| | AVERAGE PRICES. | | | | | | PAUPERISM. | | |
|---|---|---|---|---|---|---|---|---|---|
| 'uarters ending | Consols (for Money). | Minimum Rate per Cent. of Discount charged by the Bank of England. | Wheat per Quarter in England and Wales. | Meat per lb. at the Metropolitan Meat Market (by the Carcase). Beef. | Mutton. | Best Potatoes per Ton at Waterside Market, Southwark. | Quarterly Average of the Number of Paupers relieved on the *last day* of each week. In-door. | Out-door. | Mean Temperature. |
| | £. | | *s.* *d.* | | | | | | ° |
| 1868 ar. 31 | 93 | 2·0 | 72 2 | 4¼*d.*—6½*d.* Mean 5⅜*d.* | 4¼*d.*—6½*d.* Mean 5⅜*d.* | 125*s.*—170*s.* Mean 147*s.*6*d.* | 159,716 | 860,165 | 41·4 |
| ıne 30 | 94⅜ | 2·0 | 71 10 | 4½*d.*—6¾*d.* Mean 5⅝*d.* | 4¾*d.*—7*d.* Mean 5⅞*d.* | 130*s.*—170*s.* Mean 150*s.* | 142,588 | 800,944 | 55·8 |
| 'pt. 30 | 94⅜ | 2·0 | 59 1 | 4½*d.*—6¾*d.* Mean 5⅝*d.* | 4¾*d.*—6¾*d.* Mean 5¾*d.* | 120*s.*—175*s.* Mean 147*s.*6*d.* | 138,284 | 778,804 | 63·9 |
| ec. 31 | 94⅜ | 2·4 | 51 11 | 4½*d.*—7*d.* Mean 5¾*d.* | 4½*d.*—6¾*d.* Mean 5⅝*d.* | 70*s.*—140*s.* Mean 105*s.* | 152,733 | 797,546 | 45·1 |
| 1869 ar. 31 | 92⅞ | 3·0 | 50 2 | 4¾*d.*—7¼*d.* Mean 6*d.* | 4¾*d.*—7½*d.* Mean 6⅛*d.* | 70*s.*—140*s.* Mean 105*s.* | 162,308 | 850,883 | 41·3 |
| ıne 30 | 93⅛ | 4·2 | 45 7 | 4¾*d.*—7½*d.* Mean 6⅛*d.* | 5*d.*—7¾*d.* Mean 6⅜*d.* | 60*s.*—130*s.* Mean 95*s.* | 145,094 | 816,260 | 52·0 |
| 'pt. 30 | 93 | 2·9 | 50 11 | 4¾*d.*—7½*d.* Mean 6⅛*d.* | 5¼*d.*—7½*d.* Mean 6⅜*d.* | 95*s.*—125*s.* Mean 110*s.* | 137,406 | 781,382 | 61·4 |
| ec. 31 | 93$\frac{4}{8}$ | 2·8 | 46 0 | 4¾*d.*—7½*d.* Mean 6⅛*d.* | 5*d.*—7½*d.* Mean 6¼*d.* | 75*s.*—100*s.* Mean 87*s.* 6*d.* | 152,021 | 813,753 | 43·3 |
| 1870 ar. 31 | 92⅝ | 3·0 | 42 3 | 4½*d.*—7*d.* Mean 5¾*d.* | 5¼*d.*—7¼*d.* Mean 6¼*d.* | 95*s.*—110*s.* Mean 102*s.*6*d.* | 164,387 | 892,822 | 38·0 |
| ıne 30 | 94 | 3·0 | 44 8 | 4½*d.*—6¾*d.* Mean 5⅝*d.* | 5¼*d*—7½*d.* Mean 6⅜*d.* | 115*s.*—135*s.* Mean 125*s.* | 144,226 | 825,337 | 54·4 |
| 'pt. 30 | 91⅜ | 3·9 | 50 4 | 4¾*d.*—7¼*d.* Mean 6*d.* | 5¼*d.*—8*d.* Mean 6⅝*d.* | 100*s.*—140*s.* Mean 120*s.* | 138,444 | 787,976 | 60·7 |
| ec. 31 | 92⅝ | 2·5 | 50 1 | 5*d.*—7¾*d.* Mean 6⅜*d.* | 5¼*d.*—8*d.* Mean 6⅝*d.* | 50*s.*—90*s.* Mean 70*s.* | 150,729 | 802,291 | 41·6 |

Average Prices of British Wheat, Barley, and Oats, per Imperial Quarter, in each of the Sixteen Years 1855-70.

| Year. | Wheat. | Barley. | Oats. | Year. | Wheat. | Barley. | Oats. |
|---|---|---|---|---|---|---|---|
| | s. d. | s. d. | s. d. | | s. d. | s. d. | s. d. |
| 1855 | 74 8 | 34 9 | 27 5 | 1863 | 44 9 | 33 11 | 21 2 |
| 1856 | 69 2 | 41 1 | 25 2 | 1864 | 40 2 | 29 11 | 20 1 |
| 1857 | 56 4 | 42 1 | 25 0 | 1865 | 41 10 | 29 9 | 21 10 |
| 1858 | 44 2 | 34 8 | 24 6 | 1866 | 49 11 | 37 5 | 24 7 |
| 1859 | 43 9 | 33 6 | 23 2 | 1867 | 64 6 | 40 0 | 26 1 |
| 1860 | 53 3 | 36 7 | 24 5 | 1868 | 63 9 | 43 0 | 28 1 |
| 1861 | 55 4 | 36 1 | 23 9 | 1869 | 48 2 | 39 5 | 26 0 |
| 1862 | 55 5 | 35 1 | 22 7 | 1870 | 46 10 | 34 7 | 22 10 |

Certain Articles of Foreign and Colonial Production Imported in the Years 1867-70; and their Quantities.

| | | 1867. | 1868. | 1869. | 1870. |
|---|---|---|---|---|---|
| Animals, Living: | | | | | |
| Oxen, Bulls, and Cows | number | 156,335 | 114,869 | 190,674 | 170,647 |
| Calves .. .. .. .. .. | ,, | 21,613 | 21,819 | 29,516 | 31,525 |
| Sheep .. .. .. .. | ,, | 532,316 | 323,447 | 691,472 | 651,138 |
| Lambs .. .. .. .. | ,, | 7,400 | 17,708 | 18,371 | 18,767 |
| Swine and Hogs .. .. | ,, | 48,079 | 33,721 | 69,067 | 95,624 |
| Bones (burnt or not, or as animal charcoal) .. .. .. .. | tons | 83,814 | 75,851 | 95,980 | 94,923 |
| Cotton, Raw .. .. .. | cwts. | 11,272,651 | 11,857,893 | 10,900,818 | 11,931,979 |
| Flax .. .. .. .. .. | ,, | 1,440,669 | 1,816,669 | 1,542,201 | 2,373,528 |
| Guano:—From Peru .. .. | tons | 164,112 | 155,776 | 199,122 | 243,434 |
| Other parts .. | ,, | 28,196 | 26,567 | 10,888 | 36,877 |
| Total Guano | ,, | 192,308 | 182,343 | 210,010 | 280,311 |
| Hemp .. .. .. .. .. .. | cwts. | 878,374 | 1,076,198 | 1,055,769 | 1,108,839 |
| Hops .. .. .. .. .. .. | ,, | 296,117 | 231,720 | 322,515 | 127,013 |
| Hides untanned: Dry .. | ,, | 280,063 | 305,318 | 340,449 | 527,809 |
| ,, ,, Wet .. | ,, | 615,822 | 635,794 | 524,899 | 670,941 |
| Petroleum .. .. .. .. | tuns | 22,494 | 17,160 | 21,439 | 27,220 |
| Oilseed Cakes .. .. .. | tons | 121,832 | 162,339 | 159,295 | 158,211 |
| Potatoes .. .. .. .. | cwts. | 1,374,223 | 2,041,474 | 1,660,189 | 772,003 |
| Butter .. .. .. .. .. | ,, | 1,142,262 | 1,097,539 | 1,259,089 | 1,159,481 |
| Cheese .. .. .. .. .. | ,, | 905,476 | 873,377 | 979,189 | 1,041,281 |
| Eggs .. .. .. .. .. | number | 397,934,520 | 383,969,040 | 442,172,640 | 430,842,240 |
| Lard .. .. .. .. .. | cwts. | 246,839 | 237,260 | 255,964 | 217,696 |
| Bacon and Hams .. .. | ,, | 537,114 | 638,127 | 740,193 | 567,164 |
| Salt Beef .. .. .. .. | ,, | 195,797 | 240,577 | 214,955 | 203,713 |
| Salt Pork .. .. .. .. | ,, | 142,831 | 144,378 | 165,944 | 220,533 |
| Clover Seeds .. .. .. | ,, | 150,968 | 264,878 | 231,427 | 155,673 |
| Flax-seed and Linseed .. | qrs. | 1,095,360 | 1,635,528 | 1,397,066 | 1,490,695 |
| Rape .. .. .. .. .. .. | ,, | 620,782 | 356,884 | 260,212 | 551,107 |
| Sheep and Lambs' Wool .. | lbs. | 230,224,467 | 250,928,854 | 255,161,344 | 259,361,963 |

CERTAIN ARTICLES of FOREIGN and COLONIAL PRODUCTION IMPORTED in the FOUR YEARS 1866-69; and their AVERAGE PRICES, exclusive of Duty.

| Articles. | Principal Countries whence Imported. | 1866. £. | s. | d. | 1867. £. | s. | d. | 1868. £. | s. | d. | 1869. £. | s. | d. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OXEN AND BULLS .. | Schleswig Holstein and Holland .. .. each | 17 | 19 | 0 | 17 | 16 | 0 | 16 | 16 | 0 | 19 | 7 | 0 |
| COWS .. .. .. .. | Schleswig Holstein and Holland .. .. each | 17 | 16 | 3 | 17 | 3 | 0 | 14 | 13 | 0 | 16 | 15 | 0 |
| CALVES .. .. .. | Holland .. .. ,, | 5 | 5 | 1 | 4 | 14 | 0 | 4 | 7 | 8 | 4 | 16 | 0 |
| SHEEP .. .. .. | Holland .. .. ,, | 2 | 10 | 0 | 2 | 1 | 5 | 1 | 13 | 10 | 1 | 15 | 0 |
| LAMBS .. .. .. | Holland .. .. ,, | 1 | 0 | 0 | 1 | 5 | 0 | 1 | 3 | 8 | 1 | 6 | 0 |
| BONES OF ANIMALS AND FISH FOR MANURE .. .. | Various countries in Europe and South America .. .. per ton | 4 | 17 | 11 | 5 | 0 | 9 | 5 | 8 | 2 | 6 | 1 | 0 |
| COTTON, RAW .. .. | Egypt .. .. .. per cwt. | 8 | 14 | 3 | 6 | 7 | 9 | 5 | 9 | 4 | 5 | 19 | 7 |
| | United States .. ,, | 7 | 10 | 8 | 5 | 9 | 1 | 5 | 5 | 4 | 5 | 16 | 1 |
| | Brazil .. .. .. ,, | 7 | 17 | 1 | 5 | 6 | 3 | 5 | 1 | 8 | 5 | 15 | 6 |
| | British India .. ,, | 4 | 12 | 0 | 3 | 2 | 10 | 3 | 12 | 8 | 4 | 5 | 8 |
| FLAX, rough or undressed .. .. | Russia and Prussia ,, | 2 | 15 | 4 | 2 | 14 | 9 | 2 | 12 | 4 | 2 | 12 | 4 |
| | Holland .. .. ,, | 3 | 19 | 9 | 3 | 14 | 11 | 3 | 15 | 0 | 3 | 10 | 10 |
| | Belgium .. .. ,, | 4 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 3 | 13 | 4 |
| GUANO .. .. .. | Peru .. .. .. per ton | 12 | 0 | 0 | 12 | 0 | 0 | 12 | 3 | 0 | 12 | 19 | 0 |
| HEMP, rough or undressed .. .. .. | Russia .. .. .. per cwt. | 1 | 11 | 1 | 1 | 15 | 2 | 1 | 17 | 1 | 1 | 13 | 1 |
| | Austrian Italy .. ,, | 1 | 18 | 10 | 1 | 17 | 1 | 1 | 17 | 10 | 2 | 0 | 9 |
| | Philippine Islands ,, | 2 | 6 | 2 | 2 | 10 | 6 | 2 | 7 | 5 | 2 | 13 | 0 |
| | British India .. ,, | 1 | 0 | 11 | 1 | 2 | 3 | 1 | 7 | 11 | 1 | 4 | 8 |
| HOPS .. .. .. .. | Hanse Towns .. ,, | 6 | 14 | 10 | 5 | 6 | 3 | 3 | 1 | 6 | 2 | 19 | 0 |
| | Holland and Belgium ,, | 6 | 3 | 6 | 5 | 4 | 8 | 2 | 16 | 2 | 3 | 10 | 4 |
| | United States .. ,, | 7 | 15 | 3 | 8 | 18 | 10 | 3 | 19 | 0 | 3 | 13 | 0 |
| HIDES (untanned) dry | British India .. ,, | 3 | 9 | 0 | 3 | 12 | 3 | 4 | 0 | 10 | 4 | 1 | 7 |
| ,, wet | Argentine Confederacy and Uruguay .. per cwt. | 2 | 8 | 9 | 2 | 12 | 4 | 2 | 16 | 3 | 2 | 11 | 0 |
| | Brazil . .. .. ,, | 2 | 9 | 1 | 2 | 12 | 6 | 2 | 16 | 6 | 2 | 11 | 6 |
| | Australia .. .. ,, | 1 | 17 | 0 | 1 | 19 | 7 | 2 | 8 | 5 | 2 | 5 | 7 |
| PETROLEUM, refined .. | United States .. per gall. | 0 | 1 | $10\frac{3}{4}$ | 0 | 1 | $3\frac{7}{8}$ | 0 | 1 | $5\frac{1}{2}$ | 0 | 1 | $7\frac{7}{8}$ |
| ,, unrefined | United States .. per tun | 17 | 7 | 3 | 11 | 14 | 5 | 11 | 4 | 0 | 13 | 3 | 0 |
| OILSEED CAKES .. | Russia, Denmark, Prussia and Hamburg .. per ton | 8 | 4 | 1 | 8 | 3 | 4 | 8 | 12 | 0 | 8 | 4 | 0 |
| | France .. .. ,, | 9 | 2 | 4 | 9 | 13 | 6 | 10 | 9 | 4 | 10 | 2 | 0 |
| | United States .. ,, | 10 | 10 | 3 | 10 | 18 | 0 | 11 | 7 | 9 | 10 | 16 | 0 |

CERTAIN ARTICLES of FOREIGN and COLONIAL PRODUCTION IMPORTED in the FOUR YEARS 1866-69; and their AVERAGE PRICES, exclusive of Duty—*continued.*

| Articles. | Principal Countries whence Imported. | 1866. | | | 1867. | | | 1868. | | | 1869. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | £. | s. | d. | £. | s. | d. | £. | s. | d. | £. | s. | d. |
| POTATOES .. .. .. | Holland .. .. per cwt. | 0 | 6 | $4\frac{3}{4}$ | 0 | 5 | $11\frac{1}{2}$ | 0 | 5 | 8 | 0 | 4 | 11 |
| | France .. .. .. ,, | 0 | 4 | $3\frac{3}{4}$ | 0 | 5 | 6 | 0 | 4 | 7 | 0 | 4 | 7 |
| BUTTER .. .. .. | Hanse Towns .. ,, | 5 | 10 | 3 | 5 | 13 | 9 | 6 | 9 | 6 | 5 | 18 | 8 |
| | Holland and Belgium ,, | 5 | 4 | 7 | 5 | 8 | 4 | 5 | 15 | 11 | 5 | 9 | 2 |
| | France .. .. .. ,, | 5 | 0 | 8 | 5 | 0 | 6 | 5 | 9 | 7 | 5 | 9 | 6 |
| | United States .. ,, | 4 | 16 | 10 | *2 | 18 | 1 | 5 | 4 | 9 | 4 | 18 | 4 |
| CHEESE .. .. .. | Holland .. .. ,, | 3 | 1 | 9 | 2 | 17 | 10 | 2 | 18 | 3 | 2 | 19 | 2 |
| | United States .. ,, | 3 | 6 | 8 | 2 | 15 | 10 | 2 | 18 | 10 | 3 | 6 | 1 |
| EGGS .. .. .. .. | France .. .. per 120 | 0 | 6 | $0\frac{3}{4}$ | 0 | 5 | 11 | 0 | 6 | 3 | 0 | 6 | $0\frac{3}{4}$ |
| LARD .. .. .. .. | United States .. per cwt. | 3 | 9 | 0 | 2 | 10 | 3 | 3 | 3 | 10 | 3 | 12 | 4 |
| HAMS .. .. .. | Hanse Towns .. ,, | 3 | 1 | 6 | 3 | 5 | 5 | 3 | 8 | 5 | 3 | 16 | 11 |
| | United States .. ,, | 2 | 17 | 4 | 2 | 7 | 0 | 2 | 15 | 0 | 3 | 7 | 6 |
| BACON .. .. .. | Hanse Towns .. ,, | 3 | 6 | 1 | 3 | 4 | 0 | 2 | 8 | 6 | 3 | 12 | 5 |
| | United States .. ,, | 2 | 14 | 2 | 2 | 4 | 7 | 2 | 9 | 10 | 3 | 2 | 2 |
| BEEF, SALTED .. .. | Hanse Towns .. ,, | 2 | 10 | 0 | 2 | 10 | 1 | 2 | 3 | 9 | 1 | 19 | 7 |
| | United States .. ,, | 2 | 5 | 3 | 2 | 7 | 2 | 2 | 5 | 2 | 1 | 14 | 9 |
| PORK, SALTED (except hams) .. .. .. | Hanse Towns .. ,, | 2 | 15 | 8 | 2 | 8 | 6 | 2 | 15 | 3 | 3 | 2 | 0 |
| | United States .. ,, | 2 | 9 | 11 | 2 | 1 | 6 | 2 | 5 | 10 | 2 | 16 | 6 |
| CLOVER SEEDS .. .. | Hamburg, France and United States .. per cwt. | 3 | 4 | 3 | 3 | 6 | 10 | 3 | 2 | 5 | 3 | 1 | 5 |
| LINSEED .. .. .. | Russia, Baltic .. per. qr. | 2 | 11 | 4 | 2 | 16 | 4 | 2 | 8 | 10 | 2 | 10 | 2 |
| | Russia, Black Sea ,, | 2 | 19 | 10 | 3 | 1 | 0 | 2 | 13 | 0 | 2 | 13 | 1 |
| | British India .. ,, | 3 | 8 | 11 | 3 | 6 | 9 | 3 | 1 | 8 | 2 | 18 | 9 |
| RAPE .. .. .. .. | Prussia .. .. ,, | 2 | 13 | 10 | 2 | 13 | 11 | 2 | 12 | 5 | 3 | 1 | 0 |
| | British India .. ,, | 2 | 17 | 11 | 2 | 12 | 6 | 2 | 11 | 4 | 2 | 18 | 11 |
| SHEEP AND LAMBS' WOOL .. .. .. | Russia .. .. .. per lb. | 0 | 0 | $11\frac{7}{8}$ | 0 | 0 | $11\frac{3}{8}$ | 0 | 0 | 9 | 0 | 0 | 9 |
| | Hanse Towns .. ,, | 0 | 1 | $11\frac{3}{8}$ | 0 | 1 | $10\frac{3}{8}$ | 0 | 1 | $4\frac{7}{8}$ | 0 | 1 | 3[illegible] |
| | Argentine Confederacy ,, | 0 | 0 | $7\frac{1}{8}$ | 0 | 0 | $6\frac{1}{2}$ | 0 | 0 | $6\frac{1}{4}$ | 0 | 0 | 4[illegible] |
| | British Possessions in South Africa .. .. per lb. | 0 | 1 | $5\frac{7}{8}$ | 0 | 1 | $2\frac{3}{4}$ | 0 | 1 | $2\frac{9}{16}$ | 0 | 1 | 2[illegible] |
| | British India .. ,, | 0 | 0 | $9\frac{15}{16}$ | 0 | 0 | $7\frac{7}{8}$ | 0 | 0 | $7\frac{5}{8}$ | 0 | 0 | 7[illegible] |
| | Australia .. .. ,, | 0 | 1 | $8\frac{13}{16}$ | 0 | 1 | $7\frac{1}{2}$ | 0 | 1 | $3\frac{15}{16}$ | 0 | 1 | 2[illegible] |

* Imports generally of inferior quality.

# STATISTICS OF DAIRY PRODUCE.

(*The following Quotations, &c., are extracted from* 'The Grocer.' *See Nos. for Jan.* 1, 1870, *and Jan.* 7, 1871):

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

| | 1871. | 1870. | 1869. |
|---|---|---|---|
| Butter: | Per cwt. | Per cwt. | Per cwt. |
| Carlow, finest F.O.B. .. | 130s. to 134s. | 124s. to 130s. | 128s. to 136s. |
| Landed .. .. .. .. | 126 ,, 146 | 122 ,, 130 | 126 ,, 140 |
| Cork, 1sts .. .. .. .. | 142 ,, 150 | 134 ,, 137 | 136 ,, 145 |
| ,, 2nds .. .. .. | 134 ,, 142 | 123 ,, 125 | 133 ,, 140 |
| ,, 3rds, new .. .. | 122 ,, 125 | 107 ,, 109 | 125 ,, 128 |
| ,, 4ths ,, .. .. | 112 ,, 114 | 100 ,, 104 | 117 ,, 120 |
| Limerick .. .. .. .. | 128 ,, 132 | 116 ,, 120 | .. .. |
| Foreign: | | | |
| Friesland .. .. .. .. | 112 ,, 142 | 104 ,, 132 | 120 ,, 134 |
| Jersey, &c. .. .. .. | 76 ,, 130 | 74 ,, 130 | 100 ,, 130 |
| Kiel .. .. .. .. .. | 110 ,, 156 | 104 ,, 136 | .. .. |
| Normandy .. .. .. | .. .. | 90 ,, 150 | 112 ,, 145 |
| American .. .. .. .. | 94 ,, 116 | 100 ,, 112 | 112 ,, 120 |
| Cheese: | | | |
| English Cheddar, fine, new | .. .. | 90 ,, 94 | 86 ,, 94 |
| ,, good ,, | 74 ,, 100 | 74 ,, 86 | 74 ,, 82 |
| Red Somerset Loaf .. .. | 80 ,, 92 | 72 ,, 84 | .. .. |
| White or yellow Cheddar Loaf .. .. .. .. | 80 ,, 92 | 76 ,, 84 | .. .. |
| Scotch Cheddar .. .. | 70 ,, 80 | 70 ,, 80 | 64 ,, 74 |
| Cheshire, new .. .. .. | 78 ,, 90 | 84 ,, 90 | 80 ,, 90 |
| ,, good ditto .. | 60 ,, 74 | 66 ,, 78 | 64 ,, 76 |
| Wiltshire, new .. | 64 ,, 84 | 72 ,, 80 | 68 ,, 78 |
| ,, good ditto .. | .. .. | 62 ,, 68 | 62 ,, 64 |
| North Wilts, Loaf, new .. | 80 ,, 90 | 76 ,, 84 | 66 ,, 78 |
| Derby ,, | 68 ,, 86 | 72 ,, 86 | 70 ,, 86 |
| Foreign: | | | |
| American, fine .. .. | 74 ,, 80 | 72 ,, 75 | 66 ,, 74 |
| ,, good .. .. | 60 ,, 68 | 64 ,, 70 | 60 ,, 64 |
| Gouda .. .. .. .. | 50 ,, 64 | 50 ,, 62 | 50 ,, 62 |
| Kanter .. .. .. .. | .. .. | .. .. | .. .. |
| Edam, new .. .. .. | 54 ,, 70 | 54 ,, 65 | 54 ,, 68 |

"The provision trade in the year 1870 had to encounter more than one adverse influence. The year opened with much promise, especially for home produce. American cheese came forward very sparingly, and, with a good demand, enhanced prices were obtained for it, in some instances as much as 4*s.* per cwt. advance being conceded. English cheese naturally improved also, and so did all descriptions of butters."

Cork Butter Market.—"The season opened in April under favourable auspices; prices ruled high and seemed likely to continue at rates that would remunerate farmers and stimulate them to make all the butter they could. As late as the 1st of May the price of first quality was not under 125*s.*, and of second quality 120*s.*, rates which ten or fifteen years since would be counted fabulous. During May and the early part of June, while everything promised well, and before the dry weather in England had assumed the form of drought, prices rapidly declined until, on the 19th of May, the lowest point of the season was touched—firsts being quoted at 103*s.* and seconds at 100*s.* These rates were of short duration; an improvement of 3*s.* to 4*s.* per cwt. at once took place, and from that time until the present a constant and steady advance has gone on, averaging 1*s.* per cwt. per week. The prohibition of exports of butter from France, which occurred a short time since, did not produce much effect, owing probably to its happening so late in the season, when most of the dealers have their stocks in. The total quantity brought to market since the commencement of this season, in April, amounts to about 370,000 firkins of butter. It is very few short of the same period last year, which was one of the largest on record; but in money value this year's is far ahead."

In the review of the Foreign Market in the year 1870, 'The Grocer' reports that "with the Prussian army surrounding Paris, supplies of butter and other provisions into that city were stopped; larger supplies came this way, and amongst them some of unusually fine quality. Some of these in the end of November were sold in London markets at 168*s.*; the general price for our usual qualities had earlier in the month ranged from 130*s.* to 140*s.* Early in December the prohibition of further shipments of butter and other provisions from France, which had been hinted at for some time, took place; and we have now for some weeks been without any direct arrivals from France, and, consequently, are left without market quotations for Normandys and Jerseys. An increased quantity of repacked and adulterated foreign is now coming forward freely."

With reference to the high price of butter, the *New York Times* says:—"In 1852 it was complained in a New York paper that the wholesale price of butter (then 13 to 16 cents for Ohio, and 14 to 18 cents for Western New York) doubled every twenty years. In 1853 there was a great stir about some farmers receiving 35 cents per pound for very choice butter, delivered at the residence of the buyer. In September and October, 1861, after the beginning of the war, plenty of the best butter retailed in the market at 21 to 22 cents. At one time during the war it went up to 75 cents, and farmers long clung tenaciously to war prices; but eventually the price of butter found its level in the summer between 30 and 50 cents. In the early part of last summer it started at 35 cents for the best, and now stands at 55 cents, with occasional choice lots selling as high as 65 cents, the latter being obtained by first-class grocers up town for fancy customers. Speculators are now at work scouring the country in every direction, buying up all the best butter they can lay their hands on. They go to country villages, ten miles from railroads, and make arrangements with storekeepers to buy in from farmers at 38 cents, the speculators paying 40 cents. It costs about 5 cents to get it to market, including commission, from any point in this State."

Cheese.—The reporter in 'The Grocer' takes the "finest Cheddar and Cheshire to represent English, and American the foreign. The variations in prices, in the year 1870, have been unusually small. Best Cheddar was 94*s.* in January, and continued at that price until about the beginning of August, when best new was offered at 86*s.*, and continued at that price for little more than a month. The effects of the dry summer then began to be felt, and prices were gradually advanced 4*s.* to 6*s.* per cwt. In December, holders of very choice, anticipating the want of really fine as the season progressed, advanced the asking prices for choice to 96*s.* to 100*s.* Throughout the season, commoner kinds have been obtainable at quite 10*s.* to 20*s.* less. Best Cheshire began at 90*s.* in January, and continued at it to the middle of February; it then ruled at 86*s.* to 88*s.* to the middle of May; at the latter end was 90*s.*, and continued so to the middle of August, then 88*s.* The greater part of the remainder of the year has been at 88*s.* to 90*s.* for choicest. Inferior parcels have ruled at 64*s.* to 66*s.*, January to June; and at 56*s.* to 60*s.* the remainder of the year. American ruled from 60*s.* to 64*s.* for common kinds, from January to the end of May, and best at 76*s.* to 78*s.* In June some new appeared, and prices ranged from 70*s.* to 74*s.* for best, 10*s.* less for common; from July to the middle of September best ranging from 68*s.* to 70*s.*, common 10*s.* less. October began with best 2*s.* higher, and so continued. Some inferior parcels of hot weather make at 54*s.* to 60*s.* In November best was saleable at 74*s.* to 76*s.*, and is now held firmly for 78*s.* to 80*s.* Some few common parcels can still be had at 10*s.* to 15*s.* below these prices. The stocks lying here are known to be light, and, the summer having been a dry one, holders show no desire to press sales. The French have been buyers of American, and if they again come to this market for further supplies, high prices are likely to be the result."

STATEMENT of the QUANTITY and VALUE of BUTTER imported from the UNITED STATES and BELGIUM; and of CHEESE imported from the UNITED STATES, 1864-69.

| Years. | BUTTER.—UNITED STATES. | | CHEESE.—UNITED STATES. | | BUTTER.—BELGIUM. | |
|---|---|---|---|---|---|---|
| | Quantities. | Computed Real Value. | Quantities. | Computed Real Value. | Quantities. | Computed Real Value. |
| | Cwts. | £. | Cwts. | £. | Cwts. | £. |
| 1864 .. | 142,672 | 780,024 | 466,988 | 1,213,890 | 81,575 | 470,167 |
| 1865 .. | 83,216 | 437,703 | 442,913 | 1,296,204 | 70,619 | 433,179 |
| 1866 .. | 16,059 | 77,754 | 415,726 | 1,386,447 | 76,667 | 426,712 |
| 1867 .. | 39,035 | 113,290 | 526,740 | 1,470,017 | 80,754 | 470,464 |
| 1868 .. | 7,117 | 37,279 | 489,117 | 1,439,380 | 70,456 | 405,987 |
| 1869 .. | 17,203 | 84,603 | 487,870 | 1,612,325 | 85,789 | 481,609 |

## PAUPERISM.

The total number of paupers in England on the 1st July, 1870, was 988,257, being 1 in 20, or 4·9 per cent. on the actual population. The details which follow do not absolutely agree with the above statement, owing to 385 paupers having been in receipt of both in-door and out-door relief. Comparing the numbers returned on 1st July, 1870, with those at the same date in 1869, there was an increase of 8440, or 0·9 per cent., in 1870. The in-door paupers on 1st July, 1870, were 144,470, the out-door 841,670. Of the 988,257 paupers, 184,781 were men, 401,405 were women, and 348,452 were children under 16. Of 423,937 able-bodied, 38,029 were men, 116,926 were women, and 262,412 children under 16; of 564,260 not able-bodied, 146,752 were men, 284,479 were women, and 86,040 children under 16. Of the 46,989 insane, 20,561 were men, 25,537 were women, and 891 were children under 16 years. The vagrants numbered 6630. The number of adult able-bodied paupers relieved was 154,614, a decrease of 361, or 0·2 per cent. on the number on the 1st July, 1869.

# JOURNAL

OF THE

# ROYAL AGRICULTURAL SOCIETY OF ENGLAND.


## I.—*The American Butter Factories and Butter Manufacture.* By X. A. Willard, A.M., of Herkimer, New York. Lecturer at the Maine State Agricultural College, &c., &c.

### Introduction.

The American System of Associated Dairies was inaugurated during the early part of 1851. Though 20 years have elapsed since the plan was conceived, the leading features of the system remain unchanged. Great improvements, it is true, have been made in buildings and dairy apparatus and in the methods of manipulating milk for cheese and butter manufacture; still, in organizing factories, in the manner of delivering milk, in the relation between manufacturer and patron, in the care and disposal of the product,—indeed, in all the general outlines of the system,—it is the same to-day as when Jesse Williams, in 1850, mapped it out for the first cheese-factory which he erected early the following year.

After 19 years' experience in associated-dairying, during which time the system has been put to the severest tests, the American dairyman finds it more economical as regards labour, buildings, dairy machinery, and appliances; while the factory product on an average will sell for enough more than that made in the individual farm-dairy to pay the entire cost of making.

Another important result of the system has been a constant improvement in dairy management, and the better knowledge of all that pertains to milk and its products, than would naturally obtain under the old system. It has established a special profession or calling, upon which men enter with a view of making it a sole business. They, therefore, seek to perfect themselves in it, and as skill and success are sure to be properly rewarded in this department of labour, great emulation exists among manufacturers to excel in their art.

During the first 10 years of the factory system it received much opposition, especially from those who had only a superficial knowledge of its operations. So strong was this opposition among the old dairymen, that it was pretty generally believed that the system could not long endure, and it was confidently predicted that the factories would be abandoned, and those engaged in them would return to the old plan of individual or farm-dairying.

But the factories, meanwhile, were steadily gaining ground; and dairymen entering upon the new system found in it so much relief, as well as profit, that they could not be induced to abandon it; and so to-day associated-dairying in America has come to be regarded as a fixed institution.

In the original plan of Mr. Williams it was not contemplated to apply the system to butter manufacture. But the success of the cheese-factories suggested to the butter dairymen of Orange County, New York, such a modification of the system as would adapt it to their branch of business.

Orange County lies about 50 miles north of New York City, and has long been devoted to producing milk for city consumption. It is a rolling mountainous region, abounding in sweet and nutritious pasturage, with never-failing springs and streams of pure water. The whole farming population of this county has for 80 years, or more, devoted its chief attention to butter-making and the production of fresh milk for the New York market. From so long attention to a specialty, the butter of Orange County, as was to be expected, was of fine quality, acquired a high reputation, and commanded better prices than any other brand made in the State. By adopting, however, the Associated System, together with a new plan for setting the milk and obtaining the cream, the product has risen to the highest point of excellence, and in consequence extraordinary prices are paid for it.

But the farmers under this system have not only reaped better prices for their butter, they have also obtained an additional gain from the skimmed milk, which, under the old system, was fed to swine, but which now is turned into a palatable cheese. This cheese goes into the Southern States; it is shipped to China and the East Indies, and not unfrequently commands a price but little below that made from whole milk.

As the manufacture of skimmed cheese is a part of the butter factory system, we shall speak of it more fully under its appropriate head.

## The Grasses.

Before entering upon the question of butter manufacture and factory management, it will be proper to say a word concerning the food of stock. The excellence of "fancy butter" does not depend altogether upon its manufacture, for, in the first place, good milk must be secured.

"Fancy butter," that will sell for a dollar per pound,* cannot be made from bad material, from milk produced on weedy pastures, or upon the rank sour herbage of swamps, or upon land newly seeded with red clover. The experienced butter dairymen, therefore, pay much attention to the feed of their cows, and prefer old pastures.

On the old pastures of the butter district there are several varieties of grasses that spring up spontaneously, and are much esteemed as affording sweet and nutritious feed, from which the best qualities of milk and butter are produced. These grasses form a dense solid turf, leaving no intervening spaces. They embrace the June, or blue grass (*Poa pratensis*), the fowl meadow-grass (*Poa serotina*), meadow fescue (*Festuca pratensis*), red top (*Agrostis vulgaris*), the wire grass (*Poa compressa*), the sweet scented vernal and vanilla grass, together with timothy (*Phleum pratense*), orchard grass (*Dactylis glomerata*), clover, and other forage plants.

The June grass (*Poa pratensis*) is regarded as very valuable: it throws out a dense mass of leaves, is highly relished by cattle, and produces milk from which a superior quality of butter is made. It is found growing throughout the butter districts of the country. The wire-grass (*Poa compressa*) is deemed one of the most nutritive of the grasses, is very hardy, eagerly sought after by cattle, and is one of the best grasses for fattening. Cows feeding upon it yield milk of the richest quality, from which the nicest butter is made. It flourishes well upon gravelly knolls and in shaded places, and its stem is green after the seed has ripened. It is found growing in all parts of the country.

The meadow fescue is common in old grass lands where the sod is thick, and grasses of different varieties are mingled together. It starts up early in the spring, is relished by stock, and furnishes good early feed. The milk farmers hold it in high estimation as a reliable grass, tenacious of life, and not running out like timothy (*Phleum pratense*) or clover. The white clover (*Trifolium repens*) springs up spontaneously in the old pastures, and is highly esteemed, as giving flavour and quality to butter.

* A dollar (4s.) per pound seems an incredibly high price for butter, but it must be remembered that everything for which there is a home demand is very much dearer in America than in England.—Edit.

The sweet scented vernal grass grows best upon the moist soil of the old meadows. It starts very early, and gives off an agreeable odour.

We have been particular in naming the grasses which are most esteemed for producing a high priced butter, because a record of long and well conducted experiments has proved their utility. It is possible that climate and soil might so modify the character of these grasses, as to render them less worthy of esteem in other countries than among the butter dairymen of New York. Still, as the experience of farmers noted for their success in a particular direction, is more or less suggestive and valuable, we give the record as it is.

## The Stock.

It is claimed by some that the flavour and texture of butter are influenced by the breed of cows. Butter from the milk of Breton and Jersey cows is said to be not only more solid and waxy in texture, but to have a finer aroma than that produced from other breeds. The milk of the Jersey or Alderney cow is exceedingly rich in cream, and has a deep yellow colour, as is well known.

But this question need not be discussed here. It will suffice to state that among the butter dairymen of New York but little attention is paid to breeding, and no prominence is given to any particular breed. The herds are usually made up of "the common cow of the country and grade cattle." There is a sprinkling of grade Short-horns, Ayrshires, Devons, and Alderneys, and occasionally a dash of Holstein blood, obtained by crossing thoroughbreds upon the mongrel or common cows of the country. But, as we have remarked, reliance for the most part is had upon the so-called native or common cow of the country for making up the herds.

It is proper that these facts in regard to pastures and stock should be stated, in order that correct conclusions may be drawn, in making up an opinion of what we shall have to say about butter factories, and the character of product they are able to make.

As to the size of herds kept on the farms, they are usually smaller than those in the cheese dairying districts. The herds on an average, we should say, will number about 25 cows to the farm. Some farms, it is true, carry from 40 to 60 cows, but in the majority of cases the herds are small, ranging from 15 to 30 cows.

## System of Organizing Factories.

The plan of organizing factories is somewhat similar to that employed in the cheese districts. The first effort of organization in a neighbourhood generally falls upon one or two persons, who may be desirous of having a factory where they can deliver the milk from their cows, and have it manufactured. They, perhaps, have examined the workings of some factory, and have become convinced that greater profits are to be realised from the factory-system than from the farm dairy, besides relieving the wife and daughter from the drudgery attendant upon butter-making at home. They therefore endeavour to bring their neighbours to the same opinion, and to induce them to join in erecting the proper building, &c. They go about and talk with their neighbours, and finally call a meeting at some central point in the neighbourhood, when all are invited to come and discuss the advantages and disadvantages of the system.

The cost of erecting a good factory, and supplying it with machinery and dairy appliances, is not far from 4000 dollars (800*l.*), and the farmers of the neighbourhood are expected to join together, and pay for the erection of the buildings, in proportion to the size of their farms, or number of cows from which milk is to be delivered. The shares are put at from 10 dollars to 50 dollars each (2*l.* to 2*l.* 10*s.*), so as to be within the reach of farmers who have but few cows. As a preliminary, a simple agreement, something like the following, is drawn up and circulated for signature :—

"We, the undersigned, residents of the town of            , and county of            , and State of New York, hereby agree to enter into association, for the purpose of erecting and working a Butter Factory in the said town. And we severally and individually bind ourselves by these presents, on or before the 1st day of            , 1870, to pay to our regularly appointed Building Committee the several sums set opposite our names, for the purpose of building and furnishing the said factory. And it is understood and agreed that when the said factory shall have been completed and opened for work, each member of the Association is to patronise it by delivering milk for one year, in proportion to the number of cows set opposite his name. The manufactured product of the said milk shall be sold by the regularly appointed agent of the Association, and each member shall receive his share of the sales in proportion to the quantity of milk delivered, less the cost of manufacturing, &c. This agreement shall not to be binding unless the sum of 4000 dollars (800*l.*) and the milk of 400 cows are subscribed.

| Name. | Amount. | No. of Cows." |
|---|---|---|

This is intended to be only a preliminary agreement. After the stock shall have been subscribed, a meeting is called, officers are chosen, and powers are delegated for the erection of the building, and for putting it in operation.

The structure being completed and furnished, a superintendent is chosen, and help hired for running the factory; and the expenses are shared by the stockholders in proportion to the amount of milk delivered. The cost of repairs, additions, &c., from year to year, is added to the expense account.

At some of the factories having the milk of 400 cows, the expense account for labour has amounted only to a fraction above two mills per quart of the milk delivered, and the gross proceeds from sales gave to farmers about $5\frac{1}{2}$ cents. per quart (11*d.* per gallon) wine measure.

## The Milk Business.

Since the construction of the New York and Erie Railway, which, with its branches, traverses the southern tier of counties, large quantities of milk have been daily sent to New York City by regular milk trains, which gather up the milk at the various depôts. The milk trains start late in the afternoon, and milk is forwarded but once a day. A portion of the milk is 36 hours old when it arrives in the city. To carry milk sweet in our hot weather for that length of time requires some art in handling, and is effected in the following manner.

The milk, as soon as it comes from the cow, is strained and put in long tin pails which are set in cold spring water, care being taken that no portion of the milk in the pails be higher than the flowing water that surrounds it. These pails are 8 inches in diameter, and from 17 to 20 inches long.

The milk is stirred occasionally to prevent the cream from rising. It is important that the animal heat should be removed from the milk as soon as possible, at least in an hour's time after it is drawn from the cow.

The old method was to cool the milk in the large carrying cans, but it has been found that it keeps sweet longer by dividing it into small quantities, and cooling it in pails as above described. The milk stands in pails surrounded by fresh spring water until ready to be carted to the trains. It is then put into carrying cans holding from 40 to 50 gallons. The cans are completely filled, and the covers, which fit closely, are adjusted so that there shall be no space intervening between them and the milk (p. 38).

In filling the cans, if there is not quite enough milk for the last can, either a little water is added to make it as full as the others, or the milk is kept back and used for other purposes.

These establishments are conducted on the principle of association, and are called Creameries—taking that name on account of furnishing the New York market daily with a certain amount of cream. These creameries, managed on the associated system, return to the farmer a much larger profit than he is able to obtain individually. The manager of the creamery not only takes charge of the milk, &c., as it comes in, but sales are effected by him of all milk delivered.

Members of the association deliver milk night and morning, when it is measured and properly credited to them, and no further trouble is had with it on their part.

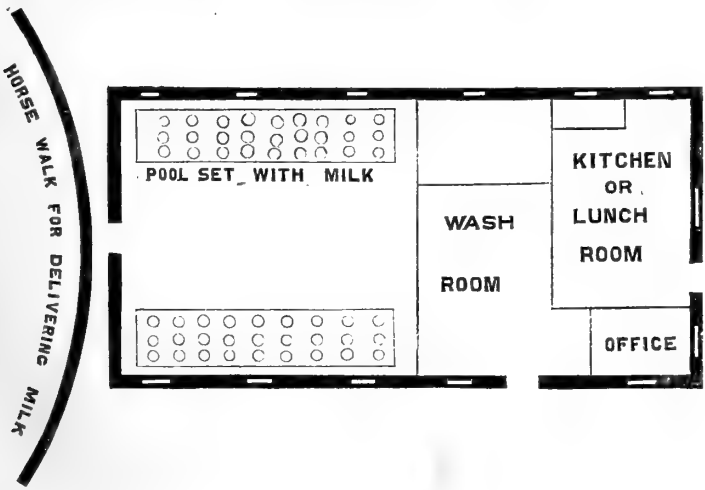
Usually the city milk-dealers make contracts with the creameries for a certain quantity of milk and cream during the season, or for such time as may be agreed upon.

Payment is made weekly, or monthly, at so much per quart, at the creamery, or at the nearest railway station.

A part of the milk is skimmed and the cream put up in cans, which, when ready for shipment, are placed in wooden tubs made tapering towards the bottom. The space between the cans and tubs is then packed with ice, the covers fastened down, and in this way the cream goes to market, where it arrives in perfect condition.

As fast as payment is made for milk-sales the money is divided among the patrons in proportion to the quantity of milk delivered. All the transactions are kept, of course, in the manager's books, which are at all times open for inspection and investigation.

*Fig.* 1.—*Ground-plan of Creamery.*



## Butter Factories.

The creamery was the first trial of the associated system by the milk dairymen, and out of it grew the butter factories. The country milk-sales, being under the control of the city operators, it was found necessary to devise means to become independent of combinations that were being made from time to time to reduce the prices of milk and cream. Hence the idea of manufacturing the milk into butter and cheese when fair terms could not be made with the milk dealers. The plan proved at once a success, as it regulated the price of milk in accordance with the value of other products of the dairy, and avoided losses that previously occurred on account of surplus milk, which, under the old system, often had to be retained at the creamery.

*The Original Factory.*—The first American butter factory was erected by Mr. Alanson Slaughter, of Orange County, New York. The main building is a cheap two-storied structure, arranged on a plan similar to that of the cheese factories. On the ground-floor are the milk vats, presses, and other appliances for making cheese (see Fig. 2), while the second-floor is entirely devoted to the dry-room, or department for storing the cheese during the process of curing, &c.

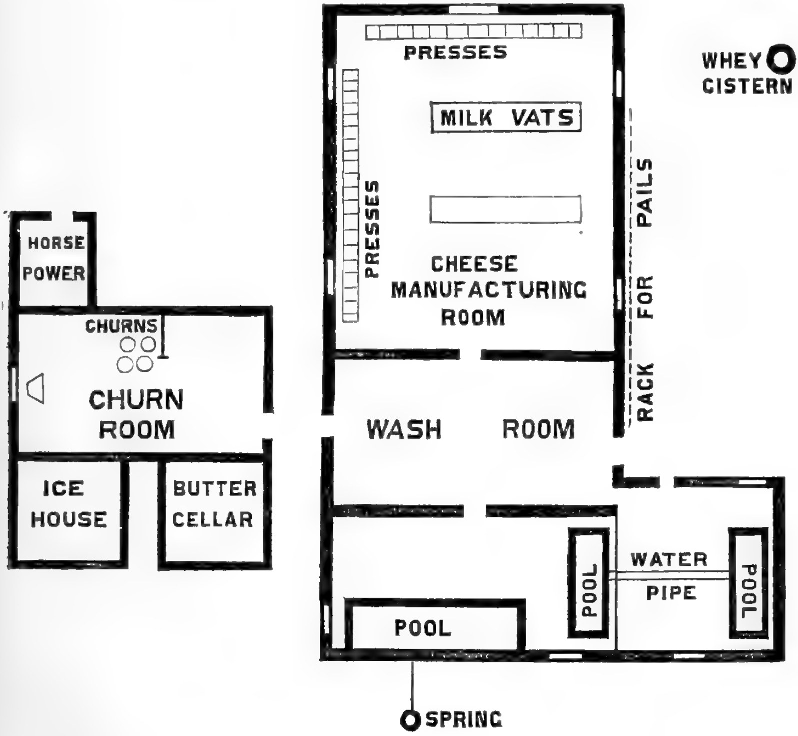
The spring-house is built out upon the end of this structure, forming a wing, and is one story high. It is divided into two rooms, one 12 feet by 16 feet, and the other 14 feet by 24 feet. The packing and churning room is in a separate building, 12 feet by 24 feet, and stands opposite the spring-room, with a narrow alley between. This alley is used for a horse-walk where the teams deliver milk and cart away the products of the dairy. Connected with the packing and churning department there is a horse-gear for churning, and an ice-house and store-room.

The subjoined cut represents the ground-floor of this establishment, which is regarded by many as convenient and economical in its arrangements. This factory is intended to take the milk of 400 cows.

## The Springs, and the Manner of Treating Milk.

Among the first factories erected, the springs are situated within the enclosure of the spring-house, and vats or tanks are constructed about the springs for holding the water. These pools are each 12 feet long and 6 feet wide. The earth is excavated, and the sides of the pool are laid up in solid masonry, or with stout oak-plank, so that the water in the pools shall rise no higher than the level of the floor of the spring-house. Near the bottom of the pools racks are arranged for holding the cans or pails of milk; the water flows up through these racks and above them to the height of 17 inches.

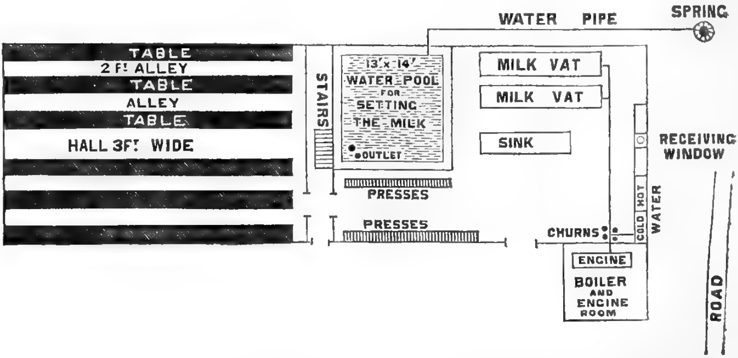
*Fig. 2.—Ground-plan of Original Butter Factory.*




When a spring cannot be had in the spring-house, the pools are sunk below the level of the floor and arranged in the same way as above described, except that the bottoms are cemented tight, covered with flagging or oak-plank, and the water conducted from the spring through pipes. The pails for holding the milk are of tin, from 20 to 22 inches in length and 8 inches in diameter. In furnishing a factory, two pails are required for each cow's milk delivered.

As fast as the milk is received the pails are filled within four or five inches of the top, and immediately placed in the water. Care is taken that the surface of the milk in the pails is not above that of the water in the pools. The pails are set close together, and each pool has capacity for holding 2040 quarts of milk. There should be a constant flow of water in and out of

*Fig. 3.—Ground-plan of Weeks's Butter Factory.*




This factory is 100 feet long and 30 feet wide; it consists of two stories, the upper one being used as a cheese-curing room in the same manner as the room on the left in the ground-plan.

the pools, and the flow should be sufficient to divest the milk of its animal heat in less than an hour.

Some experiments have been made with a view of determining at what temperature the water in the pools enables operations to be conducted with the most success; and the best results in cream (quantity and quality considered) are obtained when the natural temperature of the water flowing into the pools is about 56° Fahr. The pools should not be kept at so low a temperature as 48°, nor much, if any, above 57°. The range of temperature desired by some is from 56° to 60°. It is claimed that more cream, and that of better quality for butter-making, may be obtained by setting the milk on the above plan, than it will yield when set shallower in pans, or when exposed to uneven temperatures.

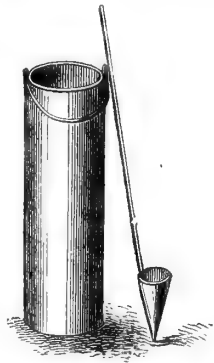
One feature in the process, deemed of great importance, is to expose as little of the surface of the milk to the air as possible, in order that the top of the cream may not get dry, as this has a tendency to fleck the butter and injure the flavour. The milk of one day is left in the pools until next morning, which gives 24 hours for the morning's mess and 12 hours for the evening's mess to cream. The pails are then taken out of the pools and the cream dipped off. In removing the cream a little tunnel-shaped cup, with a long upright handle (Fig. 4), is used, and the thin cream is dipped off down to the milk-line, which is readily recognised by the blue appearance of the milk.

In the fall and spring of the year the cream, as it is dipped, goes immediately to the churns, and is churned sweet. In summer the cream is dipped into the pails and returned to the pool, and kept there till it acquires a slightly acid taste, when it is ready for the churns.

The cream having been removed, the skimmed milk in the pails is now turned into the cheese-vat to be made into "skim-cheese." The pails then go to the wash-room, where they are thoroughly cleansed with soap and water, and set upon a rack exposed to the sun and air. At some factories, the pails, after being cleansed with soap and water, are placed over a jet of steam and thoroughly scalded. They then receive a jet of cold water, and go upon the rack to sun and dry. This arrangement is a very great improvement in cleansing dairy utensils, doing the work thoroughly and expeditiously.

The factories do not all operate alike in regard to the time of setting the milk. Where an extra fancy product of butter and skimmed cheese is desired, none of the milk is set longer than 24 hours, and at these factories it is not desired to take all the cream from the milk, but only the best part; and the balance is employed to give quality to the "skim-cheese." At some establishments the cream is allowed to turn slightly sour before churning; but when it is churned sweet the buttermilk goes into the vats with the skimmed milk and is made into cheese. Some factories adopt the plan of holding the morning's milk in the pools for 36 hours and the night's milk for 24 hours; but as the skimmed cheese by this management is less meaty than by the other method, it is a question whether any more profit is realised from it.

*Fig. 4.—Pail for Setting Milk, with Cream-dipper.*



We give a cut of the cream-dipper employed at the factories for removing the cream from the pails.

## The Churns and Churning.

The churning at the large establishments is done by horse-power. There are a variety of powers, but that most commonly used is simply a large circular platform or wooden wheel, built about an upright shaft, the lower end of which turns in a socket. The wheel sets upon an incline, so that the horse, by walking constantly on one side, keeps it in motion. At the upper end of the shaft, gearing is arranged so as to give motion to the churns. Quite recently a small engine in connection with the heating arrangement for the cheese department has been used to supply power for driving the churns.

The latest invention for supplying power for churning consists in a system of gearing, driven by a heavy weight attached to a stout rope which is wound about the cylinder of the machine. Sixteen feet of rope will run the power half an hour, carrying the churn-dashers at the rate of 50 strokes to the minute, which is the rate of stroke best adapted for producing good butter in the dash-churn. It is adapted to any size of churn, and has a regulator to vary the dash without changing the weight.

The 'Scientific American,' in speaking of the merits and advantages of this machine, says:—"Mechanical powers of this character have not heretofore been very acceptable for domestic purposes, some requiring too heavy weights, and thus using too much rope. The inventor of this movement has produced a churn-power that seems very free from the objections named. It is very compact, occupying a space only of 18 by 20 inches, applicable for pumping water and many other kinds of light work."

We give a cut of this machine (Fig. 5), the weight carried over an elevated pulley not being represented.

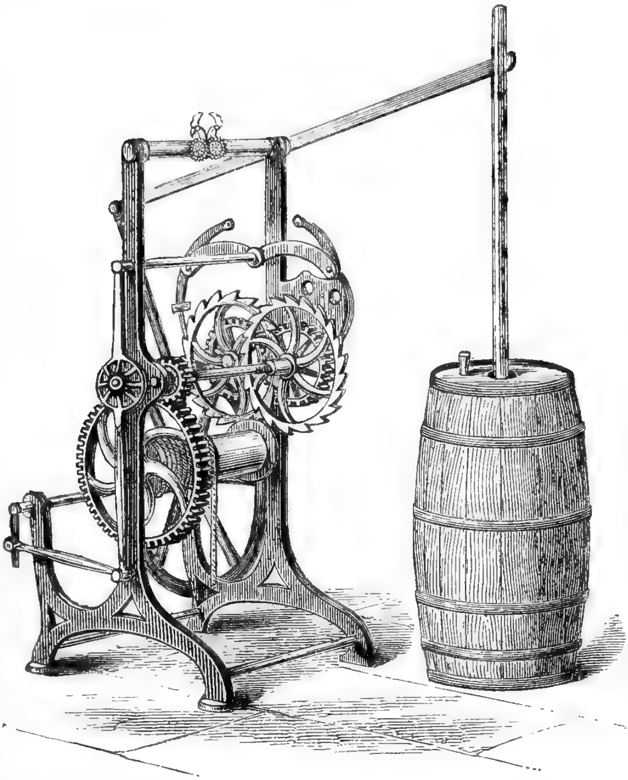
There have been many kinds of churns used in the butter districts, but the factories universally prefer the old-fashioned barrel dash-churn. They use the barrel and a half size, with dasher, as represented in Fig. 6.

Recently a churn has been invented with revolving arms, arranged so that the floats open and close at each revolution, and it does good work. By an opposite revolution to that used in churning, the floats will work the butter, thus combining a churn and butter-worker in one machine. We give its general appearance in Fig. 7.

Usually, four (of the dash churns) churns are placed side by side (see Fig. 2), so as to be all worked by the power at the same time. From 60 to 70 quarts of cream are put into each churn, and each mess of cream then receives from 12 to 16 quarts of water, for the purpose of diluting it and bringing it to a temperature of about 60°. In warm weather cold spring water is used, and in cold weather warm water.

Some prefer diluting the cream with water and passing it through a sieve before putting it in the churns, in order that the particles of cream may all be of uniform size; since if the butter does not come evenly, but is mixed with small particles of cream, it will soon deteriorate, and will not make a prime or fancy article. This point is considered of great importance by the best butter makers, and it is claimed that the method of setting the milk in deep pails, by which a thin cream is obtained, rather than the thick leathery masses skimmed from milk set in pans, renders it more evenly churned, and thus secures a better pro-

*Fig. 5.—New Mechanical Arrangement for Churning by Horse or other power.*

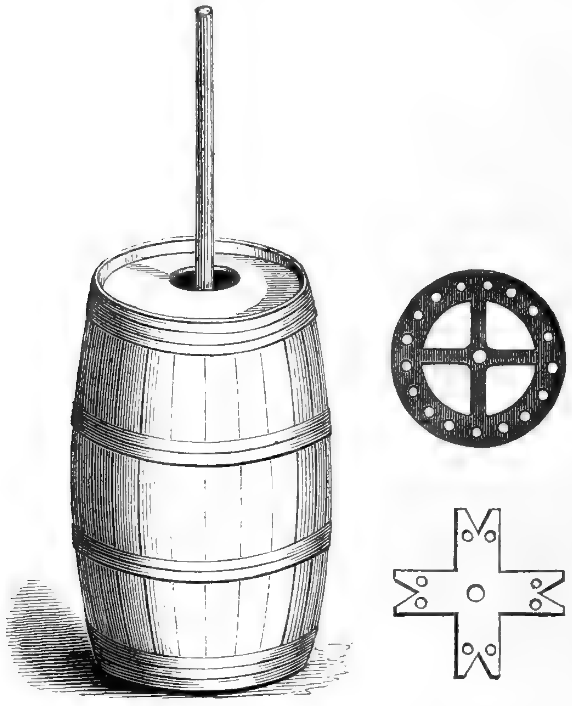


duct. It is partly on this account also that it is preferred to have the churning occupy from half to three-quarters of an hour, since it has been found that when the butter comes too quickly it is more or less injured.

In warm weather ice is sometimes broken up and put in the churn to reduce the temperature of the cream ; but it is deemed better to churn without ice, if the cream does not rise above 64° F. in the process of churning, as butter made with ice is more sensitive to heat. It is, however, a less evil to use ice than to have the butter come from the churn white and soft. In churning, the dashes are so arranged as to go downwards within a quarter of an inch of the bottom of the churn, and to rise above the cream in their upward stroke.

The temperature of the cream, while being churned, should be kept below 65°; for if at the close of the churning the butter-milk

*Fig. 6.—Churn and form of Dashers used at the Butter Factories.*

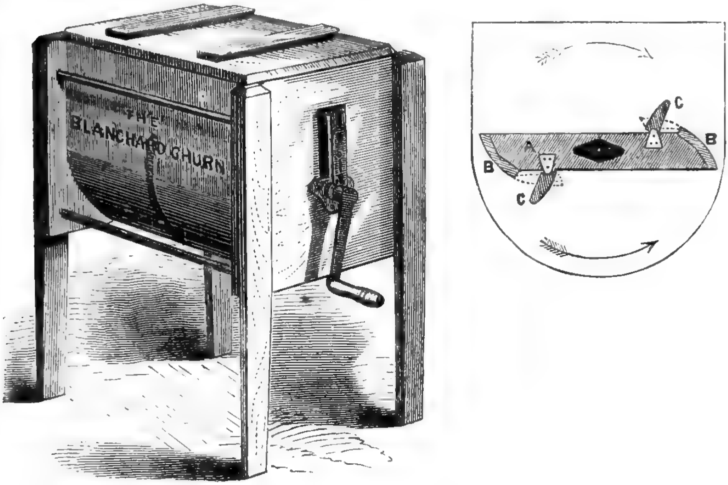


should be at that temperature or above it, the flavour and colour of the butter will be injured. In cold weather, the temperature of the cream, when ready for churning, is a little higher than in warm weather, about 62° being considered the right point. Factorymen prefer that the churning should occupy on an average about 45 minutes: a half-hour being the shortest space of time, and an hour the longest, that should be employed in this operation. When the butter begins to come, the churn is rinsed down with cold spring water. The butter should come of a firm or solid consistency and of a rich yellow colour.

## Working and Salting.

The butter is now removed from the churns, and care is taken never to touch it more than is necessary with the hands. It is lifted with the ladle into elliptical wooden trays, and the buttermilk is rinsed out with cold spring water. In the process the ladle is used lightly, while the water being turned over the butter

*Fig. 7.—The Blanchard Churn.*




A. Exterior of the churn.
B. Section of the interior of the churn, the upper arrow indicating the direction in which the crank should be turned in churning; A, A, the dash-board; B, B, the projecting margins; and C, C, the movable floats.

is allowed to pass off at one end of the tray. This process is repeated two or three times, when nearly all the buttermilk will have been rinsed away.

Salt is now added, and worked through the butter with the butter-worker, at the rate of 18 ounces for 22 lbs. of butter. Great care is taken that the salt be pure, and of those brands that are known to be free from the chloride of calcium, as a trace of this impurity gives a bitter taste to the butter. For butter that is designed to be kept over for the winter markets, a little more salt is sometimes used, often as high as an ounce of salt to the pound of butter. Not unfrequently a teaspoonful of pulverised saltpetre and a tablespoonful of white sugar are added, at the last working, for 22 lbs. of butter.

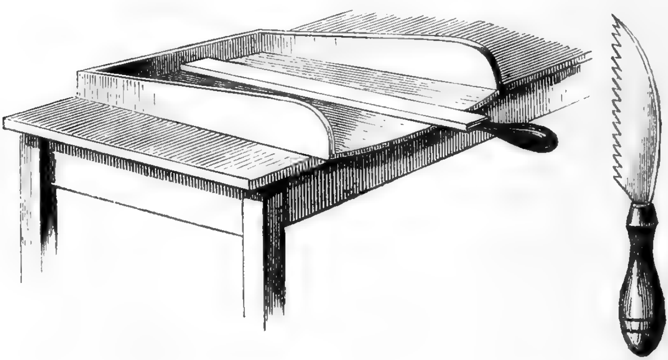
In the matter of salt, however, the factories adopt the quantity to suit the taste of their customers or for different markets. Of late years, light-salted butter sells best, and the rate of salting varies from one-half to three-fourths of an ounce of salt to the pound of butter. The butter, after having been salted and worked, is allowed to stand until evening, and is then worked a second time and packed. In hot weather, as soon as the butter is salted and worked over, it is taken to the pools and immersed in water, where it remains until evening, when it is taken out, worked over, and packed. For this purpose a separate pool is provided, which is used only for butter; it is called the "butter pool," and fresh spring water constantly flows in and out of it, as in the pools for setting the milk.

## Working the Butter.

In working the butter, considerable skill and experience are required that the grain of the butter shall not be injured. The butter must have a peculiar firmness and fineness of texture, and a wax-like appearance when fractured, which an improper handling, in expelling the buttermilk and working, will destroy. Care is taken, therefore, not to overwork it, nor subject it to a grinding manipulation like tempering mortar, as this spoils the grain and renders the butter of a greasy or salve-like texture.

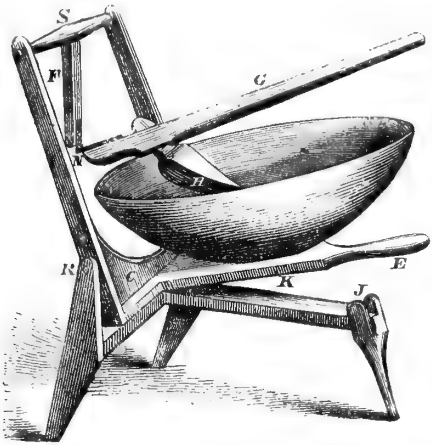
The butter is worked with butter-workers. The one in most common use consists of an inclined slab standing upon legs, and with bevelled sides about 3 inches high. The slab is 4 feet long by 2 feet wide at the upper end, and tapering down 4 inches at the lower end, where there is a cross-piece, with a slot for the reception of the end of the lever. There is also an opening at this end for the escape of the buttermilk into a pail below. The lever is made either with four or eight sides, and the end fits loosely in the slot, so as to be worked in any direction. It is quite simple, as will be seen by the figure below, but does good execution and is much liked at the butter factories.

*Fig. 8.—Butter-worker.*



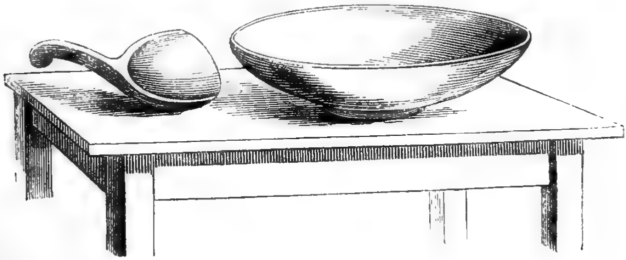
There are other butter-workers in use, and one of the more recent inventions is represented by the subjoined cut (Fig. 9).

*Fig.* 9.—*Eureka Butter-worker.*




A common butter-bowl is placed and held securely on a light, small stool, firmly against a solid rest (R) that protects it from breaking or springing. It may be revolved either way, at will, also easily tipped by a lever to drain off the fluids, and as readily removed from the stool as from a table, and bowls of different sizes may be used on the same stool.

*Fig.* 10.—*Bowl and Ladle.*



The ladle (H) is attached to a pendant lever (F G) that enables a person to press directly through hard butter in all parts of the bowl without drawing or sliding it; also to cut, turn, and work it in every manner desired. It is light, strong, and simple, everything about it is practical, with nothing to get out of place or order, and it is as handily moved, washed, and dried as any butter-bowl and ladle, such as are shown in Fig. 10.

The lever E is fastened to the slot J while the butter is being worked, and is raised up to discharge the buttermilk from the bowl as occasion requires.

There is a circular iron fastened to the bottom of the bowl, which slides in an iron groove attached to the lever K, and which allows the bowl to be moved round, and, when desired, to be removed entirely from the other parts of the worker.

After the butter has been washed in the trays, a batch weighing 22 lbs. is laid upon the inclined slab, or butter-worker, first described, and then spread out with the ladle. Pure Ashton or Onondaga salt, made fine by rolling, is now sprinkled over the mass and the lever applied, first beginning at one side, until the whole is gone over. Only a few manipulations of this kind are required to work in the salt and complete this part of the process.

As it is important that the buttermilk should be completely removed, this is facilitated during the working process by applying a slightly dampened napkin to the surface, or by the use of a damp sponge covered with a napkin for the purpose.

## Packing.

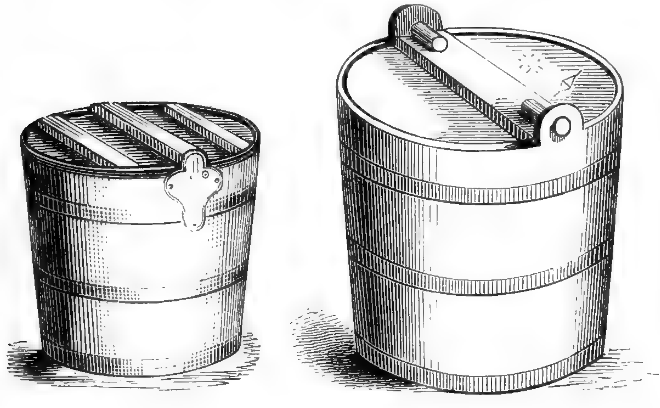
The butter is packed in firkins, in half-firkins, and in Orange County pails. The pails are "return pails," that is, they are not

*Fig. 11.—Orange County Butter-firkins.*

sold with the butter, but are to be returned to the factory after the purchaser has taken out the butter. They hold about 60 lbs. of butter, are of white oak, nicely made, and strongly hooped with heavy band-iron. They have movable covers that fit closely, and are fastened with wooden bolts or metallic clasps. The firkins are also made of white oak, heavily hooped, and the sides neatly turned.

The greatest attention is paid to have the packages perfectly tight, so as not to permit the least leakage. White oak is regarded as the best material for packages, and the butter factories use no other. The firkins hold about 100 lbs. each. The half-firkin is simply the firkin sawed in two, and provided with an oak head, which is nailed on the top of the package after it is filled. Figs. 11 and 12 show the form of these packages.

*Fig.* 12.—*Return Butter-pails.*



The firkin is prepared for use by soaking in cold water, after that in scalding water, and then again in cold water. It is then either filled with brine and soaked twenty-four hours, or the inside is thoroughly rubbed with dry salt, and left to stand for a short time, when it is considered ready for use.

In packing the butter it is pressed together as solidly as may be, and when the firkin is filled it is immediately headed up, and a strong brine poured through a hole in the top head, to fill all the intervening spaces. The orifice is then closed, and the firkin is set in a cool cellar until it is ready to be sent to market. When the half-firkin is filled, a dry cloth, cut so as to entirely cover the butter, is spread over it, and covered with a thin layer of salt. The cover is then fastened on, and the package is set away in a dry cool place until it is taken to market.

## Marketing.

The butter factories usually have orders for butter as fast as it is made, so that the consignments are from week to week. In Orange County the manner of marketing butter differs from that practised in other localities. Consignments are not generally made direct to the city dealers, but they are intrusted to "Captains," as they are called, or persons who make it a business to collect freights of this kind, and take them in charge to New York, making the sales and returning the proceeds to the manufacturer. The "Captains" go with their freight twice a week, are men of standing and responsibility, who are well acquainted with the trade, and know how and when to obtain the best prices.

They receive a commission for their labours, and find it to their interest to make good sales, otherwise they lose the confidence of those entrusting freight to their charge, and are liable, therefore, to be displaced. The Captains often receive proposals for large lots of butter, which proposals are submitted to the factories, when they are accepted or rejected as seems best to the parties interested. They supply private families and hotels, and by having a line of customers who are willing to pay a high price for an extreme fancy article, very large returns are not unfrequently made to the factories.

By this system, the producer being brought near to the consumer, he must realise full prices for his goods, instead of feeding a class of middle men, each one of whom will take his profit out of the product.

With factories quite remote from the city, the product is either consigned to the wholesale dealer, to be sold on commission, or the brand, having a reputation, is sold directly to city dealers, on contracts for weekly or semi-monthly deliveries.

## Advantages of Butter Factories.

The advantages of butter making on the associated-dairy system over that in private families are very great. In the first place, by the association system a uniform product of superior character is secured. Every appliance that science or skill, or close attention is able to obtain, is brought to bear upon the manufacture, and prime quality necessarily follows as a result.

If you could assume that in a neighbourhood of 100 families each family had the skill and convenience of the factory, and that each would give the subject the same close attention, then, doubtless, there would be no difference as to the quality of product; but such a state of things rarely exists.

Again, the factories are able to obtain a larger price, because it costs the dealer no more to purchase the 100 dairies combined, than it would to purchase an individual dairy, and the uniformity and reliability of the product does not entail the losses that are constantly occurring in different small lots by reason of inferior quality. The factories, too, as we have previously remarked, relieve the farmer and his family from a great deal of drudgery, and unless the work can be done by members of the family, who cannot be employed profitably at other labours, it is a matter of economy to have the butter and cheese made at the factory, since what would take 100 hands scattered over the country to do, is performed in the same time by three or four, when the milk is worked up together in one place.

The only serious complaint against the factory-system is in hauling the milk. This has been obviated in many instances, by establishing a route of milk-teams, where milk is delivered for the season by the payment of a small sum.

## The Skim Cheese.

We have referred to the manufacture of "skim cheese" as a part of the butter-factory system. We have said that the cream is dipped from the milk while it is sweet, and that the latter then goes into the milk-vats for making "skim cheese."

It should be remarked that at the butter factories the quantity of milk to be manipulated is usually much smaller than at the cheese factories. In making a fancy product it is found advisable that the delivery of milk be kept within moderate bounds, say from 300 to 400 cows. The factory milk-vats are all essentially alike in form and size. They hold from 500 to 600 gallons.

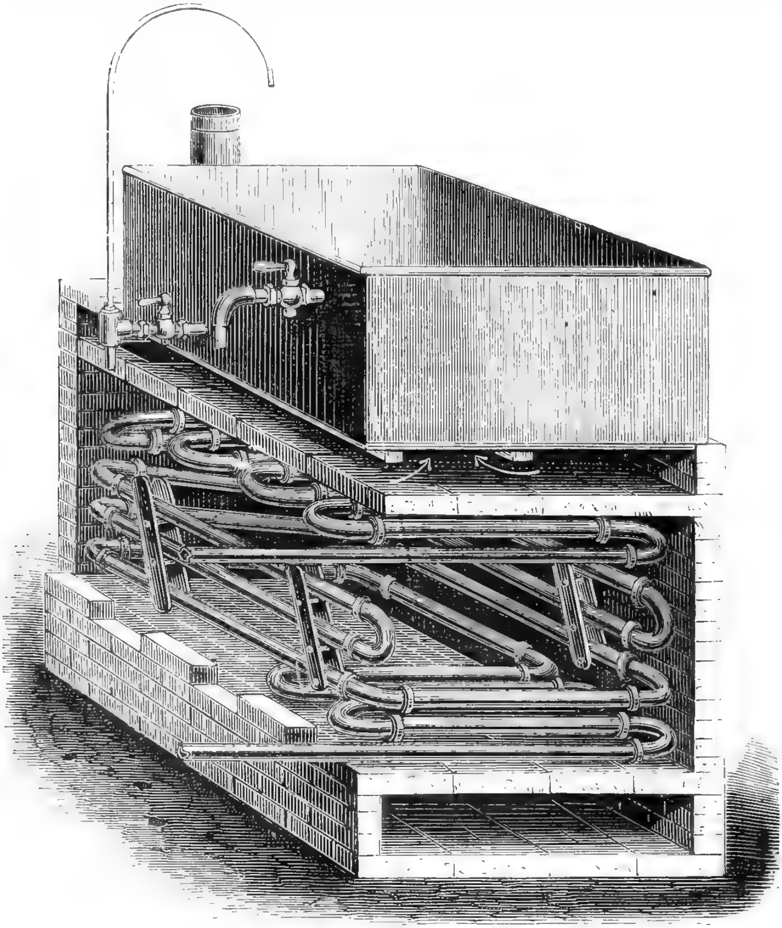
There is a great variety of heating apparatus, boilers, steamers, tanks for hot water, and what is termed "self-heaters," that is, with fire-box attached to, and immediately below, the milk-vat. This kind of heater is very popular at the butter factories, as it consumes but little fuel, is easily managed, and does as good work as the best.

The ordinary heater is constructed separately from the vat, and consists of wrought-iron pipes, screwed together in such a manner as to form a fire-chamber, and present a large amount of heated surface (Figs. 13 and 14).

Where a boiler and engine are used, power is afforded fo driving the churns, and in this respect this system must prove most convenient. Still, as the expense is considerably more than for the self-heater, both in the first cost and for fuel, many prefer the latter. We give figures of two kinds of heaters that are very largely in use (Figs. 13 to 16).

The factory vat (Fig. 15) is constructed on same principle as that

*Fig. 13.—View of Heater, with Front and Side of Brickwork removed.*



for farm dairies (Fig. 16). The fire-box underneath (Fig. 15) runs from end to end. It is simply a copper cylinder with a jacket 2 inches or more from cylinder on lower side, so that water surrounds the cylinder or fire-box. This vat requires but very little fuel. I have one of the *farm vats* upon my farm, and my farmer, in summer, has done all the work in making cheese from my dairy of 30 cows, using only "a pan of chips," say 10 to 12 quarts. The pipe at A hanging over the vat is a movable syphon for drawing off whey. It is represented with one end inserted in the tin strainer, which is also movable, or so as to be detached. B is the smoke-pipe.

*Fig. 14.—Millar's Circulating Coil-heater for Factory Milk-vat (consisting of coil of gas-pipe enclosed in brick).*

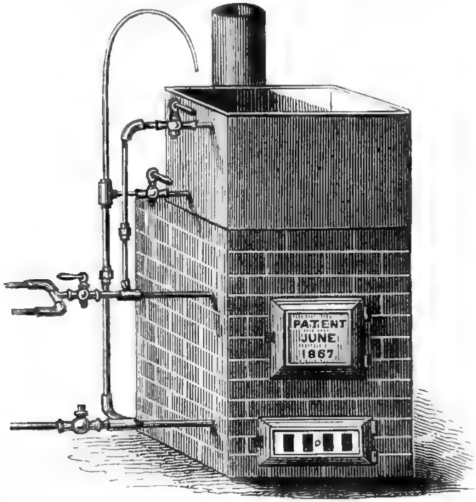
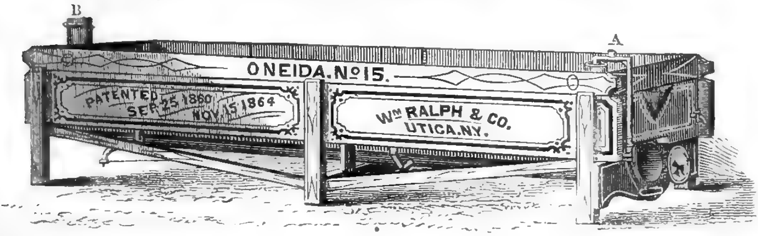


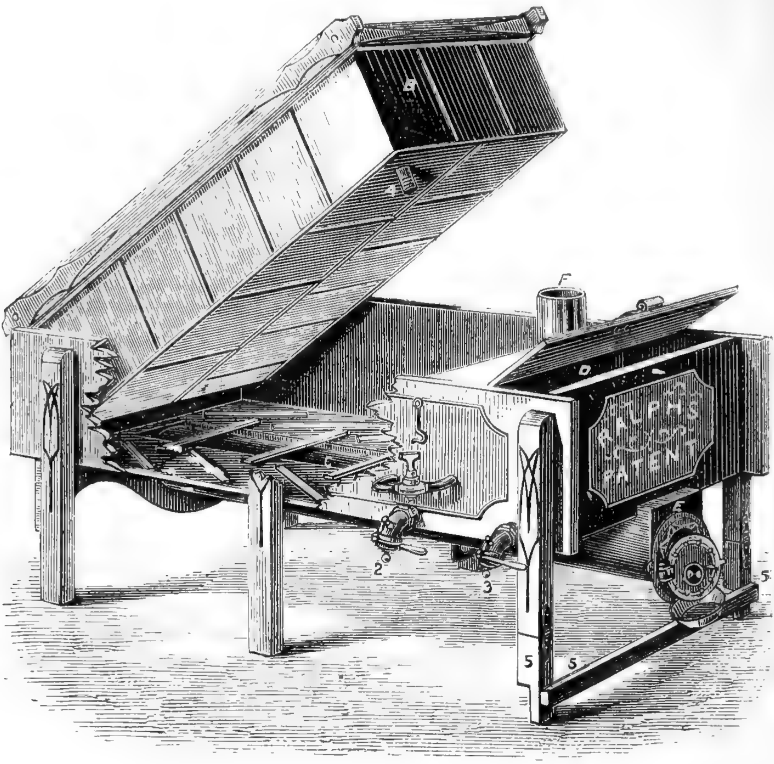

*Fig. 15.—Factory Milk-vat with Heater beneath.*




The next engraving (Fig. 16) rrepresents the tin or inner vat raised, and the sides of the outer vat broken out to show the heater ; and the supports of the inner vat.

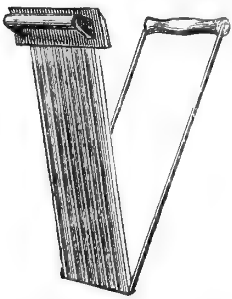
The outer vat is lined with galvanized sheet-iron ; B is the inner tin vat; C the copper vat heater, extending the entire length of the vat, and surrounded by water in a semi-cylindrical jacket open at the top, which water also fills the space between the vats. D is the tank or reservoir for hot water, separate from that between the vats, and E the copper heater for tank or reservoir. F smoke-pipe for both vat and tank heaters. The numbers indicate the following parts:—1, faucet connecting water-space between the vats with tank. 2, water-gate in outside vat. 3, water-gate in tank. 4, tube through which the whey is drawn from the strainer inside the inner vat. The strainer and whey faucet are not shown in the engraving.

*Fig.* 16.—*Interior of Milk-vat, with Heater beneath.*




The above milk-vat is for farm dairies. There is another door or fire-box at the back, similar to that at E, where fire is made to heat the water under the vat (B), when in place.

*Fig.*17.--*Gang Curd-knives.*



In making skim cheese the milk is set at 82°, and sufficient rennet added to coagulate it in from 40 to 60 minutes. It is then cut in cheeks with a gang of steel knives, the blades set $\frac{1}{4}$ inch apart.

It is now left at rest for a short time for the curd to subside, when it is further divided, the gang of blades being set at an angle of 45° with the bottom of the vat. It is now gently lifted with the hands, and the process of breaking or subdivision completed. Then a slow heat is begun to be applied to the mass; the curd, meanwhile, being stirred to keep it from packing, until a temperature of 96°

is reached. This is the highest heat to which the curds are subjected.

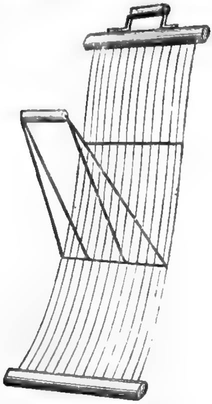


*Fig. 18.—Curd Agitator.*

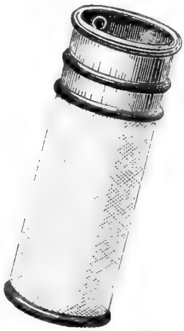


*Fig. 19.—Strainer used when the Whey is drawn, to prevent loss of Curd.*

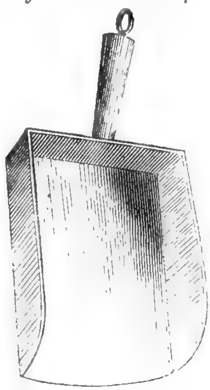
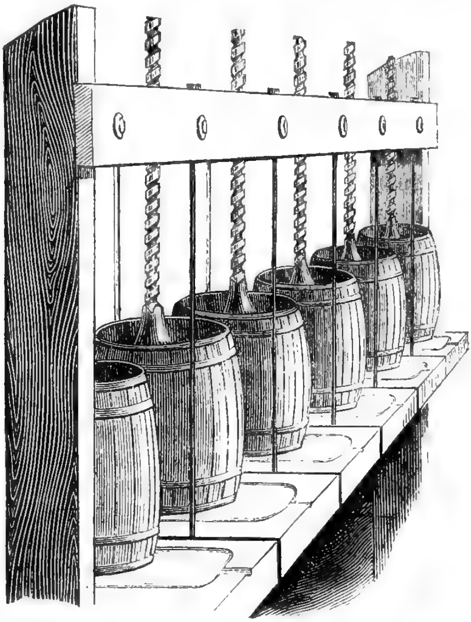


*Fig. 20.—Curd Scoop.*

When the curds have acquired a sufficiently firm consistency, the whey is drawn, and the curds thrown upon a sink to drain and cool, after which they may be run through a curd mill and salted, and then put to press.

*Fig. 21.—American Factory Cheese-presses.*



The manufacture of skimmed cheese is very similar to the American process of manufacturing whole-milk cheese, except

*Fig. 22.—Patent Ratchet Cheese-press Screw.*

that a lower heat is employed in "scalding," and less salt is used; the proportion of salt being at the rate of $2\frac{4}{10}$ to $2\frac{1}{2}$ lbs. for 1000 lbs. of milk.

The cheeses are made thin like the single Gloucester, about 4 inches thick, and pressed in hoops 14 to 15 inches in diameter. The style of cheese, however, varies at different factories; some making a small sized fancy shape, 8 to 10 inches in diameter, and about the same height.

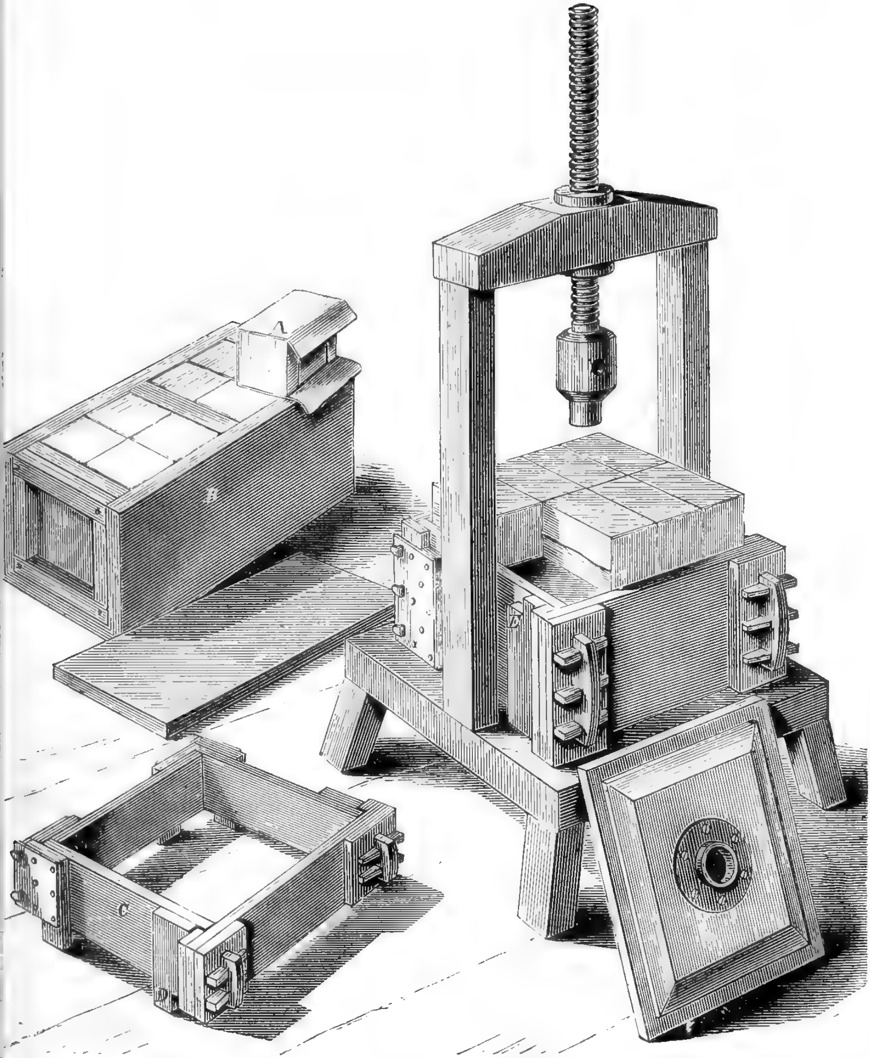
### The Oblong Shape.

Recently a new form, or style of cheese, has been introduced, which promises to be a success. The advantages claimed for it are—

1. The curd is pressed in a large cake (pressing in one curb or mould from 10 pounds to 1000 or more) and then cut into blocks of any desired size. These blocks are then bandaged, and placed in the mould in layers, and again pressed, and the whey starts again, especially at the freshly cut sides. In this manner cheeses may be made weighing from 10 to 100 pounds each, to suit any market, and small cheeses can be made at very nearly the same expense as large ones.

2. The escape of the whey by evaporation is greatly facilitated by this form of cheese-cakes, for, as the whey percolates towards the bottom of the cakes (these cakes being turned from time to time only a quarter of a revolution), the whey, instead of turning back toward the centre of the cheese—as is the case with all

*Fig. 23.—Cheese-press and Mould used for the Holdidge Cheese.*



A. Cheese with bandage. B. Composite Cheese-mould. C. Square Hoop.
D. and E. Morticed slips for connecting the Hoops.

round cheese,—is turned at right angles thereto, and is consequently always tending towards the outside; and the whey is so far expressed and evaporated that decomposition is much less liable to take place.

3. These cakes, being entirely covered with bandage, may be cured with or without greasing, and are thus rendered safe from flies.

4. They are much more easily turned and handled than round cheese.

5. They are shipped to market in boxes of thin stuff of any kind of timber. Any farmer can make them, making the boxes of such size as he chooses, and at an expense much less than for round boxes. For ten-pound cheeses boxes are used with success containing 18 cheeses, 180 lbs.; and for thirty-pound cheeses, 8 in a case, 240 lbs. This item of boxes is a great advantage. The boxes are solid, and there are no covers to come off. The cleats on the outside of the boxes prevent them from being packed too closely together in carrying or in store-houses. There is a great saving in weight, as, in the old style, down weights are given in each cheese, while in this shape only one down weight is given for 18 small cheeses or 8 large ones.

6. For retail trade this form of cheese is of great advantage. The dealer can weigh the whole cheese, and cut by measure the exact weight required, and many of the cheeses are sold without cutting.

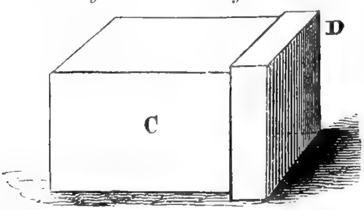
7. For family use small cakes are a great success. A ten-pound cheese is 10 inches in length and 5 inches square, and is cut for table use as follows:—

Turn the bandage back from the end, cut a thin slice from the end of the cheese, then cut off the desired slices for the table, and replace the thin slice and bandage; set the cheese on end, and it is sealed and as safe as an uncut cheese.

8. These cheeses cure much better than round ones, as the gases, if any be generated, escape from the ends, and are not forced back and forth through the cheese as with round ones.

9. They take less room in the dry-house, and women and children can easily turn and handle them.

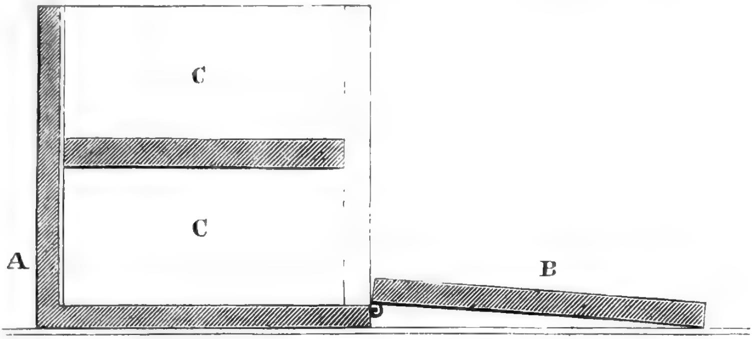
*Fig. 24.—Holdidge Cheese.*




10. For exportation they greatly excel the round cheese. They can be packed closer, boxes cost less, and small cheese can be boxed and shipped at nearly the same expense as large ones. They have been shipped to England with great success. We give cuts which will explain more fully this invention (Figs. 23 to 26).

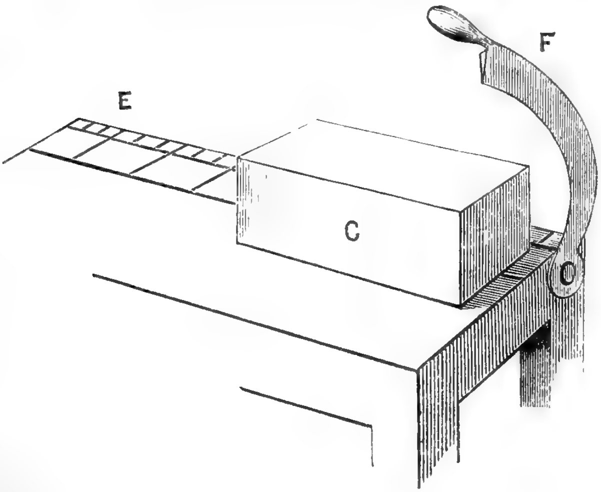
Fig. 25 represents a sectional elevation of a cheese vat or mould. When the curd is ready for pressing, it is placed in the

*Fig. 25.—Cheese-vat, or Cheese-mould, for Holdidge Cheese.*




mould (A) of rectangular form, and with one side (B) arranged to swing open on hinges for the removal of the cakes after they are pressed. After the curd is pressed into a broad flat cake it is vertically cut with a fine saw into two or more blocks (C C), and bandaged with muslin. These are placed one upon another

*Fig. 26.—Table and Knife for Cutting Holdidge Cheese.*




in layers, say two deep, in the mould, with thin boards or other plates between them, and are again subjected to the action of the press, by which the whey is still further pressed out, especially of the freshly cut sides of the cakes. The pressing is continued as long as needed, after which the cakes are removed to the shelf or curing-room, to allow the remaining whey to escape by evaporation. This is claimed to be facilitated by the form of the cake, because, as the whey percolates towards the bottom, and in turning as is required, from time to time, the cakes are only turned a quarter of a revolution, the whey instead of being turned directly back in its course is turned at right angles, and is consequently always tending nearer to the exterior.

In this way, together with the pressing, it is claimed the whey is so far dissipated that decomposition is much less liable to take place, and, therefore, the cheese may be preserved without the greasing commonly employed.

Fig. 26 represents a perspective view of a cheese made according to this improvement. It rests upon a table with scale board (E), and with knife (F) for cutting into different weights.

According to the measurement on the scale E, Fig. 26 represents a perspective view of a cheese cut and partly used.

## Butter-making at the Cheese Factories.

Within the last three or four years a good quality of butter has been made at some of the cheese factories. The plan adopted is to spread out the night's milk in the vats used for making cheese, allowing a stream of water to flow under the inner vat, or to fill the space between the inner and outer vats. The milk is by this means reduced to about 60°, and what cream rises during the night is skimmed off in the morning and made into butter.

The morning's milk is then added to the skimmed milk as it comes to the factory, and is made into cheese by the usual process, except that a lower heat and less salt is used than for whole-milk cheese.

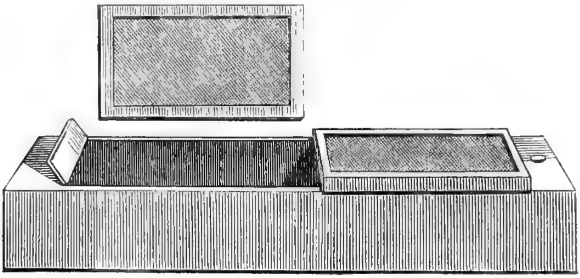
By careful manipulation and skill, very nearly, if not quite, as good a product of cheese is made as at the factories making whole-milk cheese; at least, with good milk and high skill, experts are unable to detect the difference.

At one of these factories, which we visited in 1870, the delivery of milk for the day amounted to 6839 lbs. The cream taken from the night's mess of milk made 87 lbs. of butter, and when the morning's milk was added to the skimmed milk it made 9 cheeses of 72 lbs. each.

In some factories, in order that the night's milk may not be massed together in too large quantities, resort is had to a large shallow pan set in a wooden vat with space between the two for water. The milk is set in these pans from 2 to 3 inches deep, and a stream of cold water kept flowing in the space between the pan and the vat during the night. These pans are from 8 to 12 feet, or more, long, by 2 to 3 feet wide, and are arranged so that the milk may be drawn off through an orifice in the bottom. The skimming is effected with a tin scoop.

The following figure (27) will illustrate this apparatus. It does its work very effectually.

*Fig. 27.—Pan for Setting Milk, fitted with Movable Covers of Netting to keep out Dust and Flies.*



## Whey Butter.

At the whole-milk cheese-factories a new process is beginning to be adopted for taking the butter out of whey and preparing it for table use. Whey butter is not equal in flavour or texture to the fancy product manufactured at the butter factories. Still, by the new process, whey butter may be made very palatable, and, when fresh, commands a good price.

We have seen whey butter side by side in the markets with that made from cream in the usual way, and dealers have selected the former in preference to the latter, not for a moment suspecting its origin. Indeed, so fine are some of the samples, and so neatly are they put up, that it has been sold week after week at the Little Falls market for the same price as good brands of butter made in the farm dairies.

Whey butter soon deteriorates in flavour, and should be consumed when freshly made. We give description of apparatus and process of making as follows:—

*Apparatus.*—The apparatus is a copper-bottomed vat 12 feet long by 3 feet wide, and 20 inches deep. These dimensions may be varied to accommodate the size of the dairy. The vat sets over a brick or stone arch, and is accommodated to the use of 18 or 20-inch wood. The floor is a slightly inclined plane towards the back of the vat. The vat and arch should be placed a little lower than the milk-vat so as to enable the whey to be easily drawn off by means of a syphon.

*The Process.*—After drawing the whey from the curd into the vat over the arch referred to, 1 gallon of acid is added to the whey for every 50 gallons of milk, if the whey is sweet. If the whey is changed a less quantity will be sufficient, and, if the acid is not sharp, 1 lb. of salt should be incorporated with it.

The acid having been added in the above proportions, heat is immediately applied to the mass until it indicates a temperature of from 170° to 180° Fahrenheit. The cream now begins to rise, and is skimmed off with a tin scoop; and when it has all been removed it is set in a cool place, and left to stand for 24 hours. It is then churned at a temperature of from 56° to 68°, according to the temperature of the weather, and is then worked and salted in the ordinary manner of butter-making. This process gives on an average 20 pounds of butter from 500 gallons of whey.

*Making the Acid.*—The acid is made by taking any quantity of whey after extracting the cream, heating it to the boiling-point, and adding a gallon of strictly sour whey for every 10 gallons of boiling whey, when all the casein and albuminous matter in the whey will collect in a mass, and may be skimmed off. The whey is now left to stand for 24 or 48 hours, when it will be ready for use as acid.

After the butter is made by the above process, the whey is considered by those who have made experiments with it, to be better for feeding to swine than whey not subjected to the process, as the sugar of milk is retained longer without change.

## Results obtained at the Butter Factories—Labour, &c.

The average product from the milk during the season at the butter factories is a pound of butter and two pounds of skim cheese from 14 quarts of milk. There is a variation in the quality of milk at different seasons of the year; and in the fall, when the cows are giving a smaller quantity, it is, of course, richer in cream, and better results are obtained from the same quantity than early in the season. This will be seen from the following examples of a single day's work, taken at random from the book of one of the factories :—

On May 18th, from 3512 quarts of milk, wine measure, there was produced 213 lbs. of butter and 560 lbs. skim cheese. On May 26, from 3300 quarts of milk, 210 lbs. of butter and 550 lbs. of cheese. On September 12th, from 3180 quarts of milk, 200 lbs. of butter and 546 lbs. of cheese. On October 14th, from 2027 quarts of milk, 120 lbs. of butter and 407 lbs. of cheese.

In the working of any system, practical men always desire statistics of results. The following is a statement of receipts and expenditure at one of the small butter factories, where a portion of the milk was sold.

The quantity of milk received from April 10th to December 1st, was 627,174 quarts, of which 27,308 were sold at a little above 7c. ($3\frac{1}{2}d.$) per quart, leaving 509,866 quarts to be made up into butter and cheese. The product was as follows:—31,630 lbs. of butter, 81,778 lbs. skim cheese; 15,908 lbs. whole-milk cheese; 2261 quarts cream sold at $19\frac{6}{10}$ cents. ($9\frac{8}{10}d.$) per quart, and 1561 quarts skim milk, at 15 cents. ($7\frac{1}{2}d.$) per quart.

The net cash receipts, after deducting transportation and commissions were as follows:—

| | Dols. |
|---|---|
| For pure milk sold .. .. .. .. .. .. | 1,926·22 |
| For skim milk sold .. .. .. .. .. .. | 24·02 |
| For butter sold .. .. .. .. .. .. .. | 13,344·21 |
| For skim cheese sold .. .. .. .. .. .. | 11,659·08 |
| For whole-milk cheese .. .. .. .. | 1,065·44 |
| For 2261 quarts cream .. .. .. .. | 443·33 |
| Hogs fed on whey .. .. .. .. .. .. | 446·24 |
| Buttermilk and sundries .. .. .. .. | 207·49 |
| Making total of .. .. | 29,116·03 |
| | (=£5,823 4*s.* $1\frac{1}{2}d.$) |

The expense account was as follows:—

| | |
|---|---|
| For labour .. .. .. .. .. .. .. .. | 1,476·40 |
| For fuel .. .. .. .. .. .. .. .. | 79·96 |
| For cheese boxes .. .. .. .. .. .. .. | 653·17 |
| For 20 sacks of salt .. .. .. .. .. .. | 89·25 |
| For rennets, bandages, &c. .. .. .. | 483·55 |
| For carting cheese and butter to station .. | 273·10 |
| Paid for hogs .. .. .. .. .. .. .. | 179·90 |
| Total .. .. .. .. .. | 3,235·33 |
| | (=£647 1*s.* 4*d.*) |

This gives an aggregate net receipt of 25,880,70 dollars.*

From these statements it appears that the butter averaged $42\frac{1}{4}$ cents. (say 1*s.* 9*d.*) per pound, the skim cheese $14\frac{1}{4}$ cents. (about 7*d.*), and the whole-milk cheese 18 cents. per pound, while the average amount received on the whole quantity of milk was $4\frac{1}{10}$ cents. (2*d.*) per quart. The whole expenses of the factory were a little over one-half cent. per quart.

For working this factory there were employed, besides the superintendent, three hands, viz. two men and one woman. The labour account for conducting this factory, it will be seen, is a little over two mills ($\frac{1}{10}d.$) per quart.

* Five dols. to the £ would be very nearly correct. Our currency is not yet upon a gold basis. If it were, 4·84 would be equivalent to the £.

## MEANS EMPLOYED FOR DETECTING DILUTED MILK.

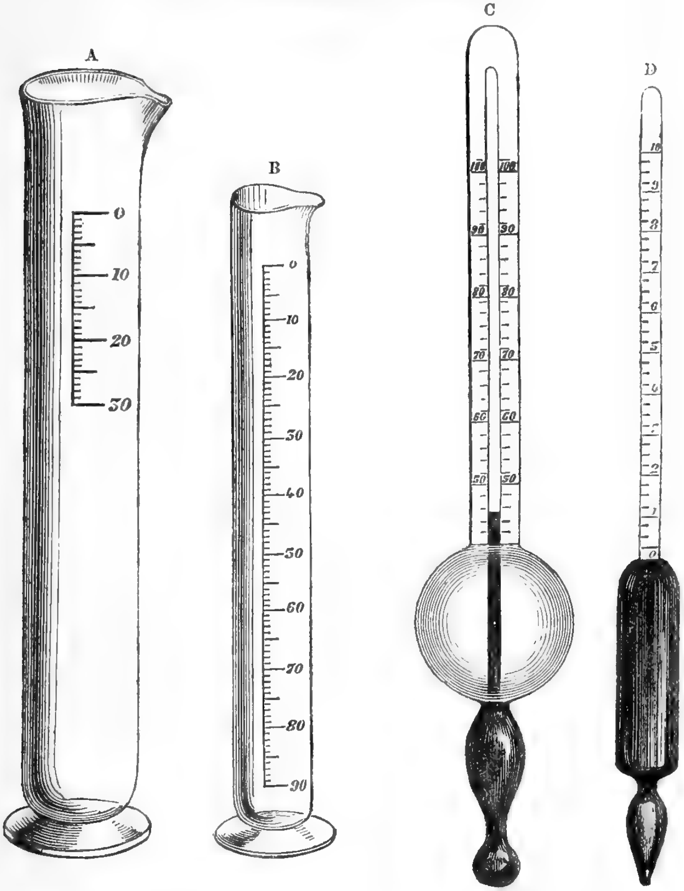
The most unpleasant feature of the factory system appears when dishonest patrons attempt to rob the Association by the delivery of watered milk. The Laws of New York are very severe on persons found guilty of this misdemeanor, punishing with heavy fines and imprisonment. The factory manager keeps watch over the milk as it is delivered, setting aside small quantities from time to time for observation and experiment with the hydrometer. Each factory is also provided with a set of small glass tubes, upon which the names of the patrons are pasted. As milk is delivered a small sample is placed in the different tubes corresponding with the name of the patron, and set aside. If the milk is not all right, the hydrometer and these samples give warning; the milk is then subjected to a more careful test, by the use of the cream-gauges and per cent. glass, which are represented in the following figures:—

In testing, one of the cream-gauges is filled to gauge-mark 10, with milk known to be pure, and drawn from several cows. This will be the standard for pure milk for that day. Another gauge is filled to the same number (10), with milk from a can which you wish to test. To avoid any mistake, the first jar containing pure milk is marked with the letters P. M. on the side or bottom. The jars are set away side by side, a sufficient length of time for the cream to rise. Now note the quantity of cream in each. If a less quantity is found on the milk you are testing than on the other, it indicates dilution, or skimmed milk. Now remove the cream from each with a spoon, introduce the hydrometer (or "lactometer," as it is usually called) into the jar marked P. M., and note on the scale-mark when it floats. Then remove it to the other jar, and note also when it floats. If it sinks lower than in the first jar, the evidence is considered almost positive of dilution with water. Replace the lactometer in jar marked P. M. from per cent. glass filled with water exactly to nought or zero; pour into P. M. jar until the lactometer sinks exactly to the same point as in the other jar. Now count a number on per cent. glass from zero down (each mark represents one-half of one per cent.) and you will have precisely the percentage of water with which the milk you are testing has been diluted.

Although there may be considerable variation in the specific gravity of milk from different cows, it has been found that when the milk of several cows is mingled together, and when the milk of different herds of a neighbourhood are compared, there is but little difference in the specific gravity of the several samples.

These tests have been very effectual in bringing offenders to justice, and with the very strict law on the subject, very little trouble is now had on account of adulterated milk.

Fig. 28.—*Instruments for Testing Milk.*




A. Cream-gauge.
B. Per cent. Glass.
C. Floating Thermometer.
D. Hydrometer or Lactometer.

### Annattoine.

The butter factories prefer to give colour to their butter by having the cows well fed, and by getting up the cream as quickly as possible after the milk is drawn. Sometimes, in winter, a little colouring may be used, and for this purpose as well also as for colouring the cheese, nothing has given so much satisfaction as annattoine, or the dry extract of annatto recently introduced.

The modes of preparing annatto for commerce are various and intricate. M. Le Blond, a French chemist, gives an account of its manufacture as follows; he says:—

The pods of the true *Bixa Orellana* being gathered, their seeds are taken out and bruised, and placed in a vat, which is called a steeper, when they are covered with water. Here the substance is left for several weeks or even months. It is then squeezed through sieves placed above the steeper, that the water containing the colouring-matter in suspension may return to the vat. The residuum is preserved under the leaves of the banana or palm, till it becomes hot by fermentation, when it is again subjected to the same operation, and this treatment is continued, till no more colour remains. The precipitate is boiled in copper to a consistent paste; it is then suffered to cool, and is dried in the shade. The annatto of commerce, as is well known, is often largely adulterated, during the boiling process, with red ochre, powdered bricks, calcothar, farinaceous substances, chalk, sulphate of lime, turmeric, &c., while salt and oil are added as preservatives against a bug which is generated in annatto, especially that which is adulterated with farinaceous substances.

Instead of this long process, which engenders disease by the putrefaction induced, and which affords an inferior product, M. Le Blond, proposed simply to work the seeds until they are entirely deprived of their colour, which lies wholly on the surface; to precipitate the same by means of an acid, and to boil in the ordinary manner, or to drain in bags as is practised with indigo. This process, it is said, has never been successfully carried out on a large scale until now (1870), as no precipitate could be found that did not in one way or another injure the colour. Small quantities were prepared according to Le Blond's theory, and the French dyers found it to be worth four times more than the ordinary annatto of commerce, that it was more easily employed, that it required less solvent, that it gave less trouble in the coppers, and that it furnished a purer colour.

The American preparation of G. De Cordova, under the name of annattoine or dry extract of annatto, is claimed to be an improvement on, and a perfection of, the Le Blond and Vauquelin theories. The latter asserts that boiling injures the colour, and as this has been clearly proven, Cordova reduces the precipitation to a powder, instead of boiling it to a paste. As this preparation gives a beautiful colour, and is very much cheaper than any preparation of annatto in the market, at the same time being free from any deleterious adulteration, the managers of American factories are greatly pleased with it, and it is rapidly taking the place of other preparations.

It is cut or made ready for use in the following manner. 1st. Put 2 lbs. of annattoine in 4 gallons of clear cold water, and let it stand in this state one day, stirring thoroughly meantime, so as to perfectly dissolve the annattoine. 2nd. Then put 2 lbs. strongest potash, and 1 lb. sal-soda (carbonate of soda) in 3 gallons of cold water. When this is perfectly dissolved and settled, pour off the clear liquor, and mix the two preparations (Nos. 1 and 2) together. 3rd. Let this compound stand two or three days, until the annattoine is cut or dissolved perfectly by the potash, stirring occasionally meantime. Use about a tea-cup full for a thousand lbs. of milk. Do not mix with the rennet, but put it in a little milk, and then mix in the mass of milk in the vats by stirring it in thoroughly, just before the rennet is used.

If a day or two after the preparation is made, the annattoine does not seem to be perfectly cut, so that specks can be seen, it is certain that the potash was not strong enough. Adding more of a stronger solution of potash will remedy the trouble.

When annattoine is used for colouring butter, a portion of the prepared liquor is added to the cream, at the commencement of churning. It gives a very rich colour, and may be used in winter-made butter with advantage.

## Milk Coolers.

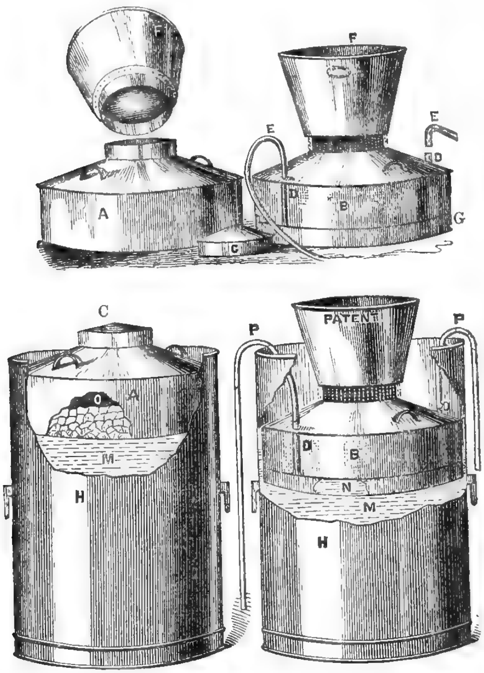
In order that milk may be properly preserved in its transit from the farm to the factory, milk coolers have been introduced among the farmers to cool the milk at the farm as fast as it is drawn from the cow. There is a great variety of these implements. We give figures of two devices (see following page) which are placed in the carrying-cans used for hauling the milk to the factory. Cold water or ice may be used for the purpose indicated. We also give illustrations (Fig. 31, p. 39) of improved handles for carrying-cans.

## Swine.

The keeping of swine to consume the whey or refuse slops resulting from butter and cheese manufacture is considered a necessary part of the dairy business. The hogs are either kept at the factory or upon the farm. When kept at the factory, grounds are selected near the buildings, but so situated that offensive odours are out of the reach of the milk-room and curing department; and upon these grounds pens are erected and the whey-reservoir is placed. Usually the grounds are large enough to give the hogs sufficient space for a range in the open yard. The pens are arranged so that each patron of the factory can have a place for his swine separated from the rest. The patrons therefore may keep their hogs in separate pens, or allow them to run in common.

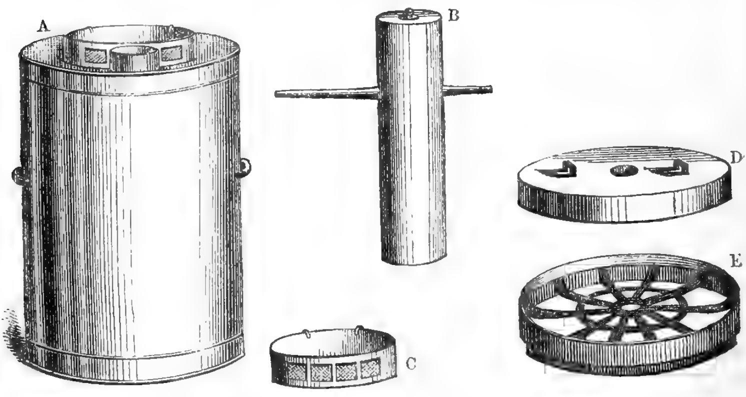
Pipes are arranged so as to conduct the whey from the reservoir to the troughs simply by opening the whey-gates or a faucet.

Fig. 29.—"*National*" *Milk-coolers.*



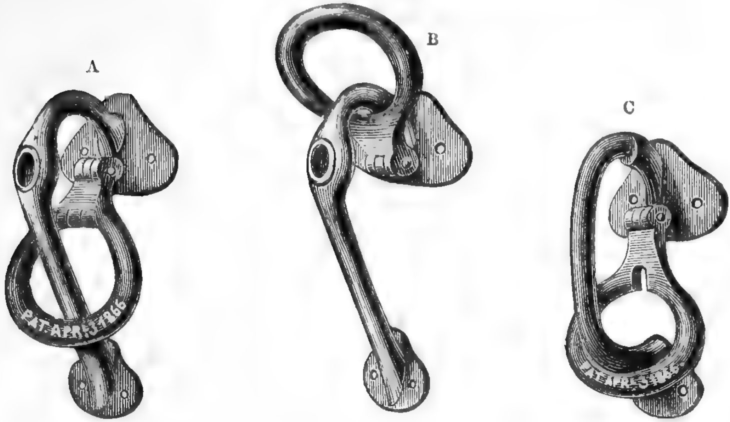

A. Cooler, for water (N) and ice (O).
B. Cooler, arranged for introducing water by means of syphons E, E, fixing on tubes D, D.
C. Cover.
F. Strainer.
G. Body of cooler.
H, H. Carrying-cans with coolers floating on the milk (M).

Fig. 30.—*Carrying-Can for Milk, with its appurtenances.*




A. Can with cooler and strainer set in place.
B. Cooler.
C. Strainer.
D. Cover of can.
E. Iron bottom of can.

Fig. 31.—*Millar's Patent Milk-can Handles.*




A and B.—New Pattern. C.—Old Pattern.

By this arrangement the feeding-troughs are so supplied that each animal gets its daily rations of whey.

Each patron is allowed the keeping of one hog for every four or five cows from which he delivers milk. The proportion of hogs varies of course with the supply of whey. Patrons who do not care to keep swine at the factory have the privilege of carting a certain amount of whey from the factory to the farm, and feeding as desired.

The difficulty of keeping the factory premises free from bad odours has induced many factory men to break up the pens and banish swine entirely from the establishment. In such cases the whey is run into a reservoir a considerable distance from the buildings, and patrons, after delivering milk, fill the carrying-cans with whey and cart back to the farm.

In feeding whey to swine, bran, ship-stuffs, or some kind of meal, should be mingled with the whey. When this is done a good quality of pork is made, and considerable profits are often realised from the whey. We do not approve of feeding hogs entirely upon whey: it does not contain the elements of nutrition in the right proportion to preserve the animal in good health and make the best quality of pork.

Hogs, it is true, will live on whey and take on fat, but the pork is soft, watery, and of inferior quality. It is doubtful whether such pork is a healthy article of food, as swine fed exclusively on such watery slop soon show symptoms of disease. Still, many dairymen keep a portion of their hogs on whey alone, and sell in early fall to the butcher or packer.

Absorbents, such as muck, sawdust, dry earth, &c., should be used freely about hog-pens to take up the liquid manures, and free the premises from disagreeable odours; and this course is especially desirable when hogs are kept in connection with butter factories, or in the vicinity of the farm-dairy. In addition to the benefits resulting from absorption and in keeping the air free from bad odours, another important advantage is gained in the increased quantity of manure.

## Conclusion.

*Philadelphia Butter.*—In conclusion, it may not be out of place to give a brief account of the manner of making Philadelphia butter, which has long held a very high reputation in America, and which often sells in Philadelphia at a dollar per pound. It is no better in flavour and texture than fancy brands made at the butter factories of New York; but it is equally as good, and being put up in small rolls, or prints, and packed in refrigerators, it arrives in market as perfect as when it left the hands of the butter-maker.

The best Philadelphia butter comes mainly from Chester, Lancaster, and Delaware counties, Pennsylvania.

The Spring-house is about 18 feet by 24 feet, built of stone, with its foundation set deeply in the hill-side, the floor being about 4 feet below the level of the ground at the down hill-side. The floor is of oak, laid on sand or gravel; this is flowed with spring-water to the depth of three inches, and at this height the flowing water passes out into a tank at the lower side of the Spring-house. The milk, when drawn from the cow, is strained in deep pans, which are set in the water upon the oaken floor. Raised platforms or walks are provided in the room for convenience in handling the milk. The walls of the Spring-house are about 10 feet high, and at the top on each side are windows covered with wire-cloth for ventilation. The depth of the milk in the pans is about 3 inches, and the flowing water which surrounds the pans maintains a temperature of about 58° Fahrenheit.

The milk is skimmed after standing 24 hours, and the cream is put into deep vessels having a capacity of about 12 gallons. It is kept at a temperature of 58° to 59° until it acquires a slightly acid taste, when it goes to the churn. The churn is a barrel revolving on a journal at each head, and driven by horse-power. The churning occupies about an hour, and after the buttermilk is drawn off cold water is added and a few turns given to the churn, and the water then drawn off. This is repeated until the water as it is drawn off is nearly free from milkiness. The butter is worked with butterworkers, a dampened cloth meanwhile being pressed upon it to absorb the moisture and free it of traces of buttermilk. The cloth is frequently dipped in cold spring water and wrung dry during the process of "wiping the butter." It is next salted at the rate of an ounce of salt to three pounds of butter, thoroughly and evenly incorporated by means of the butterworker. It is then removed to a table, where it is weighed out and put up into pound prints. After this, it goes into large tin trays, and is set in the water to harden, remaining until next morning, when it is wrapped in damp cloths and placed upon shelves, one above another, in the tin-lined cedar-tubs, with ice in the compartments at the ends, and then goes immediately to market. Matting is drawn over the tub, and it is surrounded again by oil-cloth so as to keep out the hot air and dust, and the butter arrives in market in prime condition, commanding from 75 cents. to 1 dollar per lb.

Mr. Isaac A. Calvert, who markets his butter at these high prices at Philadelphia the year round, gives the following particulars of his management in a communication to Mr. J. B. Lyman, of the 'New York Tribune.' He attributes his success to three points:—1st, the food of his cows; 2nd, temperature; 3rd, neatness and dainty refinement at every step from the moment the milk flows from the udder till the dollar in currency is paid for the pound of butter. He says, "I have found that I make my best butter when I feed on white clover and early-mown meadow hay. I cut fine, moisten, and mix in both corn-meal and wheaten shorts. Next to meal, I regard shorts, and prefer to mix them together. I feed often, and not much at a time. I do not use roots, unless it be carrots. My pastures and meadows are quite free of weeds. I cannot make this grade of butter from foul pastures or a low grade of hay.

"*Temperature.*—This I regard as a matter of prime importance in making butter that commands a high price. Summer and winter I do not want my milk-room to vary much from 58°. In summer I secure the requisite coolness by spring-water of the temperature of 55° Fahrenheit flowing over a stone or gravel floor in the milk-house. This can be accomplished without water in a shaded cellar 10 feet deep. As good butter can be made without water as with, but the milk and cream must be kept at all times a little below 60°.

"We skim very clean, stir the cream-pot whenever a skimming is poured in, and churn but once a week summer and winter. Just before the butter gathers we throw into the churn a bucket of ice-cold water. This hardens the butter in small particles and makes a finer grain. In the hot months this practice is unvarying.

"In working we get out all the buttermilk, but do not apply the hand. A better way is to absorb the drops with a linen cloth wrung from cold water. The first working takes out all the milk; at the second we handle delicately with fingers as cool as may be. The salt is less than an ounce to a pound, but not generally much less. The balls each weigh 1 lb., and receive a uniform stamp. On packing for market, each ball is wrapped in a linen cloth, with the name and stall of the marketman written upon it. Our tubs are made of cedar-plank, $1\frac{1}{2}$ to 2 inches thick, and lined with tin. On the inner face are little projections on which the shelves rest. The balls are not bruised or pressed at all, and pass into the hands of the consumer as firm, as perfect in outline, and as spotless as when they left the Spring-house.

"We find *uniformity* to be a prime virtue in the butter-maker. We produce the same article whether the cows stand knee-deep in white clover-blooms, or sun themselves on the lee-side of the barn in February.

"There is a small ice-chamber at the end of the oblong tub which we use in summer, so that in dog-days the heat within the tub does not get higher than 60° Fahrenheit. I need not add that we observe a scrupulous, a religious neatness in every act, and in every utensil of the dairy. Milk which upon leaving the udder passes through an atmosphere loaded with stable fumes, will never make butter for which we can get a dollar per pound. No milk sours upon the floor of the milk-room; none is permitted to decompose in the crevices of the milk-pans; the churn is scoured and scalded till no smell can be detected but the smell of white cedar.

"Our customers take the napkins with the prints, wash, iron, and return them when they come to the stand on the butter-days. These are generally Wednesdays and Saturdays. With these prices we have no difficulty in making a cow pay for herself twice a year: if she cost 60 dollars, we sell 120 dollars' worth of butter from her in twelve months."

It may be remarked that the sour milk is employed by the Philadelphia buttermakers as a feed for swine. It is estimated that such milk will make 100 lbs. of pork per cow.

The cows in the district where the Philadelphia butter is made are well sprinkled with the Jersey or Alderney blood, and about a pound per day from each cow is considered a fair average for the best dairies.

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## II.—*The Origin and Progress of the Factory System of Cheese-making in Derbyshire.* By GILBERT MURRAY, Elvaston, Derby.

AT a meeting of the Royal Agricultural Society of England, nearly two years ago, Lord Vernon, of Sudbury Hall, near Derby, moved for an inquiry into the working of the American Factory-system of cheesemaking, and into the question whether its introduction into this country would be advantageous to the interests of dairy-farmers generally. Owing to the long illness and the subsequent death of Mr. Frere, the late editor of the Society's 'Journal,' the subject remained in abeyance until the early part of the year 1869, when the present editor commenced the enquiries that led to his Report on the subject, which was published 12 months ago in the Society's 'Journal.'*

On the 15th September, 1869, at the dinner of the Derbyshire Agricultural Society, the Chairman—Mr. J. G. Crompton—explained the present position and future prospects of the English dairy-farmers, and the necessity for prompt and decisive action to improve the quality of their produce. On the 20th September, at the meeting of the Midland Agricultural Society, at Alfreton, Mr. James Nuttall, of Chaddesden, near Derby, a large dairy-farmer, advocated establishing the Factory-system in Derbyshire. At a general meeting of the Derbyshire Agricultural Society, held at Derby, on the 24th December, the following Committee was appointed, at Lord Vernon's suggestion, to investigate the question:—Mr. J. G. Crompton (Chairman), Hon. E. K. W. Coke, Lieutenant-Colonel Wilmot, Messrs. Murray, Coleman, Greatorex, and Sims, to which were added Lord Vernon, the Mayor of Derby, Mr. T. W. Evans, Dr. Hitchman, Messrs. Roe, Faulkner, Nuttall, Travis, Walker, Smith, and Canner. The members of the Society assembled in the Derby Town-hall, on the 18th February, to receive the report of the Committee, his Grace the Duke of Devonshire occupying the chair, and the meeting being numerously attended. The Committee considered that there were satisfactory grounds for expecting the following advantages, should the system have a fair trial:—1st. Greater uniformity in the quality of cheese. 2nd. Enhancement of value in dairies which, from poor plant and the absence of good accommodation, are now producing inferior cheese. 3rd. The removal of an arduous occupation, frequently deterring men of capital, owing to domestic considerations, from entering upon farms on which cheesemaking is a prominent feature. 4th. Improvement in the value of land, from improvement of the value of produce; and 5th, generally the introduction of uniformity of system, of better plant, skill, and supervision.

The Committee desired to give the system fair play in the county, and, in order to insure contributors of milk from any loss that might arise in case of failure, or from the produce being of so inferior a quality as not to command a price in the market equal to that realised by the average Derbyshire cheese, it was suggested that the landlords of the county and others interested

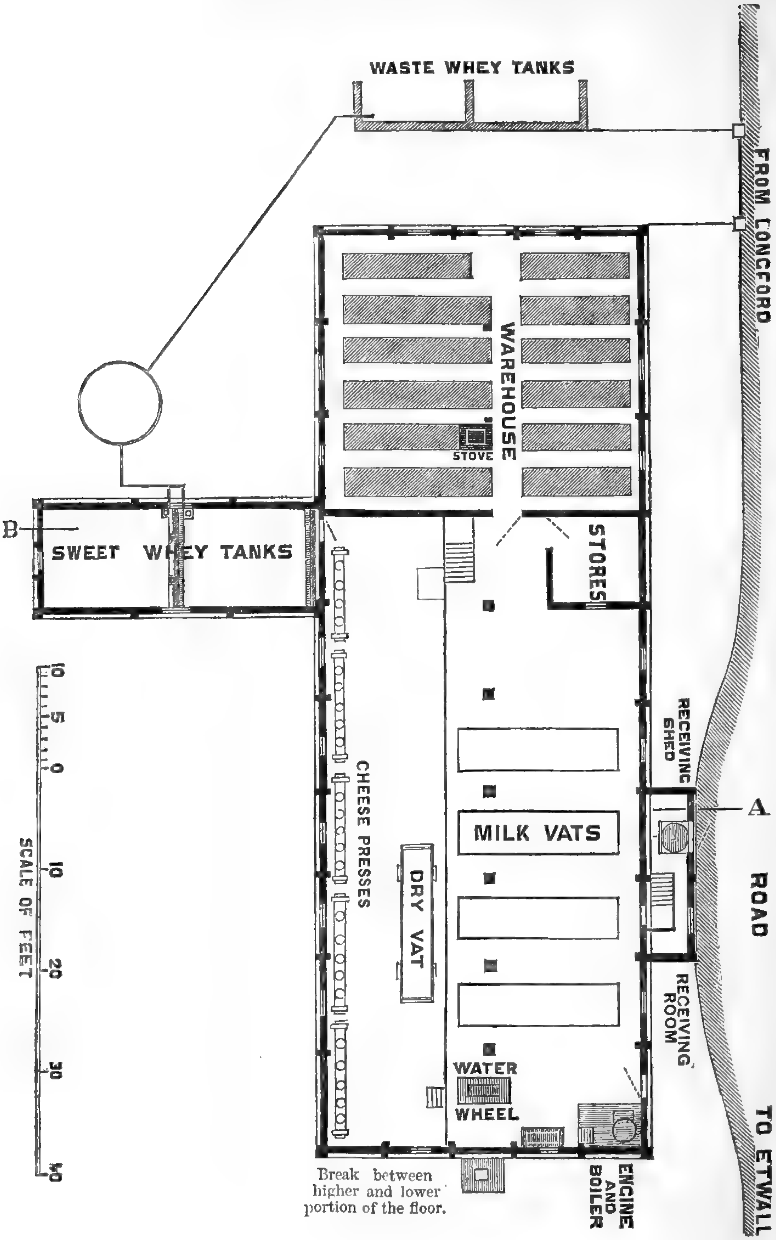
* 'Journal Royal Agricultural Society,' 2nd Series, vol. vi., p. 173.

in the movement should be solicited to subscribe to a guarantee fund. A sum of 5000*l.* having been subscribed, it was resolved that 6½*d.* per gallon be paid for the milk, such payments to be made on the last Friday of each month during the manufacturing season, the whey to be disposed of at the best possible price. When the year's produce had been disposed of, and fair working expenses deducted, the balance was to be divided *pro rata* amongst the suppliers of milk.

At first it was proposed to start only a single factory in the county last year; but Mr. Roe, of Derby, having placed at the disposal of the Committee (rent free for the first year) a suitable building, formerly a cheese warehouse, situated in a central part of the town, the Committee were induced to try the experiment in a rural as well as in an urban district. Meetings were held in various centres, the Chairman and some of the Committee being always present to answer any question, and give every information as to the basis on which the factory would be carried out. In establishing a factory in a rural district, it was deemed desirable not to start with a less number of cows than 400, to be kept within a radius of three miles, taking the factory as a centre. In the absence of direct railway communication, this is considered to be the limit of distance; it includes an area of 17,280 acres, which in a purely dairy district should furnish cows enough to supply several large factories with milk. The Committee held that, in order to insure for the system a fair trial, it was essential that a new building, embracing every accommodation and requirement, should be specially erected for the purpose. The Committee considered that it was too much to expect that they should erect a factory at their own cost; and also that it would be unfair, at this stage of the proceedings, to ask any landed proprietor to build a factory on his estate at his own expense, for the purpose of trying experiments for the public benefit, without offering him some guarantee that, in case of failure, he should be recompensed to some extent for the money he had expended. To fully test the merits of the Factory system in this country, it was deemed essential that the experiment should extend over a period of three years; and that any landlord erecting a factory on his property should place it at the disposal of the Committee rent free for the first year, after which a fair annual rent should be charged, and, in case the system should prove unprofitable at the expiration of the third year, 40 per cent. of the original cost of the building should be refunded to the proprietor, the funds for such purpose to be raised by a call upon the guarantors. Several districts were anxious to avail themselves of the opportunity of establishing a factory under such favourable circumstances. The Committee held meetings at Sudbury, Shardlow, Longford, Etwall, and Weston-Underwood. They carefully inspected the different sites, and noted all local circumstances having a practical bearing on the subject, the great desideratum being an unfailing supply of clean water, the lower and more equable the temperature the better. At each meeting a list was made of the names of those farmers willing to send their milk, and the number of cows belonging to each. The Hon. E. K. W. Coke, of Longford, and C. E. Newton, Esq., of Etwall, both offered to furnish the Committee with the requisite buildings subject to the proposed guarantee. In deciding between the two competitors, the vote of the majority was in favour of Longford.

The Committee had thoroughly to investigate the merits of the different systems of cheesemaking practised in this country, and to decide upon that which appeared to them the most capable of expansion. The Cheddar system, as practised in the American factories, was considered to offer the greatest advantages, from its simplicity and the despatch with which the whole process of manipulation is performed, effecting a vast saving in the cost of labour. Through the kindness of a member of one of the leading London houses engaged in the importation of American cheese, and consequently having good business connections in New York, a cable message was dispatched to Messrs. Webb, Turner, and Co., of that city, to secure the services of a practical cheesemaker, his salary for the cheesemaking season to be 200*l.*, with free passage to England and the same back to America, should he return home at the end of the first season, the Committee likewise to find him with board and lodgings during his engagement. Mr. Cornelius Schermerhorn was selected, being well known as a successful maker, and he arrived in Derby on the 11th March, 1870. A special meeting of the Committee was at once called, and mechanics were immediately set to work to construct the working plant and fit up the building ready for use. The site for the new factory was in many respects most favourably situated in the centre of a large dairy district, and bounded on one side by a public road. The greatest difficulty was to obtain a sufficient supply of water at a low temperature, though a considerable stream passed within a few yards of the building. During the height of summer, and with continued drought, the stream became sluggish; and the water being exposed to the direct rays of the sun, its temperature rose to a greater height than is consistent with the making of good cheese, consequently the water for supplying the factory had to be conveyed in pipes for a distance of upwards of a mile. This considerably enhanced the cost, and as the season was now far advanced, and

Fig. 1.—*Ground-plan of the Longford Cheese-factory.*



those farmers who had given in their adhesion to the factory had not engaged dairymaids as usual, it was the more important that everything should be got in readiness to commence operations as soon as possible.

The system being new to this country, the Committee, in constructing the working plant and erecting the building, were entirely guided by the advice of their manager, Mr. C. Schermerhorn. They felt bound to furnish everything in accord-

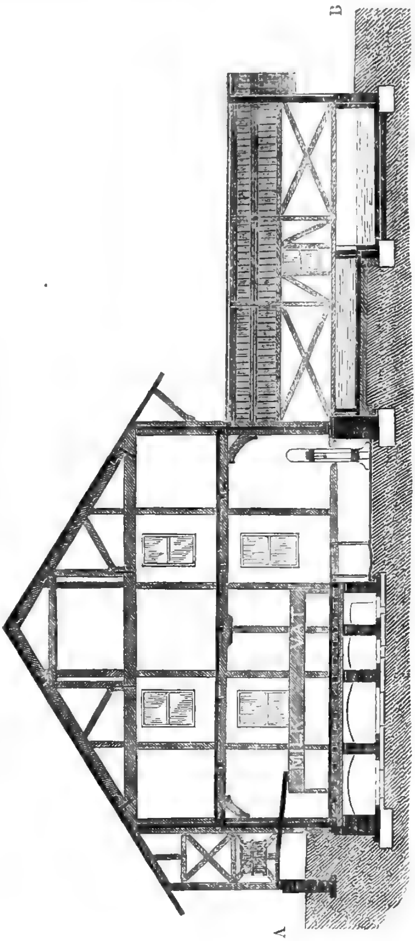



Fig. 2.—*Transverse Section of the Longford Cheese-factory, from the point* A *to the point* B *in Fig.* 1.

ance with his wishes, whatever improvements experience may teach them on future occasions to adopt. From an American point of view a wooden building is considered superior to that of brick or stone for every purpose; and, to save time and money, they decided on erecting a wooden structure. Where all the advantages of the modern wood-working machinery are available, less time is occupied in erecting a wooden building than one constructed of bricks and mortar. Everything considered,

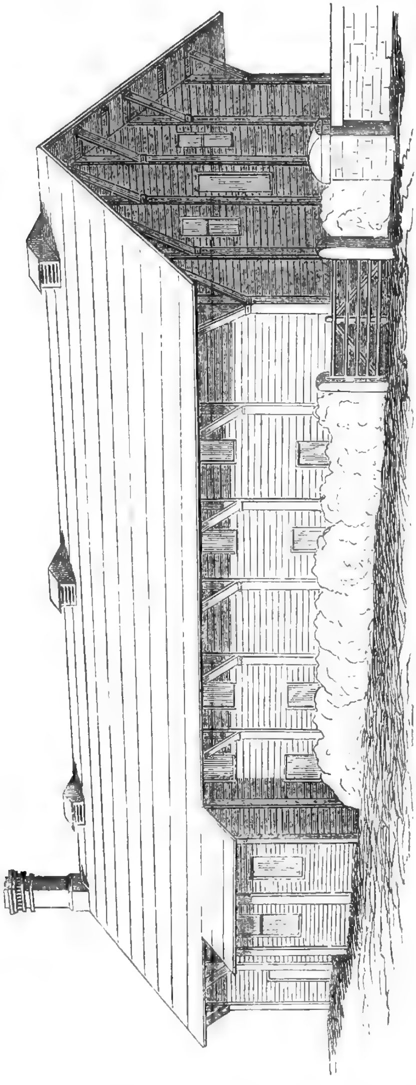


Fig. 3.—*North-east view of the Longford Cheese-factory.*

the difference in cost is small; but Messrs. Moore and Turner, of Derby, contracted to erect a building, with sufficient accommodations for working the milk of 600 cows, at a cost of 500*l.*

The Committee originally intended that Mr. Schermerhorn should superintend both the Derby and Longford factories, devoting part of the week to each, and having a leading hand in each factory to whom he could impart information and instruction, and upon whom would devolve the responsibility during his absence. But they afterwards felt that a daily produce worth from 30*l.* to 40*l.* represented a capital too large to be safely intrusted in the hands of any but an experienced person, and that a failure from mismanagement, or from any other cause, would not only be fatal to the movement but would also entail a considerable loss on the guarantors. Having, therefore, consulted with Mr. Schermerhorn, it was deemed desirable to telegraph to America for another maker to be engaged and sent over at once. Mr. Levi Schermerhorn accepted the engagement on the same terms as his brother, and arrived in Derby about the middle of April.

The original Committee having presented their Report to the Derbyshire Agricultural Society on the 18th of February, it was considered that they had satisfactorily fulfilled their mission. A new working Committee was, therefore, appointed by the guarantors, to order and superintend the construction of the working plant, and the erection of the necessary factory-buildings; to draw up a code of rules and regulations for the proper management of the factory and for the guidance of milk suppliers; to overlook and generally direct the efforts of the manager and his subordinates; to pay the milk suppliers on the first Friday in each month; to examine and pay all bills; and to dispose of the produce of the factories to the best of their judgment. The Members of the Derby Committee were Mr. J. G. Crompton (Chairman), Messrs. Murray, Nuttall, Tomkinson, and Burnett. The Longford Committee were the Hon. E. K. W. Coke (Chairman), Messrs. Coleman, Lowndes, and Salt. In all matters of importance the two Committees worked together, their interests being identical. From the commencement they were much indebted to Mr. J. C. Smith, Secretary to the Association. All the vats, presses, and tables were made by Mr. Geo. Dakin, joiner, Derby; and Mr. Higginbotham, who occupies silk-mills adjoining the Derby Factory, kindly allowed them to carry a steam-pipe from the boiler of his engine, and gratuitously supplied the factory with steam during the working season The arrangements having been so far completed as to warrant the commencement of operations, the first cheese was made in the Derby factory on the 8th of April, the milk supply having been drawn from 13 different farms, keeping an aggregate of 300 cows. The Committee had reluctantly to refuse an equal number more, as, from a sense of their inexperience and a fear lest they should involve the interests of the guarantors, they deemed it prudent to act with caution. The success of the past season has given them such confidence in the movement that they will have no hesitation in increasing the number to 500 cows. The following are the rules and bye-laws to which each milk-contributor had to append his signature before he could be admitted as a patron, or could participate in the benefits to be derived from the Association.

### Derbyshire Cheese-factory Association.

*Rules.*

That this Association be called "The Derbyshire Cheese-factory Association."

That it be managed and governed by a Central Committee, the members of which shall be those persons subscribing not less than a sum of 50*l.* to the Guarantee Fund, or their agents; and the representatives of the Managing Committee, of not more than three members from each, seven members of such Central Committee to be a Quorum.

That the Central Committee shall appoint a Managing Committee for each factory; such Committee not to exceed six members, two of whom shall be selected from the suppliers of milk to such factory; these Committees to have the entire control of their respective factories, and of the officers of such factories, the manufacture of the cheese, and the disposal of the whey. A Sub-Committee, of not more than three members, including the Chairman of such Managing Committee, or his deputy, to be appointed the Finance Committee and for the sale of cheese of such factory.

That the Managing Committee of each factory shall have power to make such Bye-laws as they may consider expedient and carry them into effect, such Bye-laws to be submitted to the Central Committee.

That Messrs. Crompton, Newton, and Co., of Derby be the Treasurers of the Association.

That the Central Committee shall appoint a Secretary to the Association, who shall be required to audit the Manager's books of each factory every month, prepare reports and accounts for such Committee, record the minutes of their meetings, and carry out their instructions, pay the suppliers of milk their due, and transact generally the business of the Association.

That all payments above 1*l.* shall be made by cheques, signed by the Chairman (or his deputy) of the Managing Committee of the factory to which such payments belong, and by the Secretary.

That the accounts of each factory be kept separate and distinct.

That persons supplying milk to either of the factories shall be required to send, twice every day, the pure milk from the whole of their dairy cows (excepting such milk as shall be required by them for their family consumption), during the manufacturing season, the termination of which shall be determined by the Managing Committee of each factory,

That the terms for the current year on which the milk is to be obtained shall be a guaranteed payment of $6\frac{1}{2}d.$ per gallon of 10 lbs. weight, payable the first Friday in every month, between the hours of 10 and 1 o'clock, at the Secretary's Office at Derby, together with a share of the profits of the factory according to the quality of the milk supplied (after payment of working expenses of such factory), which shall be paid as soon after the close of the manufacturing season as the Central Committee can arrange.

That the Manager of each factory shall have power to refuse milk that is of an inferior quality, sour, dirty, or otherwise impure, without reference to the Central Committee; and any person detected in sending milk that has been skimmed or adulterated shall be reported to the Central Committee, and render himself liable to a forfeiture of his share of the profits that may be derived from the factory, and not be allowed to supply milk to it afterwards.

That every supplier of milk shall sign a declaration that he will submit to the Rules of the Association and the Bye-laws made for the proper working of such factory with which he is connected. And in case of his failing to comply with such Rules and Bye-laws, he shall forfeit all claim to any profits that may be derived from such factory, and not be allowed to supply milk to it afterwards. But in case of his inability to supply the milk from the number of cows which he had previously declared, under such circumstances over which he has no control, or which the Central Committee shall deem to be satisfactory, he may be relieved from his agreement on such terms as the Central Committee shall decide to be just and proper.

That persons on the working staff of either factory shall not allow the admission of any person other than a Guarantor, or by the written consent of one of the Managing Committee to such factory, excepting he be on business connected therewith.

### Bye-Laws of the Derby Factory.

No milk will be received after half-past seven in the morning, and half-past seven o'clock in the evening.

Milk from a newly-calved cow must not be sent in under four days after the cow calves.

The cans used for carrying milk to the factory, and other utensils connected therewith, must be kept thoroughly clean and sweet.

Cans for carrying milk to be supplied by the Committee at cost price.

A ticket of the weight of milk received at the factory to be given to the person who brings the milk each time.

I, the undersigned, do hereby declare that I will agree to supply the milk of cows to the Derby Cheese Factory on the terms stated in the before-mentioned Rules and Bye-laws, and that I will submit to and carry out the said Rules and Bye-laws made and to be made during the season for making cheese in this present year, 1870.

(Signed) .

Date .

The Derby factory, originally a cheesefactor's warehouse, is 60 feet long by 30 feet wide, and consists of three separate floors. It adjoins the Derby canal and Mr. Roe's timber-yard, the ground on one side being on a level with the first floor. The basement, being an excavation, insures an equable temperature, which is conducive to uniform quality in the cheese. A width of 6 feet on the east end, embracing the whole width of the building, was partitioned off and excavated to the depth of 4 feet, lined with blue bricks laid in cement, and converted into a whey cistern capable of holding 3500 gallons. The evening's milk having arrived at the factory, it is weighed and run directly into the vats in the make-room, which has already been fully described in a former number of this Journal.* When the morning's milk has all been received, and run into vats along with that of the previous evening, the cold water is stopped, and by opening a tap in the bottom of the vat the whole of the water contained between the outer and inner vats is run off and steam turned on. The steam immediately fills the space previously occupied by the water, and the temperature of the milk is raised from 82° to 86°, according to the natural temperature of the atmosphere—the lower in hot and the higher in cold weather. Every experienced cheesemaker knows that coagulation takes place much quicker when milk is set at a high than at a low temperature. A most important point is to have the whole of the milk in the vat of one uniform temperature throughout. By closely covering the vat with a thick cloth, the

* 'Journal Royal Agricultural Society,' 2nd Series, vol. vi., p. 519.

loss of heat by evaporation is prevented. Inequality of temperature produces curd of different kinds, the greater heat causing the action of the rennet to be more decided, consequently the curd becomes tough. It is no uncommon occurrence to have one part of the curd in the same vat tough and the other part free and open; this difficulty will, however, be readily overcome, as the system of applying the heat is capable of great improvement. When the milk in the vats has been raised to the desired temperature, the annatto is added, if colouring is used, and the whole mass well stirred. The quantity of annatto will depend on the shade desired: this once settled, the rest will be easy; the quantity of milk being always known, the colour can be regulated accordingly. The rennet is now put in and the milk again well stirred and the vat covered over, as before described. Good rennet will coagulate 1500 times its own weight of milk; its action is more rapid when the milk is slightly sour. When this is the case the whole operation should be performed more quickly. The thicking process is accelerated with the increased temperature up to 120°; at 135° it becomes inoperative and loses its vitality. The quantity of the rennet causes more diversity in the taste and flavour of the cheese than anything else. In America filtration has been tried successfully. I have tried some experiments on a small scale: by passing the liquid through wood-charcoal, placed in a flannel bag, the active principle remains unimpaired. I think the adoption of some such simple means may lead to important results. Under ordinary circumstances the curd will be ready to cut in from 30 to 40 minutes after the rennet is added. In many English dairies the curd is still broken by hand, instead of being cut, as is now universally the case in all the American factories. The best time to perform this operation is when the curd has obtained sufficient consistency to break smooth, without whitening the whey and before it becomes tough. The cutting should be done as carefully and evenly as possible, with despatch, but with as little motion as may be. It is first cut into prisms from bottom to top; it is then cut parallel to the surface, dividing the prisms into cubes. The knives used for cutting the curd are of two kinds; in the one the blades are vertical and in the other horizontal. In America there is considerable difference of opinion as to whether the curd should be cut into large or small pieces. Coarse curd invariably gives a greater quantity of cheese from a given quantity of milk, as less casein and buttery matter pass off in the whey during the process of making. The objection to coarse curd is its liability to produce open and uneven texture, and inferior flavour, from a portion of whey becoming hermetically sealed in the centre of large lumps of curd during the process of cooking, and thus setting up a fermentation, or an acidity, which greatly deteriorates the flavour. Fine curd insures a more perfect separation of the whey. The quality may be slightly reduced, but the flavour and keeping properties are greatly improved. In England some makers advocate the grinding of the curd: this is quite unnecessary, if not actually prejudicial to the quality of the cheese. The blades of the knives used for cutting the curd should not be more than one quarter of an inch apart. When the curd has been cut it should be allowed to stand for a few minutes for the whey to separate; the heat is then turned on slowly and gradually until the temperature is raised to about 98° to 104°, which must be regulated by the condition of the milk and state of the weather. If the milk is old or has already begun to turn sour, the temperature should be raised as quickly as possible. As soon as the acid in the whey has become sufficiently developed to be perceptible to the taste the whey is run off. The exact degree of acidity is a matter of vital importance, and at present can only be approximated, the maker being entirely guided by the senses of taste and smell. A simple and inexpensive instrument might be constructed that would show the exact acidity: such an instrument would be of great value in the hands of even the most experienced maker. The system of heating the milk in the vats, as is generally practised in America, and now in use in the Derbyshire factories, calls loudly for improvement. The great desideratum is to have the whole of the milk in the vat as near the same degree of temperature as possible. With the present arrangements this cannot be accomplished; but at a small additional outlay the difficulty can be overcome. In America what is claimed as an infallible test of acidity is the application of a hot iron to a lump of curd. The iron should only be searing hot; the whey is pressed with the hand from a piece of curd, which is held on the hot iron until it adheres, when the iron is pulled gently away from the curd: if the curd is raw it will break short away from the iron; as the acid becomes developed the curd will pull out into long threads, often 6 or 8 inches in length before it breaks; it is claimed that the proper degree of acidity is that at which the curd shows the finest and most numerous threads. It is possible to construct a simple instrument that will show the acidity with the same unerring certainty and precision that a thermometer does the temperature. When the exact degree has been attained the short leg of a syphon is introduced into the vat, and the whey is run off into a pipe which conveys it direct to the whey-cistern. The curd is then transferred into what is called the dry vat: this vat is 16 feet long, 3 feet 10 inches wide inside, and 1 foot deep, having a wooden rack or perforated false bottom, over which a cloth-strainer is spread to facilitate the thorough draining of the curd. The salt is now applied and the curd turned carefully over by hand several times, and the large lumps broken. In order to insure the salt being distributed as evenly as possible through the mass, some makers apply the salt as soon as the curd is dipped or put into the dry vat; others endeavour to reduce the temperature by turning over several times before salting. The former method insures the most even flavour, but it requires the use of a greater quantity of salt, as a portion is drained off in the whey. The quantity of salt used is 2½ lbs. to each hundred pounds of curd when the curd is cold, and 3 lbs. when hot. Old cheese-makers, from practical experience, have long since discovered that the salt of one district is much better suited to their purpose than that of another, and that, in fact, by using certain salt, they cannot make good cheese. This question of salt is one of vital importance to the interests of the cheese-producer; the quality of the cheese may be sufficient to satisfy the most fastidious, yet if the flavour be rank and strong it is at once ignored, and its value in the market depreciated accordingly. Curd cannot be dissolved by the action either of cold or hot water; but add a portion of soda, and it immediately returns to its liquid state. Salt contains a greater or less quantity of free soda; this soda, acting on the curd, sets up a chemical action which permeates and taints the whole mass, and to this cause may also be attributed the flecked or spotted appearance so often met with in coloured cheese. In all industrial occupations the first element of success is to produce an article suited to the ruling taste and fashion of the customers. With the cheese-eating public the present taste is for mild clean flavour: to accomplish this the whole of the salt used in curing cheese must of necessity undergo a chemical purification; afterwards there can be no objection to using it in a liquid form. When the curd is salted and cooled it is put into the hoops: these are open at both ends; they are 15 inches in diameter and 20 inches deep, and are made of strong galvanised iron in order to resist the great pressure to which they are subjected. A square movable board fits on to the bottom of the press. This board, when drawn out, is supported in front by two legs, whilst the back rests on the bottom of the press; upon this the hoop is placed, and a square of thin cloth placed over it. The cloth is about 2 inches wider than the diameter of the hoop; the curd is now filled in by means of a filling tube, and carries the cloth with it to the bottom of the hoop; and when full a similar cloth is placed on the top, under the bed or follower; and the board, with the hoop now filled, is slipped into its proper position in the press without the hoop being moved. The pressure is then applied—slightly at first and increasing by degrees for about the space of two hours, when a pressure of three to four tons is attained. This solidifies the curd and insures sufficient cohesion to enable the maker to remove the cheese from the hoop and put on the permanent bandage, made of a thin cloth called tiffany, in width about 2 inches more than the depth of the cheese. A length sufficient to encircle the cheese is cut off, and the two ends are joined together by an overlay seam; they are then slipped on to the cheese, and the spare inch at each end is carefully turned over the top and bottom. The cheese is then returned to the hoop and the pressure again applied, this time amounting to from four to five tons. This pressure having been continued from eighteen to twenty hours, the cheeses are then taken out and at once conveyed to the curing-room. For the first two or three days after the cheese has been removed from the hoops it should be daily rubbed over with melted whey butter in a hot state. If this is neglected, sudden changes of temperature cause the rind of the cheese rapidly to contract, leaving it full of unsightly cracks and fissures, forming a birthplace and nursery for flies, skippers, and a whole host of insect enemies. It is of great importance that the curing-room should be kept at a uniform temperature; and to obtain fine quality considerable attention should be given to insure free ventilation. The cold air should be admitted only at the level of the floor of the curing-room, and a passage should be provided at the top of the building for the egress of the vitiated and heated air. Both openings should be so constructed as to be entirely under control and capable of being regulated at pleasure. For the first six weeks the cheese should be kept in an even temperature of from 70° to 75°; it should then be gradually cooled down to 65°, at which temperature it should remain for a fortnight; and if clean and well made, it will then have attained that stage of mild flavour so generally appreciated by the best customers. Both in the Derby and Longford factories the heating of the curing-rooms has been accomplished by the use of stoves. This, though the cheapest, is not the best means; for by the use of hot water the heat is more evenly distributed through the room, and the degree of temperature is more easily regulated. The boiler used for generating steam to raise the temperature of the milk during the process of manufacture might also be connected with a system of pipes in which a circulation of hot water would be kept up, sufficient of itself to heat the curing-room.

At Longford, the Hon. Mr. Coke not only devoted his time to practical details, but also spent a large sum of money in the erection of buildings, and in conveying water from a long distance through underground pipes, in order to insure a low and equable temperature. All the internal fittings are on the most improved principle of the best American factories, so that nothing is wanting to give the movement a fair and unbiassed trial. The results have exceeded the most sanguine expectations, and attained a complete success. It is not too much to say that the cheese made at Longford is considerably superior to that made at Derby. The independent and unanimous testimony of gentlemen of high standing, from widely different localities, pronounces some of the Longford make equal to that of the very best Cheddar, entirely free from the peculiar flavour inseparable from all American made cheese. Some have expressed a doubt as to the possibility of testing the quality of the milk contributed by the different patrons to a factory, and the detection of fraud by skimming or by adulterating with skim-milk or water. With ordinary care and attention it is quite within the power of the manager to detect any attempt of the kind. The cream-gauge is a true and unerring test as to the quantity of cream, and the lactometer, by showing the specific gravity of the skim-milk, would indicate an excess of water. On looking over the factories, Mr. H. M. Jenkins recommended the use of graduated glass tubes as tests of the caseine or cheesy matter contained in different samples of milk. These tubes are filled with milk to a fixed point, and a small quantity of rennet is added; the curd, when formed, is cut with a wire, and the tubes dipped into hot water to raise the temperature sufficiently to cause the separation of the whey; the curd settles to the bottom, and the graduated scale on the tube shows at a glance the proportion of curd. The quantity might be more correctly ascertained by removing and pressing the curd, and then weighing it; but to do this correctly would require the use of delicate machinery, and an amount of education and intelligence scarcely to be expected amongst ordinary cheesemakers at the present time. The state of health and condition of the cow exercises a marked effect both on the quantity and quality of the produce. It is vain to expect milk rich either in butter or in cheese from a cow when very lean, even though her present food may be rich and liberal in allowance. When proper materials are furnished the animal economy has the first claim, and the renovation of tissues prevents the secretion of milk. As is well-known, in the case of turnips and some acrid weeds, the flavour of the milk becomes tainted by the food, and this is much more the case when the cow is deprived of the use of clean water, and can only slake her thirst from some stagnant pool, which is often replenished by the urine from the cowshed, or by the drainage from the dunghill. Unlike the solid food the liquid is absorbed, and at once enters into the circulation, carrying with it, and commingling with the secretions, the germs of corruption. To the water alone may be attributed, in great part, the inferior cheese produced in most of the Dutch dairies.

Many years ago, when the breeding of Galloway cattle was extensively practised in the district whence they derive their name, and before the cultivation of the turnip became general, large droves of this thrifty breed might be yearly seen slowly wending their way to the Midland and Southern counties, there to be finished off on the rich pastures of the south. It was then the fashion to spay all the females not required to keep up the herd. The practice still lingers, and occasionally a lot of spayed heifers may be seen on Norwich Hill; they are highly esteemed by the grazier, as they graze quietly and lay on flesh much quicker than bullocks.

In some of the dairy districts of America they have adopted the system of spaying their milking cows. The operation is performed about six weeks after calving, and cows of from 6 to 8 years old are preferred. It is claimed that they produce at least one-third more milk, which is also much richer in quality, and that the milk will flow unabated for several years in skilful hands. The operation of spaying is attended with little risk, and the experiment would be a most interesting one to try in this country.

The chief cause of regret in the Derbyshire cheese-factory experiment is that the whey has not realised its full value. Although a considerable quantity of whey butter was made at the Longford factory, none was made at Derby, from the want of suitable arrangements. The experience of the past year leaves little doubt that, by scalding the whey, from 6 to 8 ozs. per cow per week may be gathered. At the Longford factory the milk contributors took the whey at ½*d.* per gallon, each man being charged with what he received. At Derby a small quantity of sweet whey was sold each day for drinking, at 2*d.* per gallon; the rest was disposed of for pig feeding, one farmer drawing it a distance of 4 miles.

As there is a considerable stock of cheese on hand at both factories, it is impossible to lay before the public the exact financial position of the Association. Suffice it to say that 40 tons of cheese have been sold at an average of 80*s.* per 120lbs., that the cost of making has been 2*s.* 3*d.* per cwt. at Longford, and 3*s.* at Derby. A vast number of people have visited the factories, more particularly the one at Derby, where there has been a constant influx of visitors every day. To no respectable person has admittance been refused, and all questions have been answered as far as possible. As an entirely new building had to be erected at Longford the early part of the season was lost. Cheese-making did not commence there until the 20th of May; there were 27 contributors of milk to this factory, forming an aggregate of 500 cows; the quantity of milk supplied was

170,867 gallons, which at $6\frac{1}{2}d.$ per gallon amounted to 4627*l.* 13*s.* The total cost of labour expended on the manufacture of the cheese was 176*l.* 7*s.* 9*d.*, or 2*s.* $3\frac{3}{4}d.$ per cwt.; the sales of whey amounted to 251*l.* 10*s.* 6*d.*, and that of whey butter to 64*l.* 2*s.*

The first cheese was made at the Derby factory on the 8th of April; there were 17 contributors of milk to this factory, giving a total of 300 cows; the quantity of milk delivered was 130,837 gallons, which at $6\frac{1}{2}d.$ per gallon amounted to 3543*l.* 10*s.*; the whey sold realised 228*l.* 7*s.* 6*d.*; the labour cost 178*l.* 12*s.* 5*d.*, or 3*s.* $\frac{1}{2}d.$ per cwt. The severe and long-continued drought, together with the prevalence of foot-and-mouth disease, which was rife in the district, and visited several farms from which supplies to the factory were drawn, making the summer of 1870 a trying one for dairy farmers, reduced the produce of the cows far below the average of ordinary seasons. The following tables show the quantity of milk received at the Derby factory from the 28th of August to the 25th of October, and also the number of pounds of milk it took to produce one pound of cheese weighed from the press. Cheese loses 8 per cent. of its weight during the process of curing.

| Date. | | Milk received. | Cheese made. | Pounds of Milk required to make 1 lb. of Cheese. | |
|---|---|---|---|---|---|
| 1870. | | lbs. | lbs. | lbs. | ozs. |
| August | 28 | 4827 | $483\frac{1}{2}$ | 10 | 3·133 |
| ,, | 29 | 4731 | 461 | 10 | 4·092 |
| ,, | 30 | 4646 | $455\frac{1}{2}$ | 10 | 3·171 |
| ,, | 31 | 4660 | 461 | 10 | 1·339 |
| September | 1 | 4751 | $461\frac{1}{2}$ | 10 | 4·392 |
| ,, | 2 | 4682 | $461\frac{1}{2}$ | 10 | 2·23 |
| ,, | 3 | 4634 | 446 | 10 | 6·122 |
| ,, | 4 | 4584 | $454\frac{1}{2}$ | 10 | 1·125 |
| ,, | 5 | 4653 | 466 | 9 | 15·177 |
| ,, | 6 | 4597 | $436\frac{3}{4}$ | 10 | 8·304 |
| ,, | 7 | 4134 | 443 | 9 | 5·137 |
| ,, | 8 | 4519 | 454 | 9 | 15·118 |
| ,, | 9 | 4357 | $454\frac{3}{4}$ | 9 | 9·25 |
| ,, | 10 | 4324 | $438\frac{1}{2}$ | 9 | 13·418 |
| ,, | 11 | 4361 | $448\frac{1}{2}$ | 9 | 11·354 |
| ,, | 12 | 4396 | 452 | 9 | 11·276 |
| ,, | 13 | 4402 | $453\frac{1}{2}$ | 9 | 11·217 |
| ,, | 14 | 4361 | 440 | 9 | 14·25 |
| ,, | 15 | 4268 | 450 | 9 | 7·338 |
| ,, | 16 | 4237 | 443 | 9 | 9·013 |
| ,, | 17 | 4285 | 434 | 9 | 13·422 |
| ,, | 18 | 4184 | 414 | 10 | 1·29 |
| ,, | 19 | 4261 | 429 | 9 | 14·394 |
| ,, | 20 | 4160 | $431\frac{1}{2}$ | 9 | 10·186 |
| ,, | 21 | 4198 | 419 | 10 | 0·128 |
| ,, | 22 | 4198 | $421\frac{1}{2}$ | 9 | 15·229 |
| ,, | 23 | 4167 | $422\frac{1}{2}$ | 9 | 13·418 |
| ,, | 24 | 4167 | $428\frac{3}{4}$ | 9 | 11·332 |

| Date. | | Milk received. | Cheese made. | Pounds of Milk required to make 1 lb. of Cheese. | |
|---|---|---|---|---|---|
| 1870. | | lbs. | lbs. | lbs. | ozs. |
| September | 25 .. .. .. | 4152 | 419½ | 9 | 14·33 |
| ,, | 26 .. .. .. | 4220 | 425½ | 9 | 14·37 |
| ,, | 27 .. .. .. | 4065 | 429 | 9 | 7·261 |
| ,, | 28 .. .. .. | 4217 | 449½ | 9 | 6·122 |
| ,, | 29 .. .. .. | 4195 | 428 | 9 | 12·352 |
| ,, | 30 .. .. .. | 3830 | 419 | 9 | 2·006 |
| October | 1 .. .. .. | 3849 | 390 | 9 | 13·354 |
| ,, | 2 .. .. .. | 3822 | 380½ | 10 | 0·352 |
| ,, | 3 .. .. .. | 3794 | 394½ | 9 | 9·322 |
| ,, | 4 .. .. .. | 3677 | 403½ | 9 | 1·397 |
| ,, | 5 .. .. .. | 3626 | 382½ | 9 | 7·334 |
| ,, | 6 .. .. .. | 3595 | 398¼ | 9 | 0·208 |
| ,, | 7 .. .. .. | 3623 | 372½ | 9 | 11·308 |
| ,, | 8 .. .. .. | 3454 | 372½ | 9 | 4·208 |
| ,, | 9 .. .. .. | 4383 | 373½ | 9 | 5·151 |
| ,, | 10 .. .. .. | 3496 | 380½ | 9 | 3·076 |
| ,, | 11 .. .. .. | 3345 | 379 | 8 | 13·081 |
| ,, | 12 .. .. .. | 3440 | 370 | 9 | 4·28 |
| ,, | 13 .. .. .. | 3380 | 374½ | 8 | 13·226 |
| ,, | 14 .. .. .. | 3248 | 366 | 8 | 13·362 |
| ,, | 15 .. .. .. | 3298 | 358 | 9 | 3·142 |
| ,, | 16 .. .. .. | 3238 | 343½ | 9 | 7·015 |
| ,, | 17 .. .. .. | 3165 | 366½ | 8 | 10·132 |
| ,, | 18 .. .. .. | 3015 | 342½ | 8 | 13·018 |
| ,, | 19 .. .. .. | 3010 | 353 | 8 | 7·217 |
| ,, | 20 .. .. .. | 2904 | 334½ | 8 | 15·322 |
| ,, | 21 .. .. .. | 2775 | 307½ | 9 | 0·192 |
| ,, | 22 .. .. .. | 2763 | 306 | 9 | 0·009 |
| ,, | 23 .. .. .. | 2650 | 306½ | 8 | 10·172 |
| ,, | 24 .. .. .. | 2747 | 311½ | 8 | 13·101 |
| ,, | 25 .. .. .. | 2724 | 313½ | 8 | 11·77 |

## III.—*On Sugar-Beets and Beetroot Distillation.* By Dr. Augustus Voelcker, F.R.S.

The existence of crystallizable sugar in beetroots was discovered in 1747 by the Berlin chemist Marggraf, who obtained from this root from 4½ to 6 per cent. of sugar identical in all essential points with that derived from sugar-cane.

For fully half a century Marggraf's discovery attracted but little attention in non-scientific circles; and bore little or no practical fruits until the beginning of the present century.

Experimentally, no doubt, sugar was extracted from beetroot long before Napoleon I. encouraged so greatly the establishment of beetroot-sugar factories on the Continent; but, on a commercial scale, beetroot-sugar was, probably, not produced before 1809.

Encouraged by Napoleon I., and aided by the scientific labours of several French chemists and the sound judgment and knowledge of one of Napoleon's ministers, the celebrated M. Chaptal—a man eminent for chemical and general scientific attainments—the new industry, for a time, made rapid progress. It sustained a temporary check soon after Napoleon's fall, and vexatious and injudicious fiscal regulations at one time threatened to crush altogether the beetroot-sugar industry on the Continent. However, increased knowledge, and the spread of sounder commercial principles, gave a fresh impulse to the beetroot-sugar industry; and, considering the difficulties under which it had to struggle at first, its progress has been rapid, especially during the last 10 years.

Since 1860 France has nearly doubled her production of beetroot-sugar, and equally great has been the development of the beet-sugar industry in North Germany and Belgium.

There are, at present, over 500 beetroot-sugar factories and distilleries in France, nearly 200 in Belgium, about 300 in Prussia, and a good number in Austria, Russia, and other Continental states. Probably the number of Continental beetroot-sugar factories and distilleries does not fall much short of 2000.

Large tracts of land have lately been put under beetroot cultivation in Russia; and, under the direction of German agriculturists and chemists acquainted with the growth of sugar-beets and the manufacture of sugar, most satisfactory practical results have been realised in that country of late years. The soil of the sugar-beet growing farms in Russia is described as very fertile, and the climate of the district well suited for the production of roots rich in sugar. From all I can learn from correspondents settled in Russia, the manufacture of beetroot-sugar has probably a great future there. Russia appears to afford a splendid field for the profitable investment of skill and capital in the growth of sugar-beet for the manufacture of sugar and the distillation of spirit.

The recent discovery of immense beds of coprolites and phosphatic rocks, running right through the centre of Russia, is very important; and some day, no doubt, millions of tons of phosphatic minerals, which at present are scarcely utilized at all, will be of the greatest service to the Russian sugar-farmer.

The manufacture of beetroot-sugar has assumed gigantic proportions in France, Belgium, Germany, and other Continental states, and is still extending in most of them, as will be seen by the following numbers, which give the production of beetroot-sugar in the year 1869-70 compared with 1867-68:—

| | 1869-70. Tons. | | 1867-68. Tons. |
|---|---|---|---|
| France | 240,000 | .... | 220,000 |
| The Zollverein | 200,000 | .... | 165,000 |
| Prussia | 90,000 | .... | 97,500 |
| Belgium | 40,000 | .... | 32,500 |
| Poland and Sweden | 22,500 | .... | 15,000 |
| Holland | 12,000 | .... | 7,500 |
| Austria | 85,000 | .... | 92,500 |
| | 689,500 | | 630,000 |

It appears from these figures that the beetroot, recent as has been its use in Europe as a source of sugar, contributes more than one quarter of all the sugar known to have been used in the world. The first experiment to produce sugar from beetroot grown in this country was begun, 3 years ago, by Mr. Duncan, at his factory at Lavenham, Suffolk. Although the quality of the roots grown in the neighbourhood of Lavenham in the two previous years was found to be fully equal in sugar to the average quality of French beets, the experiment did not prove a success in an economical point of view. Mr. Duncan had to deal with inexperienced hands, and to contend with many difficulties inseparable from a new undertaking; but by perseverance, and the exercise of much intelligence, he has overcome these difficulties, and has now satisfied himself that the growth and manufacture of beetroot-sugar can be carried on in Suffolk with quite as much success as in the north of France. Great credit is due to Mr. Duncan for having introduced successfully into England a new and profitable agricultural industry, which gives employment to the surplus labour in agricultural districts during 3 or 4 months of the slackest time of the year, and is profitable both to the grower of the roots and to the manufacturer of sugar.

When the experiment was set on foot, three years ago, to grow sugar-beets in the neighbourhood of Lavenham, grave doubts were expressed in many quarters whether the climate of England would prove suitable for beetroot culture. The Suffolk sugar-beets in 1868, it is true, were found to contain, on an average, fully 10 per cent. of sugar; still, doubts as to the suitability of the climate of England for beetroot culture may be reasonably entertained after one year's experience, for much experience of the quality of English sugar-beets for a number of years is required before we shall know positively whether England possesses natural advantages, or disadvantages, as compared with Continental countries in reference to the production of sugar-beets.

Since the publication of a Paper on the chemistry of sugar-beets in vol. v., 2nd Series, part ii., of the 'Journal of the Royal Agricultural Society,' in which will be found numerous analyses of beets grown in England in 1868, I have analysed a good many roots grown in various parts of Great Britain, and have thus had the opportunity of forming a sound opinion of the quality of sugar-beets raised in 1869 and 1870.

A record of the results of these analyses, accompanied by a few remarks likely to be interesting to sugar-beet growers, it is hoped may prove useful at the present time, when the subject of beetroot-sugar manufacture and beetroot distilling is attracting so much public attention.

*Composition of Sugar-beets grown in England in* 1869.—The following analyses express the composition of sugar-beets which were grown in Berkshire on a naturally stiff but well cultivated clay soil:—

COMPOSITION OF BERKSHIRE BEETROOTS.

| | AVERAGE OF 2 ROOTS. | | | |
|---|---|---|---|---|
| | No. 1. | No. 2. | No. 3. | No. 4. |
| Water .. .. .. .. .. | 81·28 | 81·71 | 84·40 | 85·91 |
| *Albuminous compounds .. .. | 1·24 | ·98 | ·91 | ·87 |
| Crude fibre (pulp) .. .. .. | 4·01 | 4·02 | 3·04 | 3·73 |
| Crystallizable sugar .. .. | 11·87 | 12·02 | 9·14 | 7·98 |
| Pectin, colouring matter, &c. | ·63 | ·45 | ·54 | ·41 |
| Mineral matter (ash) .. .. | ·97 | ·82 | ·97 | 1·10 |
| | 100·00 | 100·00 | 100·00 | 100·00 |
| Specific gravity of juice .. .. | 1·0698 | 1·0709 | 1·0559 | 1·0507 |
| At a temperature of .. .. | 71° F. | 71° F. | 59° F. | 59° F. |
| | lb. ozs. | lb. ozs. | lbs. | lb. |
| Weight of roots .. .. .. | 1 5 | 1 12½ | 2¾ | 1¾ |
| Weight of 2nd root .. .. .. | 1 5 | 1 1½ | | |
| * Containing nitrogen .. .. | 1·99 | ·157 | ·145 | ·139 |

These 4 specimens were grown on the same farm, but on different fields.

Nos. 1 and 2, it will be seen, are rich in sugar, No. 3 contains a fair average proportion, and No. 4, although it weighed 1 lb. less than No. 3, contained 1 per cent. less sugar than No. 3, and 4 per cent. less than No. 2.

I have not been able to learn under what particular circumstances the several roots were grown. The differences in their quality, no doubt, were due either to variations in the soil, or to the kind and quantity of manure with which they were grown.

The land upon which sugar-beets are intended to be grown should be thoroughly and deeply cultivated in order that the roots may readily penetrate into the soil, and not grow out of it, which they will do when they are grown on heavy and badly worked soils.

Deep cultivation, so favourable to all root crops, is absolutely indispensable for the production of beets rich in sugar; for experience has shown that the portion of the root, which in badly worked land grows out of the soil, is much poorer in sugar than the lower part covered by soil. For this reason it is well to draw the soil round the roots as closely as possible when the crop is horse- or hand-hoed. In proof of the fact that the lower part of beetroots grown in the soil is richer in sugar than the top part grown out of it, two analyses of a sugar-beet grown in Berkshire may be quoted. The lower part of the root weighed 2 lbs. 8 ozs., and the upper and somewhat green-coloured part weighed 5 ozs.; and an analysis of two separate portions of the root furnished the following results:—

| | Lower part, Weighing $2\frac{1}{2}$ lbs. | Upper part, Weighing 5 ozs. |
|---|---|---|
| Water .. .. .. .. .. .. | 86·05 | 87·20 |
| *Albuminous compounds .. .. | ·82 | 2·39 |
| Crude fibre (pulp) .. .. .. | 3·08 | 3·73 |
| Crystallizable sugar .. .. .. | 8·05 | 4·24 |
| Pectin, colouring matter, &c. .. | ·89 | ·40 |
| Mineral matter (ash) .. .. .. | 1·11 | 2·04 |
| | 100·00 | 100·00 |
| *Containing nitrogen .. .. | ·131 | ·382 |
| Specific gravity of juice .. | 1·0535 | |
| At a temperature of .. .. | 59° F. | |

The top part thus contained only about one-half the amount of sugar which was found in the lower portion of the same root, and it, moreover, abounded in albuminous compounds and saline mineral matters, constituents which are great impediments to the extraction of crystallizable sugar.

Roots containing only 4 per cent. of sugar, as much as 2 per cent. of saline mineral matter, and about the same quantity of albuminous compounds, are practically useless for the manufacture of sugar. For this reason the greenish-coloured top part of beets is cut off in the factory before the roots are reduced to pulp by the rasping machinery.

The proportions of water and sugar in other roots grown in Berkshire in 1869 were the following:—

| No. | Per centage of Water. | Per centage of Sugar. |
|---|---|---|
| 1. .. .. .. .. .. .. .. .. | 80·45 | 11·04 |
| 2. .. .. .. .. .. .. .. .. | 82·74 | 8·79 |
| 3. .. .. .. .. .. .. .. .. | 81·50 | 8·63 |
| 4. .. .. .. .. .. .. .. .. | 83·55 | 8·88 |
| 5. .. .. .. .. .. .. .. .. | 82·92 | 10·55 |
| 6. .. .. .. .. .. .. .. .. | 83·44 | 10·32 |

*Composition of Sugar-beets grown in* 1869, *in Ayrshire, by the Right Hon. T. F. Kennedy, Dalquarrhan Castle, Maybole.*—One root weighing $3\frac{1}{2}$ lbs. was analysed separately, and 3 other roots, weighing respectively $4\frac{1}{2}$ lbs. 2 ozs., $4\frac{3}{4}$ lbs. $1\frac{1}{2}$ oz., and $3\frac{1}{2}$ lbs. were analysed together as one sample, with the following results:—

*Composition of Ayrshire Sugar-beets in* 1869.

| | No. 1. | No. 2. |
|---|---|---|
| Water | 89·08 | 89·17 |
| *Albuminous compounds | 1·94 | 1·60 |
| Crude fibre (pulp) | 2·16 | 2·19 |
| Crystallizable sugar | 5·04 | 5·29 |
| Pectin, &c. | ·34 | ·30 |
| Mineral matter (ash) | 1·44 | 1·45 |
| | 100·00 | 100·00 |
| * Containing nitrogen | ·311 | ·256 |
| Specific gravity of juice | 1·043 | 1·045 |
| At a temperature of | 58° F. | 58° F. |

These roots are very poor in sugar, and hardly better than common mangolds. In 1868 Mr. Kennedy grew beet at Maybole of a much superior character, some containing as much as 12 per cent. of sugar. The season of 1869 was certainly not less favourable for the development of sugar in roots than 1868, and hence the poverty of the beets grown by Mr. Kennedy in 1869 must have been due entirely to the mode of culture.

Monster roots, as is well known, are always very watery, poor in sugar, and consequently equally bad for feeding purposes and for the manufacture of sugar.

Two such roots grown in 1869 at Buscot Park by Mr. Campbell were sent to me for analysis by that gentleman, together with two species of French beets. The contrast in the quality of these big roots and moderately sized specimens is very striking, as will be seen by the following analyses, which I have grouped together, with an average analysis of 15 lots of beets, grown in 1869, in the neighbourhood of Lavenham in Suffolk.

| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. |
|---|---|---|---|---|---|
| Water | 83·75 | 84·08 | 91·35 | 91·50 | 82·46 |
| Crystallizable sugar | 10·56 | 10·98 | 4·05 | 3·89 | 11·06 |
| *Albuminous compounds | ·93 | ·78 | 1·35 | 1·04 | ·81 |
| Pectin and colouring matter | ·62 | ·68 | ·34 | ·36 | ·66 |
| Crude fibre (pulp) | 2·98 | 2·71 | 1·72 | 1·90 | 3·87 |
| Mineral matter (ash) | 1·16 | ·77 | 1·19 | 1·31 | 1·14 |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |
| Specific gravity of juice | 1·0579 | 1·0646 | 1·0352 | 1·0338 | 1·06218 |
| At a temperature of | 58° F. | 58° F. | 58° F. | 58° F. | 64° F. |
| Weight of roots | lbs. $2\frac{1}{2}$ | lb. ozs. 1 $10\frac{1}{4}$ | lbs. 16 | lbs. $12\frac{1}{4}$ | |
| * Containing nitrogen | ·149 | ·125 | ·216 | ·167 | ·128 |

No. 1 Collette rose (French beet). No. 2 Lanthiez (French beet). Nos. 3 and 4 beets grown at Buscot Park. No. 5 Lavenham beets.

The beets which were grown in Suffolk, it will be seen, are fully as rich in sugar as the French roots, and in all other respects quite equal to them for the manufacture of sugar.

Well matured roots, whilst rich in sugar, contain comparatively little albuminous matter. A high percentage of water, as in the case of the Berkshire beets, is frequently accompanied by a larger amount of albuminous compounds than that in roots containing very much more solid matter.

Indeed, much albuminous matter in roots indicates immaturity and poverty in sugar, a condition characteristic of big, excessively manured roots.

*Beets grown in Ireland in* 1869.—Three lots of sugar-beets, of 4 roots each, grown experimentally at Glasnevin, on analysis were found to have the following composition.

| | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| Water .. .. .. .. .. .. | 85·60 | 85·59 | 89·09 |
| *Albuminous compounds .. | 1·47 | 1·66 | 1·27 |
| Crystallizable sugar .. .. | 8·56 | 7·87 | 6·73 |
| Pectin, &c. .. .. .. .. | ·54 | ·75 | ·45 |
| Crude fibre .. .. .. .. | 2·87 | 3·06 | 2·48 |
| Mineral matter (ash) .. .. | ·96 | 1·07 | ·98 |
| | 100·00 | 100·00 | 100·00 |
| Specific gravity of juice .. | 1·0505 | 1·0554 | 1·0478 |
| At a temperature of .. .. | 67° F. | 60° F. | 61° F. |
| Weight of each root:— | lbs. ozs. | lbs. ozs. | lbs. ozs. |
| No. 1 .. .. .. .. | 2 0 | 1 8 | 3 6¾ |
| ,, 2 .. .. .. .. | 2 12 | 2 0 | 2 8 |
| ,, 3 .. .. .. .. | 3 4 | 2 1 | 2 2 |
| ,, 4 .. .. .. .. | 1 12 | 1 13 | 2 12 |
| * Containing nitrogen .. .. | ·236 | ·267 | ·204 |

The beets marked No. 1, were sown in drills on the 13th to the 15th of May, 21 inches apart, and 6 inches in the row; no manure was applied, the previous crop (mangolds) having been manured at the rate of 25 tons per statute acre.

Estimated produce per acre—13 tons 2 cwts. 3 qrs.

No. 2. Sown 11th and 12th May, in drills 27 inches apart, and 6 inches in the row. Farmyard manure was applied at the rate of 25 tons per statute acre. Previous crop swedes.

Estimated produce per acre—19 tons 2 cwts. 3 qrs.

No. 3. Sown on the 16th of May, in drills on the flat, 21 inches apart, and 6 inches in the row. Farmyard manure was applied at the rate of 12 tons per acre. Previous crop oats, followed by rape as a stolen crop.

Estimated produce—10 tons 5 cwts. 2 qrs. per acre.

These experiments are interesting, as showing the prejudicial effect of the direct application of farmyard manure to sugar-beets, especially if the crop is sown as late as were the roots in the Glasnevin experiments.

Without manure, it will be noticed the beets No. 1 yielded 8·56 per cent. of sugar; with a moderate dressing of farmyard-manure, Lot 2 produced 7·87 per cent.; and Lot 3, with a full dressing of farmyard manure, 6·73 per cent. of sugar.

The Glasnevin experiments did not give very encouraging results, but it must not be inferred from this that the climate of Ireland is not suitable for sugar-beets, for in similar experiments made at Glasnevin in 1870, beetroots were obtained, which were much richer in sugar than those grown in the previous season. The comparative poverty of the Glasnevin beets in sugar in 1869 appears to have been mainly due to late sowing and to the application of farmyard manure to two of the lots, in consequence of which the roots did not get fully ripe.

The Hon. Agar Ellis, who takes a great interest in all matters likely to affect the material welfare of Ireland, instituted, both in 1869 and in 1870, experiments on the growth of beetroots, with a view of ascertaining whether the climate of Ireland is suitable for producing roots sufficiently rich in sugar to be used for the manufacture of sugar.

A number of sugar-beets, grown mostly in the county of Kilkenny, were sent to me for examination by Mr. Agar Ellis. Their composition is given in the Table overleaf:—

The beets, No. 1, were grown on poor light soil after a crop of ley-oats the previous year, with about 30 tons of farmyard manure and 6 cwts. of Lawes's superphosphate per Irish acre. The weight of sugar-beets upon 1 square perch without tops was 3 cwts.

The beets marked No. 2 were grown at Woodstock Farm, county Kilkenny, and No. 2 at Woodstock Garden. The seed, supplied by the Hon. Agar Ellis, M.P., was sown about the middle of April in garden ground, trenched 4 feet deep 2 years before. The ground stands at about 400 feet altitude. No manure was used, except a sprinkling of charred earth, which was put on the ground previous to the seed being sown. The ground was kept clean and a little earth was forked up to the roots in July. The plants stood in the line from 3 to 6 inches from each other. The weight of the crops per imperial acre, taking the average weight of a yard, would be about 50 tons.

No. 3. Grown by Mr. Thomas Seigne, Kilfane Farm, Kilkenny.

No. 4. Grown by Viscount Clifden, at the gardens, Gowran Castle, 200 feet above the sea-level. The seed was sown on

COMPOSITION OF BEET-ROOTS GROWN IN IRELAND IN 1869.

| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. | No. 6. | No. 7. | No. 8. | No. 9. |
|---|---|---|---|---|---|---|---|---|---|
| Water .. .. .. .. .. | 86·30 | 87·70 | 87·78 | 84·05 | 88·65 | 82·79 | 86·70 | 86·06 | 87·12 |
| *Albuminous compounds .. | ·83 | 1·48 | ·72 | 2·32 | 1·40 | 1·56 | 1·56 | 1·66 | 1·99 |
| Crude fibre (pulp) .. .. | 2·98 | 2·37 | 2·33 | 2·79 | 2·89 | 3·43 | 2·99 | 2·98 | 2·96 |
| Pectin and colouring matter | ·44 | ·50 | ·96 | ·43 | ·33 | ·46 | ·74 | ·44 | ·42 |
| Crystallizable sugar .. .. | 8·26 | 6·51 | 7·22 | 8 94 | 5·37 | 10·91 | 6·79 | 7·53 | 6·18 |
| Mineral matter (ash) .. .. | 1·19 | 1·44 | ·99 | 1·47 | 1·36 | ·85 | 1·22 | 1·33 | 1·33 |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |
| Specific gravity of juice .. | 1·0527 | 1·0498 | 1·0498 | 1·0597 | 1·0449 | 1·0656 | 1·0539 | 1·0574 | 1·0512 |
| At a temperature of .. .. | 59° F. | 67° F. | 67° F. | 66° F. | 67° F. | 60° F. | 62° F. | 61° F. | 65° F. |
| Weight of roots .. .. .. | lbs. ozs. 2 12 | lbs. oz. 4 1 | lbs. 3½ | lbs. ozs. 3 12 | lbs. 4 | lbs. 2¼ | lbs. ozs 3 12 | lbs. 3 | lbs. 4 |
| * Containing nitrogen .. .. | ·132 | ·237 | ·116 | ·372 | ·225 | ·25 | ·251 | ·237 | ·319 |

the 20th of April, on very heavy loam without manure, the land having been regularly manured for many years previous.

The crop was irregular, and produced about 40 tons of roots per acre.

No. 5. Grown at Gowran Farm.

No. 6. Grown by Mr. Thomas Lyster, Dunbell, county Kilkenny, on stiff clay land.

No. 8. shows the composition of an average sample of 6 carrot-shaped sugar-beets, grown in the county Kilkenny, and No. 9 that of 6 pear-shaped beets.

Mr. Lyster's beets, it will be seen, weighed, on an average, $2\frac{1}{4}$ lbs. each, and contained, in round numbers, 11 per cent. of sugar. Excepting Mr. Lyster's beets, the remainder of the roots grown in the county of Kilkenny in 1869 contained about $7\frac{1}{2}$ per cent. of sugar on an average.

## Composition of Sugar-beets grown in 1870 in England and Ireland.

The culture of sugar-beet in England has been largely extended in 1870, by Mr. A. Campbell, at Buscot Park, Berkshire; and by the farmers in the neighbourhood of Lavenham in Suffolk.

In both these localities the sugar-producing qualities of the roots have been most satisfactory. The beets on an average were found to contain fully 12 per cent. of sugar. Mr. Duncan informs me that he expects, as the result of this season's working, to obtain from the whole of the roots which were supplied to him in 1870, 8 per cent. of saleable crystallized sugar of fine quality.

By way of experiment, sugar-beets were grown this season in various parts of England. I have made analyses of beetroots grown in 1870, in the neighbourhood of Wallingford, Berkshire, in two places in Yorkshire, others raised near Sandwich, and also on several farms in the county of Kilkenny, Ireland. I shall now proceed by briefly reporting on the qualities of these roots.

*Composition of Sugar-beets, grown near Wallingford, Berkshire.*—The following analyses were made of average samples of 4 roots per lot.

The seed for No. 1, white Silesian Beets, was supplied by Messrs. Gibbs and Co.; No. 2 red, and No. 3, white Silesian Beets, were grown from seed obtained from Douai.

The analyses show that all three lots of Wallingford roots were rich in sugar. There is no great difference either in the weight of the roots of the several lots, or in their sugar-producing qualities. The climate of a country in which beetroots can be grown as rich in sugar as the Berkshire specimens, would appear favourable for the cultivation of that crop.

Composition of Sugar-beets grown in 1870, near Wallingford, Berkshire.

| | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| Water .. .. .. .. .. .. | 79·23 | 79·84 | 80·98 |
| *Albuminous compounds .. | 1·82 | 1·92 | 1·55 |
| Crude fibre (pulp) .. .. .. | 4·18 | 4·20 | 3·20 |
| Pectin, colouring matter, &c. | ·45 | ·54 | ·47 |
| Crystallizable sugar .. .. | 13·31 | 12·51 | 12·72 |
| Mineral matter (ash) .. .. | 1·01 | ·99 | 1·08 |
| | 100·00 | 100·00 | 100·00 |
| Specific gravity of juice .. | 1·0759 | 1·0752 | 1·0698 |
| At a temperature of .. .. | 67° F. | 70° F. | 67° F. |
| Weight of each root:— | lb. ozs. | lb. ozs. | lb. ozs. |
| No. 1 .. .. .. .. .. | 1 8¼ | 1 6½ | 1 8¾ |
| ,, 2 .. .. .. .. .. | 1 8½ | 1 4 | 1 0¾ |
| ,, 3 .. .. .. .. .. | 1 3½ | 1 3½ | 1 0 |
| ,, 4 .. .. .. .. .. | 0 15¼ | 0 10½ | 0 11¾ |
| * Containing nitrogen ... .. | ·292 | ·308 | ·248 |

Composition of Sugar-beets grown in Yorkshire and in Surrey.

| | No. 1. | No. 2. | No. 3. | No. 4. |
|---|---|---|---|---|
| Water .. .. .. .. .. .. .. .. | 84·41 | 80·78 | 82·29 | 85·45 |
| *Albuminous compounds .. .. | ·95 | ·95 | 1·23 | 1·45 |
| Crude fibre (pulp) .. .. .. .. | 2·60 | 3·65 | 3·17 | 2·40 |
| Pectin, &c. .. .. .. .. .. .. | ·67 | ·47 | ·47 | ·41 |
| Crystallizable sugar .. .. .. | 10·43 | 13·27 | 11·78 | 9·06 |
| Mineral matter (ash) .. .. | ·94 | ·88 | 1·06 | 1·23 |
| | 100·00 | 100·00 | 100·00 | 100·00 |
| Specific gravity of juice .. .. | 1·0585 | 1·0677 | 1·0658 | 1·0523 |
| At a temperature of .. .. .. | 70° F. | 60° F. | 66° F. | 70° F. |
| Weight of roots:— | lbs. ozs. | lb. ozs. | lbs. ozs. | lbs. ozs. |
| No. 1 .. .. .. .. .. .. | 2 15½ | 1 3½ | 3 5 | 6 5 |
| ,, 2 .. .. .. .. .. .. .. | .. | 1 8 | 3 4 | 6 0 |
| ,, 3 .. .. .. .. .. .. .. | .. | 1 9 | 2 12 | |
| ,, 4 .. .. .. .. .. .. .. | .. | 1 10 | 3 9 | |
| ,, 5 .. .. .. .. .. .. .. | .. | 0 15 | 2 11½ | |
| ,, 6 .. .. .. .. .. .. .. | .. | 0 14¾ | 2 10 | |
| * Containing nitrogen .. .. | ·152 | ·152 | ·198 | ·232 |

The beets marked Nos. 1 and 2 were grown in Yorkshire. No. 1, at Bassal, by Mr. Charles Ellershaw; and No. 2, at

Myton Hall, Helperley. Both lots are excellent sugar-beets, No. 2 being particularly rich in sugar, and free from an undue proportion of albuminous and saline constituents, which present obstacles to the extraction of crystallizable sugar.

The roots marked Nos. 3 and 4, were grown near Sandwich, by Sir Walter James.

Of a number of roots sent for examination I selected two very large ones, weighing, when trimmed to the same extent as they are by manufacturers of beetroot-sugar, 6 lbs. 5 ozs. and 6 lbs. respectively, and analysed them together. I fully expected the amount of sugar in these big roots to have been low, but, contrary to my expectation, I found as much as 9 per cent. of sugar in them. The analysis in column No. 3 was made with a sample of 6 beets, weighing on an average nearly 3 lbs. per root, and containing $11\frac{3}{4}$ per cwt. of crystallizable sugar.

This is a very satisfactory result, showing that good sized roots, of a high sugar-producing quality, can be grown in England under favourable conditions.

In the next place, I have to report on the quality of sugar-beets grown in 1870 on various farms in the county of Kilkenny, Ireland. The beets were sent to me for examination by the Hon. Agar Ellis, M.P., and the results of their examination are incorporated in the Table overleaf:—

Nos. 1, 2, and 3 were beetroots grown by Viscount Clifden, Gowran demesne, on heavy loam, with yellow clay subsoil; ley-oats, in 1869; manured for beet in 1870, with 6 cwts. best superphospate per Irish acre.

No. 4, grown by Mr. Thomas Seigne, Kilfane Farm, on heavy clay land resting on limestone bottom; manure 6 cwts. superphosphate per Irish acre. Preceding crops—oats following potatoes.

No. 5, grown by Mr. Thomas Seigne, Coppena Farm, on light loam, marly bottom; manure 6 cwts. superphosphate per Irish acre; preceding crop, barley. This farm is situated on a hill-side, upwards of 600 feet above the level of the sea.

No. 6, grown by Mr. Thomas Lyster, Dunbell, on a stiff clay soil; manures—half farmyard manure, and 6 cwts. superphosphate per Irish acre.

No. 7, grown by Mr. Thomas Murphy, Coppena.

No. 8, grown at Mount Loftus, on rich loam, with farmyard manure.

Nos. 9 and 10 were grown by Mr. Henry Flood, Viewmont.

The preceding analyses were made of fair average samples of 5 or 6 roots, perfectly clean, and having the top part or crown cut off.

The roots grown by Viscount Clifden are capital sugar-beets.

COMPOSITION OF SUGAR-BEETS GROWN IN COUNTY KILKENNY, 1870.

| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. | No. 6. | No. 7. | No. 8. | No. 9. | No. 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| Water .. .. .. .. .. | 76·58 | 80·42 | 79·93 | 82·10 | 81·99 | 83·49 | 83·96 | 79·10 | 77·64 | 77·88 |
| *Albuminous compounds .. | 2·10 | 1·11 | 1·11 | ·78 | 1·12 | 1·43 | 1·50 | 2·01 | 1·75 | 1·57 |
| Crystallizable sugar .. .. | 14·81 | 13·69 | 13·34 | 12·42 | 11·96 | 10·07 | 9·89 | 12·77 | 14·69 | 14·78 |
| Pectin and extractive matters | ·66 | ·59 | ·61 | ·49 | ·52 | ·58 | ·57 | ·62 | ·69 | ·63 |
| Crude fibre (pulp) .. .. | 5·01 | 3·42 | 4·04 | 3·34 | 3·48 | 3·38 | 3·10 | 4·36 | 4·42 | 4·30 |
| Mineral matter (ash) .. .. | ·84 | ·77 | ·97 | ·87 | ·93 | 1·05 | ·98 | 1·14 | ·81 | ·79 |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |
| Specific gravity of juice .. | 1·0792 | 1·0682 | 1·0698 | 1·0637 | 1·0650 | 1·0596 | 1·0578 | 1·0707 | 1·0761 | 1·079 |
| At a temperature of .. .. | 69° F. | 66° F. | 62° F. | 63° F. | 61° F. | 64° F. | 61° F. | 63° F. | 64° F. | 66° F. |
| Weight of each root:— | lbs. ozs. | lbs. ozs. | lbs. ozs. | lbs. ozs. | lbs. ozs. | lbs. ozs. | lbs. ozs. | lb. ozs. | lb. ozs. | lbs. ozs. |
| No. 1 .. .. .. .. | 2 0 | 2 15 | 2 2 | 2 0 | 3 9 | 2 8¾ | 3 0 | 0 15¾ | 1 6 | 1 5½ |
| ,, 2 .. .. .. .. | 1 13 | 2 6 | 2 0 | 1 12 | 2 10 | 2 2½ | 2 15 | 0 12 | 1 10 | 1 8 |
| ,, 3 .. .. .. .. | 1 14 | 2 13 | 2 7 | 1 5 | 3 10 | 2 2¾ | 3 5 | 1 1 | 1 7 | 1 5½ |
| ,, 4 .. .. .. .. | 1 15 | 2 12 | 1 7½ | 2 2 | 3 0 | 1 15 | 3 10 | 0 15¼ | 1 6 | 1 15 |
| ,, 5 .. .. .. .. | 1 1½ | 2 9 | 2 5 | 1 11 | 3 6 | 2 3½ | 3 1½ | 0 15½ | 1 7 | 2 4½ |
| ,, 6 .. .. .. .. | 1 11 | 2 13 | .. | 1 8 | .. | .. | .. | .. | .. | .. |
| * Containing nitrogen .. .. | ·337 | ·178 | ·178 | ·126 | ·179 | ·23 | ·241 | ·326 | ·28 | ·252 |

Although they weighed from $1\frac{1}{2}$ to 2 lbs. each, cleaned and trimmed in the same way as by beetroot-sugar makers, they, nevertheless, contained nearly 15 per cent. of sugar.

It is worthy of special notice that the beets No. 5 grown by Mr. Thomas Seigne, contained 12 per cent. of sugar in round numbers, although they weighed on an average about $3\frac{1}{2}$ lbs. each. This shows that, in a favourable season, good sized roots, and yet roots rich in sugar, can be grown in Ireland.

It will be noticed, that of the ten lots of beets three lots contained nearly 15 per cent. of crystallizable sugar.

2 lots contained $13\frac{1}{2}$ per cent. on an average.
3 ,, ,, from 12 to $12\frac{3}{4}$ per cent.
2 ,, ,, about 10 per cent. on an average.

These results speak for themselves; they show, at all events, that excellent sugar-beets were grown in Ireland in 1870. I question much whether better sugar-beets were grown in that season in the most favoured beetroot districts of Belgium or France.

The summer and autumn of 1870 were, no doubt, highly conducive to the development of sugar in root-crops, and probably the beetroots which were raised in England and Ireland in 1870 were richer in sugar than they are likely to be in average seasons. Still, considering that we now have three years' recent experience on the cultivation of sugar-beets, there seems to me no good reason why beetroot should not be profitably cultivated in many parts of the United Kingdom. In a good season, I believe from 18 to 20 tons of beets, of as good a sugar-producing quality as in France or Belgium, may be grown without difficulty.

The farmer will run very little risk by trying the experiment to grow sugar-beets instead of common mangolds, for if he cannot obtain a good price for his roots from the sugar-manufacturer he can use the beet for cattle food, and although he may not get so heavy a crop as he does when he plants common mangolds, it has to be borne in mind that 1 ton of sugar-beets is equivalent, in nutritive qualities as cattle food, to at least $1\frac{1}{2}$ ton of good common mangolds.

Sugar-beets exhaust the land far less than common mangolds, and as the former should not be grown with farmyard manure, the whole expense of the manure for a crop of beetroots will be the cost of 3 to 4 cwts. of superphosphate.

Common mangolds generally are heavily manured with rotten dung, or with dung and guano, or mixed artificial manure rich in nitrogen. In consequence of the excess of nitrogenous manures which are usually applied to mangolds, the roots do not get fully ripe by the time frost sets in, and the crop has to be taken up in a more or less immature condition. In this unripe state mangolds, when given to sheep or cattle, not only do them no good, but they act medicinally, causing stock to scour. Hence mangolds have to be stored in pits, and, speaking generally, are not in a fit condition to be consumed either by sheep or cattle before the middle of January. Sugar-beets, on the other hand, come earlier to maturity, and in fair average seasons may be consumed as cattle food with advantage, as early as October. A few acres of sugar-beet, I cannot help thinking, would supply more solid feeding matter, and food of a more nutritious character, than a good many acres of watery and spongy, tasteless and innutritious, stubble-turnips. It appears a very desirable thing on many farms to have the command of good autumn or early winter food, and not to consume the mangold or swede crop too soon, and sugar-beets would be useful, I believe, in bridging over the period when common mangolds cannot be given to stock with safety.

*Beetroot distillation.*—In connection with the manufacture of sugar, the distillation of spirit is frequently carried on in continental beetroot-sugar factories. In France alone there are about 500 beetroot distilleries, and in Belgium and Germany also the work of distilling spirit is often combined with the manufacture of beetroot-sugar. The most profitable return for the molasses produced in refining and crystallizing beetroot-sugar, appears to be realised by their conversion into spirit; and hence we find, on the continent, attached to many beetroot-sugar factories, distilleries in which molasses are thus utilized. The combination of these two branches of industry, moreover, has the advantage that, in seasons when the proportion of sugar in the roots is too poor to yield much profit to the manufacturer, if he extracts the sugar in the beets, he may, with greater profit, utilize the beet-crop by fermenting the sliced beets or their sugary juice, and obtain, by distillation from the fermented materials, the spirit which has been produced by the act of fermentation. Again, when the market price of spirit is high and that of sugar low, it may, even in good seasons, pay better to make spirit instead of sugar from beetroots, and hence beetroot distilling is at times vigorously pursued in France, whilst the manufacture of sugar is stopped for a season. Indeed, it is maintained by the advocates of beetroot distilleries, that the distillation of spirit is on the whole a more profitable business than the manufacture of beetroot-sugar; and in consequence of this opinion prevailing in France, a good many sugar-factories in that country have of late years been entirely converted into distilleries.

In comparison with the manufacture of beetroot-sugar, the operations that have to be carried out in beetroot distilleries are very simple.

In the first place, the roots are passed through a washing-machine, and thoroughly cleansed from all adhering earth and dirt. The clean roots are then rasped, or cut by proper machinery into thin slices. The pulped or sliced beets have next to be treated according to one of the three following plans :—

1. The pulp is mixed with a small quantity of sulphuric acid, and then placed in suitable presses; the expressed pulp is carted away, and constitutes a valuable food for fattening cattle. The juice is run into the fermenting vats, of convenient capacity. A number of fermenting vats, generally made of wood, and filled with juice in a more or less advanced state of fermentation, are kept in a separate room, in which a proper and uniform temperature highly conducive to a steady fermentation of the sugary liquid is maintained. When all the sugar has been transformed into alcohol, and the fermentation been completed, which is seen by the liquid ceasing to give off bubbles of carbonic acid gas and becoming quiet, the dilute alcoholic liquid or wash is pumped into the stills, and, by the simple process of distillation, the alcohol, more or less diluted with water, and contaminated with certain by-products of fermentation, is separated from the larger proportion of the water, which remains in the stills, and subsequently is allowed to run to waste as useless. By these simple operations impure spirit of a certain strength may be obtained by labourers of ordinary intelligence.

2. The sliced beetroots are subjected to the process of maceration, and displacement of the sugary juice by hot wash (Champonoi's method). It is essential to success that the slices are neither too thick nor too thin; in the former case, the liquid employed in macerating the sliced beets, which is slightly acidulated with sulphuric acid, does not readily penetrate the cells containing the sugary juice, and a larger quantity of liquid has to be used for the extraction of the juice than is necessary if the slices are of the proper dimensions. In consequence of this excess of acidulated water, which has to be used in order to avoid loss of sugar, the juice obtained under these circumstances becomes too dilute to ferment subsequently with regularity. On the other hand, if the slices are too thin, their texture is broken up too much, and they are apt to form pulpy masses, which can only be imperfectly extracted by the warm macerating liquid. In Champonoi's process of maceration the use of presses is avoided, and the sugar contained in the beets passes by displacement into solution. The sugary liquid readily enters into fermentation without the addition of yeast. The alcohol contained in the fermented juice or wash is finally obtained by distillation in ordinary stills.

3. According to Leplay's plan the beets are sliced, and the

slices placed in vats and subjected to fermentation without undergoing any previous treatment. During the fermentation the sugar is converted into alcohol, which remains in the slices, and on completion of this transforming process the fermented slices are introduced into stills of a peculiar construction, and the alcohol drawn off by distillation. The residuary slices in the stills, having been subjected to the effects of boiling water, are too much saturated with water, and in too pulpy a condition to be carted away for cattle-food, with convenience or advantage, to a farm at some distance from the distillery; hence the cooked slices in the stills, after the extraction of the alcohol, have to be consumed by fattening cattle in the immediate neighbourhood of the distillery.

With regard to the comparative merits of the press-system and Chanponoi's plan or Leplay's system, it may be stated that the opinions of practical distillers in France and Germany are divided. Some advocate one system, others speak in favour of another. The advantages and defects of each of the three systems have been freely discussed by writers on beetroot distilling without leading to a definite result showing, under all circumstances, a decided superiority of any one plan. Arguments based on purely theoretical considerations may be advanced in favour of any of the three preceding systems, but it appears to me that local conveniences rather than practical arguments will decide which of the three plans is the most economical and desirable for adoption in a particular place.

The spirit obtained by simple distillation from the fermented beetroot juice, or the fermented sliced beets, is not saleable, as it is neither sufficiently strong, nor pure enough, to be employed for the purposes for which alcohol is used. Besides water, the product of the first distillation of the fermented beets contains certain compounds, some of which are more volatile than alcohol, and others less so. All these by-products of the fermentation of the saccharine beetroot juice are more or less unpleasant to the smell and taste. Moreover, several of these impurities in crude spirit are poisonous, and hence great care has to be bestowed upon the separation of these impurities from the alcoholic liquid obtained by the first distillation.

With a view of separating the alcohol from much of the water which is present in the dilute product of the first distillation, and of obtaining the alcohol in a pure condition, the impure spirit has to be redistilled in a rectifying still, that is, a distilling apparatus of a peculiar construction. The special object of this rectification is to get rid of the compounds which impart a most disagreeable smell, burning taste, and poisonous properties to impure grain or beetroot spirit. These impurities, known under the generic name of grain-, potato-, or fusel-oils, have an oily consistency, hence the name.

They are mixtures of several liquids boiling at a temperature varying from 185° to 270°. Fusel, or grain oils, substantially consist of a species of alcohol, which, under the name of amylic alcohol, is described by scientific chemists as a colourless oily liquid, lighter than water, and having a specific gravity of ·815. Amylic alcohol has a nasty burning taste, a disagreeable smell, and is poisonous. It has an analogous constitution to ethyl-alcohol, which is but another name for ordinary alcohol, or spirits of wine. Amylic alcohol burns readily on approach of a lighted taper, mixes in all proportions with wine, alcohol, and ether, but not with water. Shaken up with water, amyl-alcohol (fusel-oil) rapidly separates, and floats on the surface of the water, forming an oily liquid.

The more perfectly fusel-oil is removed from alcohol in the act of rectification, the greater is the commercial value of the rectified spirit, apart from its strength, which, of course, affects the value of alcoholic liquids.

The rectification of crude beetroot spirit, and the production of clean spirit from it, has been much simplified of late years by the introduction of improved rectifying stills, which enable the beetroot distiller at the present time to produce spirit of a degree of purity which contrasts most favourably with the impure beetroot spirit that twelve years ago was made in various localities in England. Beetroot distilleries, it may be in the recollection of some of the readers of this Journal, were established about twelve years ago at Birmingham, in the neighbourhood of Wallingford, at Minety (Gloucestershire), and in several other localities. After a languid existence for a few years, these distilleries had to be closed; and during the short time that they were in operation, they produced a very inferior kind of spirit that could not be used for any of the purposes for which tolerably pure spirit must be employed. In fact, the beetroot spirit that was made at the time was so much impregnated with fusel-oil, that it could only be used for the manufacture of varnishes, French polish, and for other preparations for which the strong and impure alcohol, selling at the lowest market price, is as suitable as well rectified and much more expensive spirit.

Formerly animal charcoal was largely used by rectifiers of crude grain and beetroot spirits. At present the use of charcoal has been entirely superseded by the improved distilling and rectifying apparatus that may be seen in operation in most of the Continental distilleries.

Two years ago, Mr. Robert Campbell, of Buscot Park, erected a beetroot distillery on an extensive scale on his estate in Berkshire, and is now carrying out for the second year an experiment on a scale which will ultimately result either in a splendid success or a gigantic failure. Mr. Campbell's spirited enterprise will be watched with great interest by the agricultural community. Mr. Campbell, who farms about 5000 acres of land, expects to grow yearly not less than from 10,000 to 12,000 tons of beetroot for distilling purposes, and to be supplied by his distillery with sufficient refuse pulp to feed 12,000 sheep and 2500 oxen.

Mr. Campbell, on the strength of the best information obtainable in France and elsewhere, as regards the most efficacious rectifying stills for obtaining pure alcohol, decided in favour of Messrs. Savalle and Co.'s stills. These stills are held in high esteem, not only in France, but likewise in Germany, Holland, Belgium, and other parts of the Continent; and they received a gold medal for excellence and superiority at the International Exhibition in Paris in 1867. By the use of these stills, Mr. Campbell obtains from beetroot an extremely pure alcohol of great strength, which cannot be distinguished from pure spirit of wine. When I saw the Buscot distillery in active operation in the spring of last year, the pulped beetroot was passed through Collett's presses, and the juice thus produced was fermented, and subsequently distilled.

This season, I am informed, Mr. Campbell has changed his *modus operandi*, and discarded Collett's presses for obtaining the saccharine beetroot juice, and altered his fermenting and distilling machinery so as to adapt it to the macerating and diffusion system. All improved stills are heated by steam, which, on account of its regularity of action and economy, possesses great advantages over the former plan of heating by a naked fire. Savalle's stills include a boiler, a distilling column, separating condenser, cooler, and a special reservoir for the reception of fusel-oils, and a steam regulator.

The distilling column consists of a metallic cylinder, fitted in the interior with a number of diaphragms, which are placed one above the other. On leaving the distilling column, the impure alcoholic vapours enter the analysing condenser, in which their densest constituents are liquefied and thrown back into the distilling column, and the more volatile escape. The condenser communicates with the refrigerator, which receives the volatile vapours, and rapidly condenses them. The condenser as well as the refrigerator are tubular. The regulator is a novel and ingenious contrivance introduced by Mr. Savalle for maintaining a uniform temperature and pressure, conditions essential for producing a rapid flow of good alcohol. The operation, consequently, is never interrupted by excessive heat, over which there is no control in ordinary stills.

The tank for the collection of the fusel-oil is placed below the column: it holds the heavy products of distillation, which are produced during the rectification, and are prevented from becoming mixed with the alcoholic liquid in the boiler. Savalle's rectifying stills are self-regulating, and can be managed by any ordinary intelligent labourer.

Perfectly rectified beetroot spirit is identical with pure spirit of wine, and commands in the open market as high a price as the best grain spirit; it is applicable for the production of perfumes, liqueurs, and all purposes for which alcohol, free from fusel-oil and similar by-products of fermentation, is required.

An experience extending over three years has convinced Mr. Duncan that beetroot sugar can be profitably manufactured in England; and as the distillation of spirits from beetroots is acknowledged to be even a more profitable operation than the manufacture of sugar, beetroot distilleries are likely ere long to be established in various districts in England favourable to the growth of sugar-beets. There is every prospect that such distilleries, when managed by men of good business habits and capital, and possessing experience and skill, will yield a very profitable return for the capital employed in the undertaking. It may perhaps be said that as the attempts which were made some ten or twelve years ago to establish beetroot distilleries in this country turned out complete failures, the renewal of the attempt to manufacture alcohol from beets is not likely to succeed better than in former years. There are, however, good reasons why beetroot distilleries did not then succeed. During my residence at Cirencester I had the opportunity of becoming intimately acquainted with the operations in a mangold-wurzel distillery, which was established about ten years ago at Minety, a village a few miles from Cirencester. Like all the other mangold distilleries erected at that time, the Minety beetroot distillery, after a few seasons, had to be abandoned as an unprofitable speculation.

The roots which were employed in that distillery and in other distilleries, some ten years ago, were common mangolds, for which the farmers in the neighbourhood of the works were paid 1*l.* a ton by the company.

It was, of course, the interest of the farmers who supplied the distillery with mangolds, to grow heavy crops per acre. The mangolds, therefore, were strongly manured with rotten dung, guano, and other artificial manures rich in nitrogenous compounds, and calculated to produce large-sized roots. At that period little information existed in England as regards the conditions of growth that favour the development of sugar in the roots, and the aim of the farmer was to grow as large a crop of mangolds as possible, irrespective of quality. Common mangolds of a moderate size seldom contain more than $4\frac{1}{2}$ to 5 per cent. of sugar, and in large bulbs I have found less than 4 per cent. The return in spirit, it need hardly be remarked, depends mainly upon the percentage of sugar in the roots employed by the distiller; and as the roots bought by the manager of the Minety distillery were, for the greater part, large-sized common mangolds, which probably contained not quite 4 per cent. of sugar, the farmer who grew something like 25 tons per acre of such mangolds, and got 1*l.* per ton for them, did a good stroke of business, whilst the distiller lost money by the transaction.

In the next place, I would observe that in several instances brought under my notice at the time, I found that the persons who had charge of the distillery were ignorant of the details which have to be observed, in order to convert the sugar in the roots completely into alcohol; in other words, want of a proper knowledge to carry on the process of fermentation caused a loss of alcohol.

In the third place, it has to be remarked that the process of rectification of the crude spirit was very imperfectly carried out by beetroot distillers. The rectifying stills in use ten or twelve years ago rendered it next to impossible to produce pure spirit from beets; and nothwithstanding all the skilled experience of a careful superintendent, the old-fashioned rectifying stills at the best produced only a moderately clean spirit which could not compete with good grain spirit. Most of the beetroot spirit that was made in England at that period had an earthy burning taste and an extremely disagreeable smell, which rendered it unfit for all the purposes for which a fairly clean spirit is required. By far the larger proportion of English beetroot spirit, in consequence of its bad qualities, could only be used by makers of varnishes and French polish, and for purposes for which methylated spirit is applicable. It had, therefore, to be sold at a price scarcely higher than the low price at which methylated alcohol can be bought.

To sum up briefly, three distinct causes—each sufficient in itself to lead to disappointment—led to the failures which followed the first introduction of beetroot distilleries in this country some ten or twelve years ago:—

1st. The distiller employed common mangolds, instead of beetroots, or, in other words, he used a raw material yielding on an average only $4\frac{1}{2}$ per cent. of sugar, and paid as much per ton as for beets containing on an average from 9 to 10 per cent. of sugar, and yielding of course more than double the amount of alcohol.

2nd. The processes of fermentation were badly managed in the former beetroot distilleries ; and

3rd. A very inferior spirit, which had to be sold at the lowest market price, was produced owing chiefly to the imperfect construction of the rectifying stills then in use.

Of late years much attention has been bestowed by scientific men upon the theory of rectification, and their labours have borne good fruit in the improved apparatus, such as Coffee's or Savalle's stills, for obtaining pure spirit with comparative ease and certainty.

The latter stills have been satisfactorily tested by the success which Mr. Campbell has obtained with them at his distillery at Buscot in Berkshire.

Beetroot distillation, as has been remarked already, in comparison with the manufacture of sugar, is a simple and, I may add, a less expensive operation.

The machinery required for the manufacture of beetroot-sugar is more expensive than the stills and other implements required in a beetroot distillery. The buildings of a distillery, moreover, can be erected at less expense than those which have to be put up in a sugar-factory.

There is another advantage in growing beetroots for the use of the distiller, to which I must briefly allude. Experience on a large scale has proved that sugar cannot be profitably manufactured from beetroots, unless they contain at least 8 per cent. of sugar. Now it may happen, and even on the Continent it does occasionally happen, that in bad seasons the percentage of sugar in the roots is too low to be profitably extracted. In such bad seasons the sugar-factory would have either to stand idle or to work at a loss, were it not for the fact that beetroots may be used profitably for distillery purposes, if they are comparatively poor in sugar; for it has been found that roots containing not more than $5\frac{1}{2}$ per cent. of sugar will yield a fair profit when they are employed for the production of spirit. In bad seasons the whole of the crop may thus be profitably employed, by manufacturers of sugar who combine with their occupation that of distillers. It is further worthy of notice that albuminous compounds or saline matters in beets, which so greatly impede the manufacture of crystallized sugar, exercise no injurious influence upon the production of spirit. Hence the distiller can make spirit from molasses, or from impure saccharine materials, from which sugar cannot be produced. It matters little to him if the sugar in beetroots is associated with such an amount of saline matter or albumen which would sorely try the patience of the sugar manufacturer, and materially affect his profits.

When roots are grown with much manure, they are generally richer in saline and albuminous compounds than roots raised upon comparatively poor and unmanured soils. In a country where rents are high, it appears to me more profitable to employ manure, and to produce rather a heavy crop of beets of fair average quality than to abstain from its use and to grow a small crop rich in sugar. If the sole object for which the beets are grown is to produce sugar from them, it is of course to the interest of the manufacturer of sugar to be supplied by the neighbouring farmers with roots grown on unmanured land, as rich in sugar and as free from albuminous and saline compounds as they can be grown. Roots of that description do not, as a rule, yield a heavy crop per acre, and hence it may not pay the farmer as well to grow a small crop of superior sugar-producing quality, as it will pay him to grow a heavy crop of not quite so good a quality. The distiller of beetroot spirit can afford to give a better price for inferior roots than the manufacturer of sugar, because the impurities in beets of an inferior quality do not interfere with the production of alcohol, whereas they are highly objectionable to the sugar manufacturer, inasmuch as they greatly reduce the amount of crystallized sugar which can be extracted from the roots. The interests of the farmer and distiller are, therefore, in harmony to a greater extent than are the interests of the farmer and the manufacturer of sugar.

Mr. Campbell, for the last two seasons, has been carrying out on a large scale the experiment to grow sugar-beets and to convert the crop entirely into spirit and cattle-food. In a few years, when, no doubt, other distilleries will have been established in other parts of the country, we shall be able to form a more correct estimate of the profit that may be derived from beetroot distillation than we can at present. In the absence of accurate data it is vain to calculate what the profits are likely to be, and I therefore abstain from giving currency to the statements which have been put forward in order to show the extremely profitable character of beetroot distillation. With a view of giving persons interested in beetroot distillation some idea of the probable cost of establishing a beetroot distillery, I may observe that the produce of 500 to 600 acres requires the following machinery, which, according to Messrs. Savalle's catalogue, costs in round numbers 10,000*l.* :—

| | £ |
|---|---|
| 2 Steam generators of 90-horse power .. .. .. | 880 |
| 1 Steam engine of 20-horse power .. .. .. .. | 300 |
| 1 Steam engine of 8-horse power .. .. .. .. | 104 |
| 1 Steam engine of 1-horse power .. .. .. .. | 72 |
| 1 Washing machine .. .. .. .. .. .. .. | 48 |
| 2 Rasping machines .. .. .. .. .. .. .. | 164 |
| 6 Presses .. .. .. .. .. .. .. .. | 960 |
| 5 Pumps .. .. .. .. .. .. .. .. .. | 280 |
| 2 Strainers .. .. .. .. .. .. .. .. | 24 |
| 1 Mixer .. .. .. .. .. .. .. .. .. | 28 |
| 6 Fermenting vats .. .. .. .. .. .. .. | 143 |
| 1 Reservoir .. .. .. .. .. .. .. .. | 170 |
| Savalle's stills (in iron and copper) .. .. .. .. | 3350 |
| Pipes and cocks .. .. .. .. .. .. .. | 512 |
| | 7,035 |
| Building, carriage, erection of machinery, &c. .. | 2,965 |
| | £10,000 |

The actual success and rapid development of beetroot industry on the Continent, and the satisfactory experiments on the growth of sugar-beets which have been made in England during the last three years, in all probability will lead to a considerable breadth of land being applied to the production of sugar-beets. Sugar factories and beetroot distilleries, in addition to the two establishments already in existence, are likely to spring up in localities favourable to the growth of sugar-beet.

The question may be asked, is it more profitable to manufacture sugar or to distil spirit from beet-roots? It is said that the distillation of spirit has been found the more profitable operation of the two; and probably this is the case when the market price of spirit is high and that of sugar low, or as long as the distillation of beetroot spirit, in comparison with the manufacture of sugar, is carried on on a limited scale. But should the cultivation of sugar-beets in this country increase at a similar rate to what it has on the Continent, the probability is that both branches of beetroot industry will grow together.

In many Continental beetroot-sugar factories, arrangements exist for converting the molasses resulting from refining crude sugar into spirit, and, if desirable, the bulk of the beet-crop can be used in the same establishment either for the manufacture of sugar or for the distillation of spirit. The manufacture of sugar or of spirit, in favourable seasons, yields a very good return for the capital employed in either industry; and there can be little doubt that it will pay a farmer very well to sell his beets, if he can grow something like 18 tons per acre, and get for them at the works 1*l.* a ton. The profit to the farmer appears great, if he can dispose of a crop of 18 tons of roots at that rate;

but at the same time it has to be borne in mind that he has to deliver the beet at the factory free of cost. The cartage from the farm to the factory, on an average, cannot be less than 5*s.* per ton, leaving 15*s.* per ton. Large as the profit appears to be when he can succeed in raising 18 or 20 tons of beet per acre, it may yet be questioned whether he turns his produce to the most profitable account if he sells it to the sugar-manufacturer and buys back from him the expressed pulp. If, like many a Continental beet-grower, the farmer has not sufficient capital or facilities to fatten beasts, or no good market to dispose profitably of his fat stock, it will no doubt answer his purpose very well to sell his beets at 15*s.* per ton nett. But let us suppose that he finds it profitable to send to market annually a considerable number of fat animals, and further that he is obliged to buy oilcake, Indian corn, or similar food in addition to the roots, straw, and grass-crops he raises on the farm for home-consumption; it then becomes a question whether he would not find it more profitable to give the root to his stock than to sell them to the sugar-manufacturer.

Silesian sugar-beets of fair average quality, grown in England, on an average contain:—

| | |
|---|---|
| Water | 84·5 |
| *Albuminous compounds | 1·5 |
| Sugar | 9·5 |
| Crude fibre | 3·5 |
| Mineral matter (ash) | 1·0 |
| | 100·0 |
| *Containing nitrogen | ·24 |

Now, as 100 lbs. or tons of raw beets contain 15½ lbs. or tons of the perfectly dry matter of which beet consists, it will take about 6½ tons of raw beets to produce 1 ton of the perfectly dry substance. This dry substance, according to the preceding average analysis, has the following composition:—

100 parts contain:

| | |
|---|---|
| Sugar | 61·29 |
| *Albuminous compounds | 9·68 |
| Crude fibre | 22·58 |
| Mineral matter | 6·45 |
| | 100·00 |
| * Containing nitrogen | 1·55 |

It will be conceded by everyone who gives a moment's consideration to the subject, that this is a very fattening food.

If a farmer sells 6½ tons of raw beets, and obtains 15*s.* per ton, he obtains 4*l.* 17*s.* 6*d.*, and disposes of 1 ton of perfectly dry feeding matter, containing, as the preceding analysis shows, as much as 61·29 per cent. of pure sugar, in addition to flesh-forming matters, readily digestible fibre, and bone and blood-forming mineral constituents. Now, what description of food approaching in composition to the dry substance of beet, it may be asked, can be bought at 4*l.* 17*s.* 6*d.* a ton? The answer to this question is conclusive. There is no kind of food at all approaching in nutritive and fattening properties the solid substance of beets, of which 1 ton can be laid down at the farmer's door, at anything like the price at which he sells 1 ton of the dry feeding matter of beets to the sugar-manufacturer. On farms, therefore, on which not sufficient food can be raised to meet the requirements of the fattening stock, and where considerable sums of money are spent in the purchase of oilcake, meal, and other dry food, it would be folly on the part of the farmer to sell beets at 1*l.* a ton, and to pay the cost of cartage to the factory, which cannot be less than 5*s.* per ton on an average.

Beetroot-sugar manufacturers or distillers, in Continental States where no ready and profitable sale for fat stock exists, will have, it strikes me, far less difficulty to induce farmers to grow the beets required to keep the factory at full work than in many parts of England, where farmers find it profitable not only to consume the food raised on the farm but to buy additional food for the fattening stock, and where always a much better price can be realized for well-fattened meat than on the Continent.

*Laboratory*, 11, *Salisbury Square, Fleet Street, E.C.*,
*January*, 1871.

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## IV.—*On the Best Mode of preparing Straw-Chaff for Feeding Purposes.* By Dr. AUGUSTUS VOELCKER, F.R.S.

IN Volume VI. Part 1, 1870, of this Journal, Mr. Samuel Jonas, of Chrishall Grange, Saffron Walden, gave an interesting account of a plan of preparing straw-chaff for feeding purposes, and preserving it for winter use, which he found extremely useful in practice.

The peculiarity of Mr. Jonas's plan consists in the use of a small quantity of green rye, or green tares, as a fermenting agent.

Mr. Jonas, who for many years has been a great advocate for the consumption of a large portion of straw-chaff for feeding purposes, uses a 12 horse-power engine, by Hornsby, for threshing, dressing, and bagging the corn ready for market, and cutting the straw into chaff at the same time. With a ton of straw-chaff he uses about 1 cwt. of rye or tares, cut green into chaff, and 1 bushel of common salt. This is done in spring and summer; the chaff is not used until October or the winter months.

The addition of the green stuff causes the straw-chaff mixture to heat; the volatile and odoriferous principles produced by the fermentation are retained by the straw-chaff, itself undergoing a kind of slow cooking process, and they impregnate the whole mass with an extremely pleasant flavour, scarcely inferior to that which characterises well made meadow-hay.

It appeared to me interesting, if not useful, to compare the nutritive properties of straw-chaff prepared according to Mr. Jonas's plan with ordinary wheat-straw, and I therefore made a careful analysis of a sample of chaff taken from the bulk at Chrishall Grange, and kindly supplied to me by Mr. Jonas.

The following results were obtained in the analysis of this straw-chaff:—

| | |
|---|---|
| Moisture | 7·76 |
| Oil and fatty matter | 1·60 |
| *Albuminous compounds (flesh-forming matters) | 4·19 |
| Sugar, gum, and other organic compounds soluble in water | 10·16 |
| Digestible fibre | 35·74 |
| Woody fibre (cellulose) | 34·54 |
| Insoluble mineral matter (chiefly silica) | 3·20 |
| Saline mineral matters (chiefly common salt) | 2·81 |
| | 100·00 |

* Containing nitrogen .. .. .. .. ·67

In explanation of the term woody fibre (Cellulose) in the preceding analysis, I would observe that it applies to that portion of the straw-chaff which remains behind after successively boiling the material with water, dilute sulphuric acid, and dilute caustic potash solution, and exhausting the residual dried substance with alcohol and ether. There can be no doubt that the different alkaline and acid secretions in the animal organism exercise similar, probably even more, energetic effects upon straw than these successive exhaustions with various chemical agents in the laboratory. The treatment with dilute acid and alkali, therefore, affords a better insight into the digestibility of the bulk of straw than the mere exhaustion with water. Let us now compare the preceding analytical results with the composition of ordinary wheat-chaff.

The following is the composition of a sample of well-harvested wheat-straw, which was neither under nor over ripe:—

| | |
|---|---|
| Moisture | 13·33 |
| Oil and fatty matter | 1·74 |
| *Albuminous compounds (flesh-forming matters | 2·93 |
| Sugar, gum, and other organic compounds soluble in water | 4·26 |
| Digestible fibre | 19·40 |
| Woody fibre (cellulose) | 54·13 |
| Insoluble mineral matter (chiefly silica) | 3·08 |
| Saline soluble mineral substances | 1·13 |
| | 100·00 |
| * Containing nitrogen | ·47 |

A comparison of the composition of ordinary good wheat-straw with that of straw-chaff prepared by the system pursued by Mr. Jonas brings out several points of interest, on which a few observations deserve to be made.

1. In the first place, it may be remarked that both kinds of straw-chaff contain about the same proportion of oil. The oil exhausted from straw by means of ether has a bright yellow colour, is sweet to the taste, and renders straw more palatable and more nutritious than it would be without this constituent. It is appreciable in quantity, for according to the preceding data 1 ton of straw-chaff contains about 39 lbs. of oil.

2. It will be seen that fermented straw-chaff contains rather more than 4 per cent. of albuminous or flesh-forming compounds, whereas ordinary wheat-straw contains in round numbers only 3 per cent. The prepared wheat-chaff, therefore, is one-fourth richer in materials which produce the substance of the lean fibre of meat, or the muscle.

3. Common wheat-straw of good quality contains about 4½ per cent. of sugar, gum, and similar soluble organic compounds. In over-ripe straw the amount of these soluble matters is less. On the other hand, in the sample of fermented straw-chaff analysed by me, the percentage of sugar, gum, &c., amounted to 10·16, or to nearly two and a half times the amount which occurs in good unprepared wheat-straw. The much larger proportion of sugar and other soluble matters in the fermented straw, no doubt, is due to the green-stuff employed in its preparation; but at the same time, the process of heating the mixture, it is quite probable, may have had the effect of rendering the chaff more soluble in water.

Bearing in mind that the chaff prepared by Mr. Jonas contains so large a proportion of succulent matter, it is no wonder that cattle and sheep are fond of it, and thrive upon it in a much higher degree than upon ordinary wheat-straw.

4. A comparison of the relative proportions of digestible and of woody fibre in fermented wheat-chaff, with their proportions in common wheat-straw, exhibits striking differences, which cannot fail to arrest the attention of stock-feeders.

Taking together digestible and woody fibre, we have in the fermented straw-chaff 70·38 per cent., and in ordinary wheat-straw 73·53 per cent; showing a slight difference in favour of the fermented chaff, which, being richer in sugar and other matters soluble in water, contains about 3 per cent. less vegetable fibre than common wheat-straw.

When the vegetable fibre of each kind of straw-chaff, or the material insoluble in cold and boiling water, is treated with dilute acid and alkalies of the same strength, for the same length of time, and in all other respects precisely alike, a certain proportion of the vegetable fibre is rendered soluble. This soluble portion figures in the preceding analysis as digestible fibre, whilst the matters insoluble after treatment with the various chemical agents is termed indigestible or woody fibre (Cellulose).

Although it is not meant to convey by those terms the idea that animals have the power of resolving crude vegetable fibre into digestible and into woody fibre, in precisely the same ratio in which we can separate them in the laboratory, a tolerably good opinion may be formed of the relative digestibility of various foods consisting principally of vegetable fibre, by submitting them to the process usually employed in laboratories for the determination of woody fibre.

In the cases before us, it will be seen that, of the total amount of vegetable fibre present in the fermented wheat-chaff, 45¾ per cent. were rendered soluble by the treatment described, and 34½ per cent. (in round numbers) left behind as indigestible woody fibre, whilst the 73½ per cent. of vegetable fibre present in common wheat-straw chaff were resolved, by treatment with dilute acid and alkaline liquid, into 19½ per cent. only of digestible, and into 54 per cent. of indigestible, woody fibre. In other words, the same treatment rendered soluble 50·85 per cent. of the vegetable fibre of the fermented prepared chaff, and only 26·38 per cent. of the fibre of common wheat-straw.

These differences are very marked, and well calculated to explain, in a great measure, the great inferiority of the fermented chaff as a feeding material over common straw-chaff.

The fermentation to which the straw is submitted in Mr. Jonas's plan thus has the effect of rendering the hard and dry substance which constitutes the bulk of straw more soluble and digestible than it is in its natural condition. But useful as the effect of the slow and moist heat, developed in the mixture of straw-chaff with green rye or cut tares, no doubt is in rendering the fibre of the chaff more digestible, this is not the only recommendation of Mr. Jonas's admirable plan of preparing a really very nutritive and important food for stock.

Another recommendation is the extremely delicate flavour and the palatable condition which is conferred upon the straw in the process of fermentation. The prepared straw-chaff, kindly sent to me by Mr. Jonas, had all the agreeable smell which characterises good green meadow-hay, and a hot infusion with water produced a liquid which could hardly be distinguished from hay-tea.

Although fermented chaff resembles hay so much in taste and smell, it need hardly be stated that the latter is more valuable for feeding purposes. However, the differences in the nutritive properties of meadow-hay and straw-chaff made from rather under-ripe wheat-straw, prepared and fermented in accordance with Mr. Jonas's directions is not so great as might be imagined by some. A little cake ground into meal and sprinkled over the chaff would go far to obliterate the difference in the feeding quality of the two kinds of chaff.

I would particularly recommend for that purpose a cake rich in albuminous compounds. Green German rape-cake or decorticated cotton-cake, added to the straw-chaff in but small quantities will bring up the percentage of albuminous compounds to what it is in good meadow-hay. Best decorticated cotton-cake contains about 40 per cent., green rape-cake about 33 per cent., and the finest linseed-cake from 30 to 32 per cent. of albuminous compounds. About 2 cwts. of decorticated cotton-cake ground into meal and added to one ton of fermented straw-chaff, presuming it to have always the same composition as the sample analysed by me, I find constitutes a mixture which agrees closely in composition with good meadow-hay.

In order to enable others to compound a mixed food from straw-chaff, resembling in composition good meadow-hay, I have placed in the following Table the analyses of ordinary wheat-straw, of the fermented sample, and the mean results of 25 analyses of common meadow-hay.

| | Compositions of | | |
|---|---|---|---|
| | Common Meadow-Hay. | Fermented and Prepared Straw-chaff. | Wheat Straw-chaff. |
| Moisture .. .. .. .. | 14·61 | 7·76 | 13·33 |
| Oil and fatty matter .. .. | 2·56 | 1·60 | 1·74 |
| *Albuminous compounds (flesh-forming matters) .. .. | 8·44 | 4·19 | 2·93 |
| Sugar, gum and other soluble organic compounds .. .. | 41·07 | 10·16 | 4·26 |
| Digestible fibre .. .. .. | .. | 35·74 | 19·40 |
| Indigestible woody fibre (cellulose) .. .. .. .. | 27·16 | 34·54 | 54·13 |
| Mineral matter (ash) .. .. | 6·16 | 6·01 | 4·21 |
| | 100·00 | 100·00 | 100·00 |
| * Containing nitrogen .. .. | 1·35 | ·67 | ·47 |

Meadow-hay, it will be seen, contains rather more than twice as much albuminous or flesh-forming matter as the sample of straw-chaff of which the analysis is here given; hence the advisibility to add to the latter some oil-cake, which, moreover, will have the effect of raising the percentage of oil, and bringing it up to about the same amount as is found in meadow-hay.

Chaff, especially if it be made from over-ripe straw, is not much liked by sheep or cattle, on account of its insipid taste and harshness; and considerable difficulty is experienced to induce stock to consume straw-chaff in as large a quantity as is desirable. To meet this difficulty, several stock-feeders with whom I am acquainted have found it useful in practice to use straw-chaff with some treacle previously diluted with sufficient water to impregnate uniformly the chaff with the sweet liquid. The only fault I have to find with this otherwise good plan of rendering chaff more palatable, is that the farmer has to pay from 13*l.* to 14*l.* per ton for the treacle, and obtains in that material only about 54 to 60 per cent. of sugar, the rest being water and impurities of no feeding value.

By Mr. Jonas's plan straw-chaff is not merely made more palatable, but, as it is mixed with a little green food, it undergoes a slow cooking process, and becomes more digestible, and permeated by a delicate hay-flavour. Thus the most is made both of the green stuff and the straw, and an excellent food is produced at a trifling expense, greatly superior in feeding properties to treacled ordinary straw-chaff, which costs more money.

The great simplicity of preparing and storing straw-chaff, and the inexpensiveness of Mr. Jonas's plan are further advantages, which all who consume much straw for feeding purposes may secure to themselves.

The more one looks into this subject, the more one becomes impressed with the great practical value of Mr. Jonas's plan of preparing a most useful and nutritious auxiliary food; and it is much to be desired that this extremely simple, inexpensive, and in all respects excellent plan of dealing with straw for feeding purposes may be spread throughout the length and breadth of the country.

11, *Salisbury Square, Fleet Street, E.C.,*
*January,* 1871.

## V.—*Effects of the Drought of* 1870 *on some of the Experimental Crops at Rothamsted.* By J. B. Lawes, Esq., F.R.S., F.C.S., and J. H. Gilbert, Ph. D., F.R.S., F.C.S.

The rainfall of Great Britain is usually sufficient for the growth of a considerable variety of crops, in fairly abundant quantity. Indeed, so far at least as the growth of corn is concerned, our fears are of injury from an excess rather than from a deficiency of rain. It is only occasionally, and generally at long intervals, that a season of great drought occurs; and then it is that we forcibly realise how essential for luxuriant vegetation is an abundant supply of water.

Throughout the Midland, Southern, and Eastern portions of England, the year 1870, just past, has been characterised by a season of drought, commencing with the period when vegetation usually becomes active, and extending, with little intermission, to the time when its activity has upon the whole greatly diminished, and in the case of some crops entirely ceased. To find a parallel we must go back to 1844, or more than a quarter of a century. The summer of 1868 was, it is true, one of great drought; and, being hotter than that of 1870, it is not improbable that there was at some periods of it a greater deficiency of moisture in the soil than in the latter year. In fact, those who travelled through the Southern and Midland counties of England in July, 1868, will not soon forget the almost entire absence of green in the meadows, and the intense heat of the atmosphere, resembling more what we read of in tropical countries than the usual experience of our own summers. Although both the drought and heat were more extreme during the months of May, June, and July in 1868 than in 1870, the deficiency of rain commenced a month earlier and extended later last year; and hence, not only the first crops of grass and hay, but also the second growth, suffered much more in the season just past than in 1868.

It is only when crops are grown under precisely similar circumstances, as to manure and other conditions, for many years in succession, that we can obtain satisfactory data for studying the influence of variation of season on the amount and character of the produce. At Rothamsted, as is known to most of the readers of this Journal, numerous experiments on the growth of various crops, each grown year after year on the same land, with different descriptions of manure, the same description being applied year after year to the same plot, have been carried on without change for many years; in some cases reaching back as far as the drought of 1844, above referred to. Taking advantage of the results so obtained, it is proposed, in the present paper, to consider briefly :—

1. The probable amount of water exhaled during growth by some of our most important crops.
2. The source whence the required supply of water is obtained.
3. The difference of the effects of the drought of 1870 on the different experimental crops.

## Amount of Water given off by Plants during Growth.

A series of experiments was commenced in 1849, and was continued for ten years, to determine the amount of water given off by plants during their growth, in relation to the amount of the various constituents they assimilated. Of agricultural plants, wheat, barley, and mixed grasses, as representatives of the Graminaceous family; beans, peas, and clover, of the Leguminous family; and swedes, white turnips, mangolds, potatoes, and artichokes, as root-crops, were thus experimented upon. Similar experiments were also made on the exhalation by evergreen and deciduous trees, six of each being selected.

The plan of experimenting was as follows:—Cylindrical vessels, first of glass and afterwards of zinc, 14 inches in depth, 9 inches in diameter, and holding about 40 lbs. of soil, were employed. Soil from the plot in the experimental wheat-field which had grown 10 successive crops without manure was selected. The general rule was to make three experiments with each description of plant; one with the above soil without further addition; one with the same soil with purely mineral manure added; and the third with the same soil and both mineral manure and ammonia-salts in addition. In the cases of wheat and barley, plants from three seeds, and of beans, peas, and clover, one plant only, were planted in each vessel. A glass plate, having a hole in the centre about three-quarters of an inch in diameter for the plants to grow through, and another smaller one, closed at pleasure by a cork, for the supply of water, were then firmly cemented upon the top of each vessel. One vessel, supplied with soil and fitted with a glass cover like the rest, was, however, always left without a plant, in order to ascertain the probable amount of evaporation from the surface of the soil itself, through the centre orifice, independently of growth; though, in the experiments with plants, the hole was always partially closed, by laying small pieces of glass over it as far as the stems would allow. Of course in experimenting with root-crops the holes in the glass covers were larger, but they were kept closed around the plants as far as possible, in the manner just described.

The vessel with its contents, weighing more than 40 lbs., was weighed from time to time, generally every ten days during active growth, by means of a delicate balance made for the purpose; which, though carrying so heavy a weight, was capable of indicating a change of a few grains. The plants were of course supplied with water as it was needed. The earlier results, both with agricultural plants and trees, are published in the 'Journal of the Horticultural Society of London,' and to the reports there given we must refer the reader for the details of the inquiry as far as they are yet recorded.*

Referring here only to the results obtained with some of the agricultural plants, it will be sufficient for our present purpose to summarise them as follows:—

1. The amount of water given off by the plants during growth was found to bear relation to the quantity of the total dry matter, or the total non-nitrogenous substance, fixed or assimilated; and within somewhat narrow limits the same relation was observed in the case of both graminaceous and leguminous corn-crops.

2. In relation to a given quantity of water exhaled, twice or three times as much nitrogenous substance is fixed by a leguminous, as by a graminaceous corn-crop.

3. In the growth and ripening of either graminaceous or leguminous corn-crops, probably on the average from 250 to 300 parts of water are given off for 1 part of total dry substance fixed or assimilated.

Before considering the application of this estimate to any special cases, it may be well to give an illustration of its bearing in general terms. Several plots in the experimental wheat-field give an average of about 3 tons of total produce (corn and straw) per acre per annum; and if we assume one-sixth of this to be water, we have remaining $2\frac{1}{2}$ tons of dry substance ripened by the end of July, or the middle of August, each year; and if we further assume that 300 parts of water may be exhaled for 1 part of dry substance fixed, we have $300 \times 2{\cdot}5 = 750$ tons of water evaporated per acre by the growth of such a crop.

Owing to the difficulty of eliminating surface evaporation other than through the growing herbage, in experiments on the exhalation from a sod of mixed grasses, we cannot so safely adopt a figure to represent the probable average amount of water given off for 1 part of dry substance fixed in their case as in that of their ripened allies, wheat and barley. We will

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* 'Experimental investigation into the amount of water given off by plants during their growth, especially in relation to the fixation and source of their various constituents.'—('Jour. Hort. Soc. Lond.,' vol. v. part i. 1850.)

'Report upon some experiments undertaken at the suggestion of Professor Lindley, to ascertain the comparative evaporating properties of Evergreen and Deciduous Trees.'—('Jour. Hort. Soc. Lond.' vol. vi. parts iii. and iv. 1851.)

assume, however, for the purpose of illustration, that in the growth of hay, as in that of the grain-crops, about 300 parts of water will be exhaled for 1 part of dry substance assimilated; and since one of the experimental plots of meadow land at Rothamsted has given an average, over fifteen years, of 3 tons of hay, or about $2\frac{1}{2}$ tons of dry substance per acre per annum, its growth would again represent an exhalation of about 750 tons of water per acre per annum—but extending in this case not later than to the middle or end of June.

We will now adduce some special cases illustrating the amount of water exhaled by different crops, and their dependence on the rainfall of the period of active growth, or on the supplies of moisture previously accumulated within the soil.

### Results relating to the Growth of the Hay-crop.

The following Table (I.) shows the amount of hay obtained per acre each year for fifteen years in succession (1856-1870):—

1. Without manure.
2. With mixed mineral manure and 400 lbs. ammonia-salts per acre per annum.
3. With mixed mineral manure and 550 lbs. nitrate of soda per acre per annum (thirteen years only, 1858-1870).

The Table also shows, side by side with the records of produce, the amount of rain, in inches, which fell at Rothamsted each year

Table I.

| Years. | Hay per Acre. | | | | Rain at Rothamsted. | | | |
|---|---|---|---|---|---|---|---|---|
| | Without Manure. | Mineral Manure and Ammonia-salts. | Mineral Manure and Nitrate of Soda. | Mean. | April. | May. | June. | Total. |
| | Cwts. | Cwts. | Cwts. | Cwts. | Inches. | Inches. | Inches. | Inches. |
| 1856 | $22\frac{1}{2}$ | $56\frac{3}{4}$ | .. | $39\frac{5}{8}$ | 2·61 | 4·70 | 1·91 | 9·22 |
| 1857 | $25\frac{1}{2}$ | $57\frac{1}{4}$ | .. | $41\frac{3}{8}$ | 2·16 | 1·10 | 2·21 | 5·47 |
| 1858 | 22 | 64 | $50\frac{3}{8}$ | $45\frac{1}{2}$ | 2·58 | 2·55 | 0·96 | 6·09 |
| 1859 | $22\frac{5}{8}$ | $55\frac{1}{4}$ | $54\frac{1}{4}$ | 44 | 2·70 | 2·09 | 2·72 | 7·51 |
| 1860 | $24\frac{5}{8}$ | $50\frac{1}{4}$ | $49\frac{7}{8}$ | $41\frac{5}{8}$ | 1·94 | 4·30 | 6·26 | 12·50 |
| 1861 | $25\frac{3}{8}$ | $56\frac{3}{8}$ | $52\frac{3}{8}$ | $44\frac{3}{4}$ | 1·28 | 1·04 | 2·98 | 5·30 |
| 1862 | $27\frac{1}{4}$ | $57\frac{1}{8}$ | 51 | $45\frac{1}{8}$ | 2·84 | 2·91 | 3·41 | 9·16 |
| 1863 | $20\frac{3}{8}$ | $53\frac{3}{4}$ | $58\frac{1}{4}$ | $44\frac{1}{8}$ | 0·96 | 1·01 | 4·60 | 6·57 |
| 1864 | 24 | $50\frac{1}{4}$ | $60\frac{7}{8}$ | 45 | 1·25 | 1·88 | 1·79 | 4·92 |
| 1865 | $11\frac{1}{2}$ | $34\frac{1}{2}$ | $47\frac{1}{4}$ | $31\frac{1}{8}$ | 0·47 | 3·05 | 0·68 | 4·20 |
| 1866 | $23\frac{3}{4}$ | $44\frac{1}{4}$ | $58\frac{3}{4}$ | $42\frac{1}{4}$ | 1·95 | 1·24 | 4·51 | 7·70 |
| 1867 | $29\frac{3}{4}$ | 48 | $64\frac{1}{8}$ | $47\frac{1}{4}$ | 2·82 | 3·35 | 1·06 | 7·23 |
| 1868 | $17\frac{1}{2}$ | $59\frac{1}{8}$ | 69 | $48\frac{1}{2}$ | 2·19 | 0·73 | 0·37 | 3·29 |
| 1869 | 38 | $68\frac{3}{4}$ | $76\frac{1}{8}$ | 61 | 2·13 | 3·23 | 1·07 | 6·43 |
| 1870 | $5\frac{3}{4}$ | $29\frac{1}{2}$ | $56\frac{1}{4}$ | $30\frac{1}{2}$ | 0·46 | 1·35 | 0·98 | 2·79 |
| Average | $22\frac{3}{4}$ | $52\frac{3}{8}$ | $57\frac{5}{8}$ | $43\frac{1}{2}$ | 1·89 | 2·30 | 2·37 | 6·56 |

during the months of April, May, and June, which may be considered as including the period of active growth of the hay-crop.

Although there is much to be learnt from the results brought together in the foregoing Table, much more information than is there given would be required—as to the difference in the character of the herbage produced under the different conditions, the distribution of the rain, the degree and range of temperature, and the mutual adaptations of moisture, heat, and stage of growth) of the plants—to enable us to account for all the fluctuations in the amounts of gross produce which the records show.

It is seen at a glance that the fluctuations from year to year in the amounts of produce without manure, though doubtless greatly dependent on the quantity and distribution of the rain falling during the period of active growth, by no means correspond with the fluctuations in the total amount of rain during the three months. Thus, the average fall for the three months is 6·56 inches, and the average produce of hay without manure is $22\frac{3}{4}$ cwts. But we have, with almost exactly the same total amount of rain during the same period in 1863 (6·57 inches), only $20\frac{3}{8}$ cwts. of hay; whereas, with even rather less (6·43 inches), in 1869, we have the heaviest produce obtained in any one of the series of 15 years, namely, 38 cwts. The fact is that, coincidently with the small produce of 1863, less than one-third of the total rainfall of the three months occurred during the first two months of the period; whilst, coincidently with the very heavy produce in 1869, there was considerably more than the average fall of rain in both April and May, and less than half the average fall in June; the result being that more than five-sixths of the total fell during the first two of the three months, when its influence upon the growth would be the greatest. Again, the heaviest total fall within the growing period was in 1860, when there was nearly double the average amount, whilst the produce only exceeded the average by less than 2 cwts. of hay; the facts being, that about half the total amount fell in June, that is, not until the last month of growth; and that the temperature was very unusually low almost throughout the period of active vegetation.

The lowest amounts of produce were—$17\frac{1}{2}$ cwts. in 1868, $11\frac{1}{2}$ cwts. in 1865, and only $5\frac{3}{4}$ cwts. in 1870. This last, the lowest amount in the series, is coincident with the smallest amount of total rain over the three months throughout the fifteen years, namely 2·79 inches. With only 3·29 inches in the three months of 1868, there was a produce of $17\frac{1}{2}$ cwts., but with 4·2 inches in 1865, there was only $11\frac{1}{2}$ cwts. But whilst, in the latter year, there was in April only about one-fourth the average fall, and very high temperature, there was during the same month in 1868 more than the average fall, and about the average temperature.

Turning to the columns of produce obtained by the two artificial manures, it is seen that, whilst in the earlier years the mineral manure and ammonia-salts gave more hay than the mineral manure and nitrate of soda, in the later years the mineral manure and nitrate yielded considerably more than the mineral manure and ammonia-salts. It is obvious, therefore, that the fluctuations in the produce are dependent on other conditions than the variations in external or climatic circumstances alone. It will come within the special province of our subject to explain this further presently; but, in passing, we may here remark that the character of the mixed herbage in regard to the distribution of plants, and the prevalence of individual species, was very widely different in the two cases; and the dependence of the amount of produce on external supplies of moisture will, of course, be greatly measured by the degree of root range, and the consequent command of the moisture within the soil itself, of the particular species favoured.

These few observations will be sufficient to indicate some of the points of interest which the study of the subject in detail is calculated to elucidate, and to show the complexity of the conditions upon which the final result—the weight of hay—depends.

We will now turn to the more special object of the present communication.

The following are the amounts of hay obtained per acre in 1870, on each of the three plots already referred to, and also the average amounts over 15 years without manure, and with mineral manure and ammonia-salts, and over 13 years with mineral manure and nitrate of soda.

Table II.

| | Hay per Acre. | | |
|---|---|---|---|
| | 1870. | Average 15 (or 13) Years, 1856-70. | Deficiency in 1870. |
| | Cwts. | Cwts. | Cwts. |
| Without manure .. .. .. .. .. | $5\frac{3}{4}$ | $22\frac{3}{4}$ | 17 |
| Mineral manure and ammonia-salts .. | $29\frac{1}{2}$ | $52\frac{3}{8}$ | $22\frac{7}{8}$ |
| Mineral manure and nitrate of soda .. | $56\frac{1}{4}$ | $57\frac{5}{8}$ | $1\frac{3}{8}$ |

Thus, under the influence of the extraordinary drought of 1870, there was a variation in the amount of produce on closely adjoining plots, from only $5\frac{3}{4}$ cwts. of hay without manure, to

$29\frac{1}{2}$ cwts. with mineral manure and ammonia-salts, and to $56\frac{1}{4}$ cwts. with mineral manure and nitrate of soda. Indeed, without manure there was not only less produce than in any preceding year of the fifteen, but only about one-fourth the average amount. With mineral manure and ammonia-salts there was again considerably lower produce than in any other of the fifteen years with the same manure, and a deficiency of nearly 23 cwts. compared with the average. Notwithstanding this, we have the remarkable result of 2 tons 16 cwts. of hay produced by mineral manure and nitrate of soda, or only about $1\frac{1}{4}$ cwt. less than the average amount by that manure; about $2\frac{1}{2}$ tons more than without manure, and $1\frac{1}{3}$ ton more than by the mixture of mineral manure and an amount of ammonia-salts containing about the same quantity of nitrogen as the nitrate.

On the assumption that probably about 300 parts of water pass through the plants for one part of dry substance fixed, about 700 tons of water must have been exhaled by the herbage during the growth of the 56 cwts. of hay. But, reckoning an inch of rain to represent a fall of 101 tons per acre, the 2·79 inches which fell in 1870 during April, May, and June, the period of active vegetation, could only supply 282 tons of this, provided (which would not be the case) none of it was lost by drainage, and none of it passed off by evaporation otherwise than through the plants themselves. On the same assumptions, the amount which fell would be about 160 tons less than sufficient for the requirements of the crop grown by mineral manure and ammonia-salts, but more than three times as much as would be required by the growth of the unmanured produce.

So striking was the difference in the effect of the drought on two plots side by side, the one manured with mineral manure and a given quantity of nitrogen in the form of ammonia-salts, and the other with the same mineral manure and the same quantity of nitrogen, but the latter in the form of nitrate of soda instead of ammonia-salts, that it was decided, on the removal of the crop, to determine the quantities of water existing in the soil of the three plots to a depth somewhat greater than the lowest to which roots could be traced; and also to observe the difference in the development and distribution of the roots, if any, on the different plots. Accordingly, on July 25 and 26, 1870, samples of soil were taken from the three plots to the depth of 54 inches in each case, roots having been traced on one of them to within a few inches of that depth.

The plan of collecting and preparing samples of soil for analysis will be understood from the following description of the process in the present instance: A square yard, comprising a fair proportion of the species contributing to the bulk of the herbage, having been carefully selected on each plot, a case or frame, open at the top and bottom, made of strong sheet-iron, 6 inches square by 9 inches deep (but which may be of any desired size), was driven into the ground in the centre of the square, level with the surface. The enclosed soil was then dug out exactly to the depth of the case. The soil around the case, to the extent of the square yard selected, was then removed to the level of the bottom of it; it was again driven down, and its contents carefully taken out; and so on, the process was repeated, until the desired depth was attained. The determination of the water in the samples being the special object of the experiments in question, the exact weight of the soil was taken immediately on removal, so that any loss of moisture by evaporation during preservation, or preparation for analysis, might be duly taken account of. The whole was then broken up, the stones sifted out, separating first those which did not pass a 1-inch sieve, next a ½-inch, and finally a ¼-inch sieve being used. The mould, or soil, passing the ¼-inch sieve was weighed, a proportional part of it finely powdered for analysis and re-weighed. In the soils so prepared, the loss of moisture, at different temperatures, has been and the nitrogen and some other constituents will be determined.

The following Table shows the percentage of moisture, as determined by the loss when dried at 212° Fahr., inclusive of that by evaporation during preparation for analysis, in the soil from each of the three plots of the experimental meadow-land, at each depth to which the samples were taken:—

TABLE III.—MOISTURE in the Soil from Plots of Permanent Meadow Land differently Manured. Samples collected July 25–6, 1870.

| Depth of Sample. | PERCENTAGES OF MOISTURE (Soils dried at 212° Fahr.). | | |
|---|---|---|---|
| | **Plot 3.** Without Manure. | **Plot 9.** Mineral Manure and Ammonia-salts. | **Plot 14.** Mineral Manure and Nitrate of Soda. |
| First 9 inches .. .. .. | 10·83 | 13·00 | 12·16 |
| Second 9 inches .. .. .. | 13·34 | 10·18 | 11·80 |
| Third 9 inches .. .. .. | 19·23 | 16·46 | 15·65 |
| Fourth 9 inches .. .. .. | 22·71 | 18·96 | 16·30 |
| Fifth 9 inches .. .. .. | 24·28 | 20·54 | 17·18 |
| Sixth 9 inches .. .. .. | 25·07 | 21·34 | 18·06 |
| Mean .. .. .. .. | 19·24 | 16·75 | 15·19 |

The results recorded in this Table are of great interest and significance; and they supply important data towards the explanation of the extraordinary difference in the amount of produce obtained on the different plots. It should be premised, however, that between the removal of the crops and the date of sampling the soils, in all nearly an inch of rain had fallen, perhaps affecting somewhat the actual percentages, but the relative amounts probably but little.

The first point to remark is, that the first 9 inches of soil of both the heavily manured, and more or less heavily cropped, plots contained a higher percentage of moisture than that of the unmanured and lightly cropped plot. But from that point downwards to a depth of 54 inches, and doubtless further still, the manured and more heavily cropped soils contained much less moisture than the unmanured; and the most heavily cropped soil, that of Plot 14, manured with mineral manure and nitrate of soda, contained considerably less than that of Plot 9, manured with mineral manure and ammonia-salts. And whilst at a depth of from 45 to 54 inches the unmanured soil contained 25 per cent. of moisture, that receiving mineral manure and ammonia-salts contained only 21·34 per cent.; and that receiving mineral manure and nitrate of soda only 18 per cent., or scarcely $\frac{3}{4}$ths as much as the unmanured soil at the same depth. To sum up the results, there is an average amount of moisture down to the depth of 54 inches, of $19\frac{1}{4}$ per cent. on the plot without manure, of only $16\frac{3}{4}$ per cent. on the plot manured with mineral manure and ammonia-salts, and of scarcely $15\frac{1}{4}$ per cent. on that manured with mineral manure and nitrate of soda, or only about $\frac{4}{5}$ths as much on the latter as on the unmanured plot.

The subsoil of this meadow land is a reddish yellow clay, interspersed with grey veins, and the specific gravity increases by about one-half from the surface down to the greatest depth taken. For our present purpose it will be a sufficiently near approximation to the truth to assume that down to the depth of 54 inches, the soil (exclusive of stones) weighed an *average* of 1,000,000 lbs. per acre for every 3 inches of depth, or an aggregate of 18,000,000 lbs. per acre to the depth of 54 inches. Adopting this estimate, and the percentages of moisture given in Table III., it results that down to the depth of 54 inches, or 4 feet 6 inches, the unmanured soil retained 1546, the soil of Plot 9, 1346, and that of Plot 14, 1221 tons of water. That is to say, to the depth of 4 feet 6 inches, the soil of Plot 9, manured with mineral manure and ammonia-salts, contained 200 tons, and that of Plot 14, manured with mineral manure and nitrate of soda, 325 tons less water per acre than that of the unmanured soil to the same depth; whilst, from the great difference in the percentage at the lowest depths taken in the three cases, there can be no doubt that the difference extended considerably deeper still.

Here, then, we have evidence of the source whence the manured crops derived the water required for their growth, over and above that supplied by the rain actually falling during the period of active vegetation. But the questions obviously arise—if the unmanured subsoil retained so much more water, why did the crop suffer from the drought so very much more than the manured crops? and why did the crop manured with mineral manure and ammonia-salts suffer so much more than that manured with mineral manure and nitrate of soda, and not avail itself so fully as did the latter of the stores of moisture within the soil? To gain some information on the points here suggested, careful examination was made of the distribution of species on the square yard of the plot selected, of the section of the soil and subsoil, and of the distribution of roots within them.

It should be stated that 53 species in all are found on the continuously unmanured plot; this great complexity of herbage being maintained in consequence of the little encouragement to luxuriance of any. On the other hand, by the application of mineral manure and ammonia-salts on Plot 9, and of mineral manure and nitrate of soda on Plot 14, for many years in succession, and the consequent great encouragement and predominance of certain individual species, the total number discernible has become reduced to 30 on each of these plots. And whilst the herbage on the unmanured plot comprises 17 graminaceous, 4 leguminous, and 32 miscellaneous or weedy species, that of Plot 9 includes only 15 graminaceous, 2 leguminous, and 13 miscellaneous species, and that of Plot 14 only 14 graminaceous, 3 leguminous, and 13 miscellaneous species.

But such, again, is the difference in the character of the two nitrogenous manures—ammonia-salts and nitrate of soda—in regard to their reactions upon the soil, and the consequent degree of rapidity and range of distribution of them or their products of decomposition within it, that they respectively encourage the development of species of widely different underground, as well as above-ground habit of growth. Thus, the dominant plants were very different on the two manured plots. Under the influence of the annual application of mineral manure and ammonia-salts, *Dactylis glomerata* (rough cock's-foot), *Agrostis vulgaris* (common bent-grass), *Festuca ovina* (sheep's-fescue), and *Poa pratensis* (common meadow-grass), among graminaceous plants, and *Rumex acetosa* (sorrel-dock), among the miscellaneous herbage, prevailed somewhat in the order of enumeration; whilst under the influence of mineral manure and nitrate of soda *Bromus mollis* (soft brome-grass), had become so prominent as to constitute probably about one-half the crop; *Poa trivialis* (rough meadow-grass)was also very prominent, *Holcus lanatus* (woolly soft-grass), *Festuca ovina* (sheep's-fescue), *Lolium perenne* (rye-grass), *Dactylis glomerata* (rough cock's-foot), *Avena flavescens* (yellow oat-grass), and among weeds *Anthriscus sylvestris* (wild beaked-parsley), coming next in order of prevalence. And, whilst the plants most encouraged by the ammonia-salts have a tufty habit of growth above ground, and a tendency to luxuriate within a limited range beneath the surface, some of those most favoured by the nitrate of soda, and especially under its influence, are very different in character, not growing in tufts, but producing comparatively uniformly dense herbage, with many stems, comparatively few root-leaves, and roots having a characteristically downward tendency, those of the *Bromus mollis* especially (which contributed such a large proportion of the whole crop) being strong and wiry, and descending far into the subsoil.

The sectional examinations, indeed, showed great differences in the character of the turf, in the prevalence and character of development of the roots within and below it, and in the character of the soil and subsoil, as the following brief abstract of the observations made will show. It should be first stated, however, that whilst on the square yard selected as characteristic of the unmanured plot, there were found 9 graminaceous, 4 leguminous, and 11 miscellaneous species—in all 24; on that of Plot 9, having mineral manure and ammonia-salts, there were only 6 graminaceous, no leguminous, and only 3 miscellaneous species; and on that of Plot 14, receiving mineral manure and nitrate of soda, again only 6 graminaceous, only 1 leguminous, and 2 miscellaneous species.

Owing to the great complexity of the herbage on the unmanured plot, including a comparatively large number of leguminous, and miscellaneous or weedy species, some fleshy roots were observed at a considerable depth. The turf consisted of a complex network of fine roots and fibrils, which were much less in size and strength than in the case of either of the manured plots. These fine roots seemed to have more or less complete possession of the soil to a depth of about 6 inches, and some of them then showed a downward tendency; becoming, however, much fewer, and even in the second and third 9 inches extremely fine; and at a depth of about 40 inches they were as fine as a fibre of silk or a spider's web. It was concluded, though not with great certainty, that the roots found at the greatest depth were those of *Agrostis vulgaris* and *Bromus mollis.* The sample of the first 9 inches of the unmanured soil possessed the character of mould not much less than that of the manured plots; the second 9 inches was also very much altered from the character of the clay subsoil; but below this point very slight difference was observable; though, of the four lower samples, the uppermost, that is, the third from the surface, perhaps showed slightly the least, and the lowest, or sixth, the brightest red tinge.

The turf of Plot 9, manured with mineral manure and ammonia-salts, consisted of a dense, almost peat-like mass, of decomposing roots, radicle leaves, and stubble, thickly penetrated with strong roots and fibrils, the whole being as much matted as on the unmanured soil, showing, however, less complexity, but greater strength of roots. The horizontal subterraneous stems of the *Agrostis vulgaris* greatly predominated, emitting many fibrils, and sending out many descending fibrous roots. *Poa pratensis* also developed a large amount of strong root, and a profusion of fibrils. Roots penetrated to about the same depth as on Plot 3, but in larger quantity, and of larger size; being, however, in the fifth 9 inches, both very few in number and very fine. As already said, the samples of the first 9 inches of the soil of the three plots differed comparatively little from one another in the degree of their change by the action of vegetation; but, if anything, that of this Plot 9 was the darkest, indicating so far more of mould-like character. The second 9 inches of this plot was decidedly more changed than that of the unmanured, or of even Plot 14. The third and fourth 9 inches were, compared with the unmanured, slightly darker, or less bright in colour, showing still some change. The fifth and sixth were little, if at all, distinguishable in colour from the raw, reddish-yellow clay of the unmanured plot at corresponding depths.

The turf of Plot 14, manured with mineral manure and nitrate of soda, had not the peaty appearance of that of Plot 9; the prevailing plant, *Bromus mollis*, which made up about half the crop, possessing comparatively few radicle leaves; whilst, especially under the influence of this manure, *Poa trivialis*, *Holcus lanatus*, and *Lolium perenne*, have a tendency to assume the same character of development above ground. The *Bromus mollis*, too, was found in a most striking degree to send down strong wiry roots into the subsoil, leaving only its fibrils, and the roots of less prominent or smaller species, to feed near the surface. The second 3 inches of soil also held together, being full of fibre. At the extremity of the fibrils of the *Bromus mollis* small tubercles, much like those which occur on the roots of some leguminous plants, were observed down to a depth of perhaps 12 or 14 inches. The roots of this grass extended, however, to a depth of nearly 4 feet, still maintaining their wiry character. The difference in the character of the samples of soil, and especially of the subsoil, of this compared with those of either of the other plots, was very striking. The first 9 inches differed little from that of the unmanured plot. The second was, however, more altered than that of the unmanured plot at the corresponding depth. The third, fourth, fifth, and sixth 9 inches were very strikingly different in appearance from the corresponding layers of either of the other two plots; the clay, instead of being of a comparatively uniform reddish yellow colour, was very much mottled or veined, showing a mixture of yellow, grey, red, and brown, with the yellow and grey predominating. So much was this the case that when the samples were powdered they were of a yellowish grey colour, instead of reddish yellow; and the lighter or less yellow the greater the depth of the sample, that of the sixth 9 inches being the lightest of all.

There was, perhaps, more of natural grey vein in the subsoil of this than in that of the other plots, but the difference in colour and texture was too great to be so accounted for. Upon the whole the lower layers were softer and more soapy than in the case of either Plot 3 or Plot 9; though, as Table III. at page 98 shows, they contained a considerably less percentage of moisture. Indeed, the subsoil of this plot had much more the appearance of disintegration from some cause than that of either of the others; it was consequently much more easily worked, and especially more so than that of the unmanured plot, which was very tough and hard.

To sum up these distinctions: it is seen that not only did different plants become dominant according to the different condition of the plot as to manure, but those which prevailed on the unmanured land, though numerous, had much finer and much less vigorous roots; the raw clay of the subsoil was much less changed; and it had yielded up very much less moisture to the growing crop. On the plot manured with mineral manure and ammonia-salts free-growing grasses predominated; but chiefly those whose underground habit of growth was such as rendered them dependent for their food and moisture in great measure on that which is to be found in the upper layers of the soil. Still, owing to the increased vigour of growth under the influence of the manure, it is seen that moisture was obtained, either directly by the roots of the plants, or by capillary action induced by the pumping out of the upper layers, from the extreme depths to which the samples were taken; and, from the great difference in the percentage of moisture at that depth compared with that of the unmanured plot, there is no doubt that the action extended deeper still. On Plot 14, on the other hand, where nitrate of soda was applied, the plant which contributed about half the produce had roots of a very characteristically downward tendency. We find the soil, to the depths examined, pumped drier still; and, coincidently, the drought has comparatively little affected the amount of the crop.

Intimately connected with the greater change in the subsoil of the plot manured with nitrate of soda than in that manured with ammonia-salts, with the greater predominance and luxuriance of the deeper-feeding herbage, and with the consequent little evil effects from the drought where the nitrate was employed, is doubtless the fact that the ammonia of the ammonia-salts is much more readily absorbed and retained by the soil than is the nitric acid of the nitrate. The latter, consequently, becomes, under the influence of rain, more rapidly distributed and washed into the subsoil, whither the roots follow it. As this filtration, into and through the subsoil, of a solution of the nitrate, or of its products of decomposition within the soil, has been proceeding for thirteen years in succession, there is little cause for surprise that the subsoil should have become much more changed than where the ammonia-salts had been used. It seems intelligible, too, that those plants of the herbage, whose habit of growth is characterised by a comparatively large development of descending roots, aided as they would be when once they had asserted their predominance by more and more self-sowing each succeeding year, should get such complete possession of the lower layers of the soil, with their stores of food and moisture. On this point it may be remarked, that the *Bromus mollis*, which so strikingly predominated on the nitrated plot, and whose roots, though only a biennial, had obtained more complete possession of the subsoil than those of any other plant, is one of the earliest of the grasses, and has, in point of fact, generally seeded to a greater or less extent before the crop has been cut.

It may be here mentioned in passing, that, wherever, in the course of the experiments at Rothamsted, nitrate of soda is employed year after year on the same plot of arable land, the difference in the appearance and texture of the soil is very great, and is discernible at a considerable distance. The soil apparently retains very much more moisture, becomes more agglutinated, and so sticky compared with that of adjoining plots under equal conditions of weather, as to be with difficulty worked at the same time, and never brought to the same tilth without the expenditure of extra labour upon it. It may be judged, indeed. that during the wet season the nitrated soil, and its more disintegrated subsoil, would acquire more moisture, or at least more available moisture, than the soil and raw clayey subsoil of the other plots.

We have, then, in the properties of the nitrate of soda and its effects upon the soil and subsoil, in the influence of these in determining the character of the prevailing herbage, and in the comparative independence of external sources of moisture which a deep root range gives to the plants encouraged, an explanation of the fact that, notwithstanding the unusual drought of 1870, which almost suspended the growth of the unmanured herbage, and much diminished that manured with mineral manure and ammonia-salts, the plants which had gradually asserted possession over others on the plot continuously manured with mineral manure and nitrate of soda, should have yielded, under the same circumstances of scarcity of rain, an all but average crop.

Before leaving the subject of the influence of the drought of 1870 on the hay-crop, it may be added that a portion of the park adjoining the experimental plots was liberally manured with London stable-dung, but no benefit whatever was apparent, and the crop was so light as to be scarcely worth mowing.

The evidence at command in regard to the effects of the drought on other of the experimental crops, is not of the same, or in some respects of so direct a kind, as that relating to the mixed herbage, and to the soils, of the experimental plots of grass land. Nevertheless, some facts of interest may be recorded illustrating the influence of the moisture stored up within the soil on the growth of both wheat and barley.

## Results relating to the Growth of Wheat.

The following Table (IV.) shows the amounts of grain, and the amounts of total produce (corn and straw together), obtained in the experimental wheat-field for 19 years in succession, 1852-1870 inclusive :—

1. On Plot 3, continuously unmanured.
2. On Plot 2, receiving 14 tons farmyard manure per acre per annum.
3. On Plot 7, receiving, annually, mixed mineral manure, and 400 lbs. ammonia-salts per acre.
4. On Plot 9A, receiving, annually, the same mixed mineral manure as plot 7, and 550 lbs. nitrate of soda per acre.

The Table also shows, side by side with the amounts of produce, the fall of rain each year during the months of April, May, June, and July, which may be said to include the period of active vegetation and accumulation of substance. It should be further explained, that, in order that the different amounts of grain from year to year may be more strictly comparable one with another, and to avoid the necessity of recording and considering the weight per bushel in each case, the total weight of dressed corn has been divided by 61, and the Table shows, therefore, not the actual number of measured bushels in each case, but the number of bushels of an assumed uniform weight of 61 lbs.

TABLE IV.—Produce of Wheat by different Manures, and fall of Rain during the 4 Months of active growth each Year, for 19 Years, 1852—1870.

| Years. | Dressed Corn. (In Bushels of 61 lbs.) Plot 3. Without Manure. | Plot 2. Farmyard Manure. | Plot 7 *ab.* Mineral Manure and Ammonia-salts. | Plot 9*a.* Mineral Manure and Nitrate Soda. | Mean. | Total Produce. (Corn and Straw.) Plot 3. Without Manure. | Plot 2. Farmyard Manure. | Plot 7*ab.* Mineral Manure and Ammonia-salts. | Plot 9*a.* Mineral Manure and Nitrate Soda. | Mean. | Rain at Rothamsted. April. | May. | June. | July. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bushels. | Bushels. | Bushels. | Bushels. | Bushels. | lbs. | lbs. | lbs. | lbs. | lbs. | Inches. | Inches. | Inches. | Inches. | Inches. |
| 1852 | 12⅞ | 26¼ | 24½ | (1) | 21¼ | 2457 | 5173 | 5440 | (1) | 4357 | 0·52 | 1·84 | 4.70 | 2·28 | 9·34 |
| 1853 | 4⅜ | 16 | 20⅛ | (1) | 13½ | 1772 | 4492 | 5101 | (1) | 3788 | 3·00 | 1·73 | 3·47 | 4·49 | 12·69 |
| 1854 | 20⅞ | 42⅛ | 46⅛ | (1) | 36⅜ | 3496 | 7125 | 8497 | (1) | 6373 | 0·49 | 4·38 | 0·77 | 0·86 | 6·50 |
| 1855 | 16½ | 35¼ | 32⅛ | 28⅜ | 28⅛ | 2859 | 6082 | 6146 | 5878 | 5241 | 0·41 | 2·32 | 1·65 | 6·97 | 11·35 |
| 1856 | 12⅞ | 34⅞ | 34⅞ | 30⅜ | 28¼ | 2450 | 6594 | 6757 | 5894 | 5424 | 2·61 | 4·70 | 1·91 | 1·48 | 10·70 |
| 1857 | 19 | 40¾ | 44⅜ | 43⅛ | 36⅞ | 2813 | 5910 | 6628 | 6634 | 5496 | 2·16 | 1·10 | 2·21 | 1·61 | 7·08 |
| 1858 | 17⅞ | 39⅞ | 39¾ | 37⅜ | 33¾ | 2811 | 6349 | 6519 | 6701 | 5595 | 2·58 | 2·55 | 0·96 | 3·19 | 9·28 |
| 1859 | 15¾ | 33½ | 31¾ | 26¾ | 27 | 3226 | 7073 | 6833 | 7076 | 6052 | 2·70 | 2·09 | 2·72 | 3·02 | 10·53 |
| 1860 | 11⅛ | 29⅜ | 24⅝ | 27⅝ | 23¼ | 2197 | 5304 | 4675 | 6635 | 4703 | 1·94 | 4·30 | 6·26 | 1·99 | 14·49 |
| 1861 | 10⅝ | 34⅝ | 33¾ | 31⅜ | 27⅝ | 1990 | 5303 | 5751 | 6607 | 4913 | 1·28 | 1·04 | 2·98 | 3·19 | 8·49 |
| 1862 | 15⅛ | 38⅜ | 34⅞ | 42⅜ | 32¾ | 2709 | 6642 | 6143 | 8738 | 6058 | 2·84 | 2·91 | 3·41 | 1·80 | 10·96 |
| 1863 | 17¾ | 45½ | 55 | 56⅝ | 43¾ | 2727 | 7165 | 9358 | 9888 | 7284 | 0·96 | 1·01 | 4·60 | 0·70 | 7·27 |
| 1864 | 16¾ | 41 | 47⅜ | 52⅛ | 39⅜ | 2428 | 6488 | 7970 | 9315 | 6551 | 1·25 | 1·88 | 1·79 | 0·89 | 5·81 |
| 1865 | 13¼ | 37⅜ | 40⅝ | 44⅛ | 33⅞ | 1861 | 5484 | 6249 | 7563 | 5289 | 0·47 | 3·05 | 0·68 | 2·93 | 7·13 |
| 1866 | 12⅛ | 33 | 29⅞ | 32¼ | 26⅞ | 2046 | 6128 | 5775 | 7377 | 5314 | 1·95 | 1·24 | 4·51 | 3·01 | 10·71 |
| 1867 | 8⅛ | 27¾ | 22⅛ | 28⅝ | 21⅝ | 1505 | 4891 | 4179 | 6773 | 4337 | 2·82 | 3·35 | 1·06 | 4·10 | 11·33 |
| 1868 | 16⅝ | 42⅛ | 39⅞ | 47⅞ | 36⅝ | 2027 | 6794 | 6317 | 8150 | 5822 | 2·19 | 0·73 | 0·37 | 0·37 | 3·66 |
| 1869 | 13⅛ | 35⅝ | 26¾ | 36½ | 28 | 2198 | 6193 | 4972 | 7298 | 5165 | 2·13 | 3·23 | 1·07 | 0·97 | 7·40 |
| 1870 | 15⅛ | 38 | 42 | 46¾ | 35½ | 2002 | 5092 | 5836 | 6851 | 4946 | 0·46 | 1·35 | 0·98 | 1·12 | 3·91 |
| Averages | 14¼ | 35⅜ | 35¼ | 38½ (1) | 30¾ | 2398 | 6016 | 6267 | 7336(1) | 5406 | 1·72 | 2·36 | 2·43 | 2·37 | 8·88 |

(1) In 1852, 1853, and 1854, there was no mineral manure employed on plot 9*a*, and the amounts of nitrate used were less than the quantity mentioned in the text. Hence the produce is not given for those years; and the average produce by the mineral manure and nitrate is taken over 16 years only.

The evidence afforded by the results in the foregoing Table is confessedly quite inadequate to show what are the climatic conditions favourable or otherwise to the growth of wheat. It is, however, quite sufficient for our present purpose, which is to illustrate the comparative independence of the crop on the mere amount of rain falling during the period of active vegetation. It will suffice to call attention to a few of the more extreme examples.

The four years of largest total fall of rain over the four months in question were, 1853, 1855, 1860, and 1867, and three of them were also the seasons of smallest average crop, both of corn and total produce, whilst the fourth (1855) was a season of generally less than the average produce. On the other hand, the three years of highest produce, both corn and total produce, were 1854, 1863, and 1864, and all three were seasons of less than the average fall of rain during the four months of active growth. Lastly, the two seasons of lowest fall of rain during April, May, June, and July were 1868 and 1870; and both gave, with each of the four conditions as to manure, more than the average produce of corn over the nineteen years; and in 1868, though not in 1870, there was even more than the average of total produce also, under each of the three manured conditions. But although there was in both these years of great deficiency of rain during the growing period, more than the average produce of corn without manure, there was, in both, less than the average amount of both straw and total produce.

As in the case of the hay crop, so again with the wheat, it is seen that, whilst during the earlier years the mineral manure and ammonia-salts gave more produce, both corn and total produce, than the mineral manure and nitrate of soda, during the later years the nitrate has given more, and sometimes considerably more, of straw especially, than the mineral manure and ammonia-salts. The questions arise, how far may this be due: to the more rapid and more extended distribution of the nitrate of soda, or its products of decomposition, within the soil and subsoil? to the mutual reactions of the manure and the soil? to the greater power of retention of moisture acquired by the latter, as the result of such reaction? and to more active root development in the spring under these conditions?

Unfortunately, no comparative determinations of moisture in the soils of these two plots, or of root development, have been made, so as to obtain direct evidence in regard to the questions here suggested. Due weight should, however, be given to the fact that, whilst the ammonia-salts are sown in the autumn, before the seed, the nitrate is applied as a top-dressing in March. It is known that nitrate of soda, or its nitric acid in combination with some other base, distributes more rapidly, and, under equal circumstances as to rain, is more liable to be washed into the subsoil or the drains, than is the ammonia of the ammonia-salts. Hence it is not applied until the commencement of active growth, when the plant is able rapidly to avail itself of it. It is also known that a portion of the ammonia of the ammonia-salts itself becomes converted into nitric acid, and then is subject, in like manner, to loss by drainage; but to what degree a saturated condition of the soil during winter may cause serious loss, in this way, of the ammonia applied as ammonia-salts in the autumn, is a question not yet sufficiently investigated, and to which we shall make some further reference before concluding.

Although, as has been said, there is no evidence at command in regard to wheat, in reference to the questions above raised, so direct as that referring to the meadow land, yet the results now to be adduced nevertheless supply interesting and important data in respect to the variation in the amount of moisture within the soil at different depths, as affected by season, by manure, and by the growth of the crop.

Such were the drought and heat of May, June, and July, 1868, that it is hardly possible to suppose conditions more calculated to induce extreme dryness of soil than those preceding the harvest of that year. Accordingly, towards the end of July, just before the crop was ripe, samples of soil were taken from three plots of the experimental wheat-field, with the special view of determining the amount of moisture retained at different depths. The plots selected were:—

Plot 3. Without manure since 1839.

Plot 2. With 14 tons farmyard manure per acre per annum.

Plot 8*a*. With mixed mineral manure, and 600 lbs. ammonia-salts per acre per annum.

The mode of collecting the samples was that already described, excepting that the iron frames employed were only 3 inches deep, instead of 9; the object being to determine the amounts of moisture at each 3 inches of depth, down to a total depth of 36 inches, or rather below the pipe-drains.

The subsoil of the farm consists of a tolerably tenacious reddish-yellow clay, resting upon chalk, and the corn crops seldom suffer from a scarcity of rain. At the time the samples were taken, the wheat had suffered but little from the drought, as the results already quoted show. But barley and oats were exceedingly light crops, and a bean crop in an adjoining field was quite dried up and dead for want of moisture.

For comparison with these samples taken at a time of extreme dryness, others were collected from the same plots in January, 1869, after much rain during the preceding ten days;

the drains were running, and it was supposed that the ground was quite saturated. It was, indeed, so wet that it was necessary to lay down boards for the men to stand upon whilst working.

Table V., overleaf, shows the percentages of moisture in the different samples of soil; bringing together—first, the results for the three plots during the drought; second, those for the three plots when the land was saturated; and lastly, the same results arranged for the convenient comparison of the percentages in the dry state and the wet state, and showing the difference between the two, for each plot separately.

It will be obvious that the amount of water at the different depths in July, 1868, after about three months of great deficiency of rain, and the growth of a crop then approaching ripeness, must, in the main, be dependent on the supplies accumulated during the previous winter and early spring. But it is affected, to a greater or less depth from the surface: by any difference of texture and power of absorption, the result of previous cultivation, manuring, and cropping; by the influence of the pipe-drains, which are at a depth of about 30 inches; also, by the shade of the crop on the one hand, lessening evaporation from the soil itself, and on the other, by the requirements of the growing crop increasing, according to its amount, the exhalation through the plants themselves, and the consequent pumping out of the stores within the soil.

The soil of Plot 3, which had received no manure and produced little root (tending to disintegrate the soil and increase its absorptive surface), which had comparatively little shade from the growing plants, preventing surface evaporation, and whose crop would exhale comparatively little, is seen to retain a somewhat less percentage of water than either of the others within 3 inches of the surface, but more than either within the next 9 inches. In it, as in the others, the percentage of moisture increased gradually from that point downwards, until obviously affected by the action of the pipe drains.

The soil of Plot 2, which had then been manured with 14 tons of dung per acre per annum for twenty-five years in succession, notwithstanding the greater requirements of the crop, retained rather more moisture than the unmanured soil within 3 inches of the surface; a result partly due, perhaps, but not wholly, to more shade. But, from that point downwards, doubtless influenced by the requirements of the crop, the dunged soil retained less at every stage (excepting the lowest) than the unmanured.

The soil of Plot 8, manured annually with mineral manure and ammonia-salts, and yielding pretty uniformly a heavier crop

TABLE V.—PERCENTAGES of MOISTURE, in SUMMER and in WINTER, in the SOIL at different depths, of PLOTS in the EXPERIMENTAL WHEAT-FIELD differently manured.

| Nos. of Samples; each 3 Inches deep. | Collected July, 1868. | | | | Collected January 6–7, 1869. | | | | Plot 3. Without Manure. | | | Plot 2. Farmyard Manure. | | | Plot 8a. Mineral Manure and Ammonia-salts. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plot 3. Without Manure. | Plot 2. Farmyard Manure. | Plot 8a. Mineral Manure and Ammonia-salts. | Mean. | Plot 3. Without Manure. | Plot 2. Farmyard Manure. | Plot 8a. Mineral Manure and Ammonia-salts. | Mean. | Collected July, 1868. | Collected Jan. 6, 1869. | Difference. | Collected July, 1868. | Collected Jan. 7, 1869. | Difference. | Collected July, 1868. | Collected Jan. 6, 1869. | Difference. |
| 1 | 4·05 | 4·48 | 4·31 | 4·28 | 21·43 | 39·67 | 26·53 | 29·21 | 4·05 | 21·43 | 17·38 | 4·48 | 39·67 | 35·19 | 4·31 | 26·53 | 22·22 |
| 2 | 7·20 | 7·01 | 6·07(1) | 6·76 | 24·54 | 35·62 | 22·93 | 27·70 | 7·20 | 24·54 | 17·34 | 7·01 | 35·62 | 28·61 | 6·07(1) | 22·93 | 16·86 |
| 3 | 8·91 | 7·38 | 6·66 | 7.65 | 24·35 | 28·85 | 20·62 | 24·61 | 8·91 | 24·35 | 15·44 | 7·38 | 28·85 | 21·47 | 6·66 | 20·62 | 13·96 |
| 4 | 10·65 | 8·14 | 8·45 | 9·08 | 21·41 | 23·95 | 24·07 | 23·14 | 10·65 | 21·41 | 10·76 | 8·14 | 23·95 | 15·81 | 8·45 | 24·07 | 15·62 |
| 5 | 11·24 | 9·98 | 12·44 | 11·22 | 22·07 | 20·59 | 24·84 | 22·50 | 11·24 | 22·07 | 10·83 | 9.98 | 20·59 | 10·61 | 12·44 | 24·84 | 12·40 |
| 6 | 13·20 | 12·26 | 14·34 | 13·27 | 21·48 | 21·07 | 24·79 | 22·45 | 13·20 | 21·48 | 8·28 | 12·26 | 21·07 | 8·81 | 14·34 | 24·79 | 10·45 |
| 7 | 14·03 | 12·51 | 15·20 | 13·91 | 21·82 | 26·96 | 23·69 | 24·16 | 14·03 | 21·82 | 7·79 | 12·51 | 26·96 | 14·45 | 15·20 | 23·69 | 8·49 |
| 8 | 15·09 | 12·91 | 16·86 | 14·95 | 23·59 | 24·87 | 28·98 | 25·81 | 15·09 | 23·59 | 8·50 | 12·91 | 24·87 | 11·96 | 16·86 | 28·98 | 12·12 |
| 9 | 16·84 | 13·78 | 17·98 | 16·20 | 24·74 | 25·75 | 27·01 | 25·83 | 16·84 | 24·74 | 7·90 | 13·78 | 25·75 | 11·97 | 17·98 | 27·01 | 9·03 |
| 10 | 18·03 | 13·45 | 18·53 | 16·67 | 25·71 | 25·34 | 28·59 | 26·55 | 18·03 | 25·71 | 7·68 | 13·45 | 25·34 | 11·89 | 18·53 | 28·59 | 10·06 |
| 11 | 14·64 | 14·49 | 17·67 | 15·60 | 23·97 | 25·18 | 28·93 | 26·03 | 14·64 | 23·97 | 9·33 | 14·49 | 25·18 | 10·69 | 17·67 | 28·93 | 11·26 |
| 12 | 15·44 | 16·11 | 16·85 | 16·13 | 22·94 | 22·75 | 27·40 | 24·36 | 15·44 | 22·94 | 7·50 | 16·11 | 22.75 | 6·64 | 16·85 | 27·40 | 10·55 |
| Mean | 12·44 | 11·04 | 12·95 | 12·14 | 23·17 | 26·71 | 25·70 | 25·19 | 12·44 | 23·17 | 10·73 | 11·04 | 26·71 | 15·67 | 12·95 | 25·70 | 12·75 |

(1) There was an error in the determination in this case; and the figure given is calculated on the assumption that the amount of the moisture in the second 3 inches would probably bear about the same relation to that in the first and third 3 inches as in the case of Plot 3.

than the dung, shows less moisture within the first 9 inches, and but little more within the next, or fourth 3 inches, than that of the dunged plot; also a total to that depth considerably less than the unmanured soil. From that point, however, there is a gradually increasing amount down to the range of the drains; notably more than in the dunged soil, and even more than in the unmanured, whose crop could only have withdrawn from it about one-third as much.

Supposing the three plots to have possessed exactly the same character of soil and subsoil, and to have contained the same amount of moisture to a given depth at the time of the commencement of active growth, we could well understand that, when the growth was nearly completed, the subsoil of the dunged plot, growing more than three times the crop, should contain less moisture than the unmanured subsoil. But, on the same suppositions, it would be difficult to account for the subsoil of Plot 8*a*, which grew even a larger crop than the dung, retaining not only more than the subsoil of the dunged plot, but more also than that of the unmanured plot. The differences between plot and plot as to percentage of moisture are, it is true, in some cases not great. But there is too much regularity and consistency in the results to admit of the supposition that the differences are due to errors arising from the unavoidable difficulties incident to the collection, weighing, and preparing the samples for drying, without some error of experiment affecting the estimation of the amount of water. The results relating to the soils and subsoils when supposed to be in a state of saturation will show, indeed, that the active growth of the crops probably did not commence with equal soil-supplies of moisture in the three cases.

The unmanured soil, when saturated, contained, to the depth examined, not much less than one-fourth its weight of water, and nearly twice as much as in the dry condition. The range of variation in the percentage was much less than in the dry soil; but, on the other hand, the order and degree of increase or decrease is much less regular in the wet soils. The top 3 inches contained rather less water than the second and third; otherwise, there would seem to be, at the time of saturation, more water near the surface, then a decreasing amount, and then a gradually increasing quantity, until the range of the drains is reached.

The dunged soil, with its vast accumulation of organic matter, and doubtless greater degree of disintegration, porosity, and power of absorption within some distance from the surface, is seen to hold about one and a half times as much water within the first 6 inches as the unmanured soil, or even as that manured with mixed mineral manure and ammonia-salts. The third 3 inches, also, contains more than either; and the fourth more than the unmanured, and about as much as the artificially manured soil. The quantity continues to diminish to the fifth 3 inches, and then increases to about the level of the drains. To the total depth examined, the dunged soil contained more than a quarter of its weight of water, about 3½ per cent. more than the unmanured, and about 1 per cent. more than the artificially manured soil.

The soil receiving mineral manure and ammonia-salts also retained more water within what may be called the staple than immediately below it. It then again increased in percentage of moisture, more or less regularly, until within the direct influence of the drains. It is to be observed, too, that, whether owing to a greater retentive power of the natural clay at that point, or more probably to the accumulation, and the action, of the constituents of the manures, or of their products of decomposition, rendering the clay more hygroscopic, the lower layers of the soil of this plot retained considerably more water when saturated than did the corresponding layers of either of the other plots. The amount of water to the total depth was about 2½ per cent. more than in the unmanured soil, but not so much as in the dunged soil.

As might be expected, there are greater irregularities of increase or decrease indicated in the percentages of water at the different depths, among the results relating to the saturated, than among those relating to the dry soils. This may be due in part to accidental differences of permeability of the soil, and consequently to variation in the freedom of access of the percolating water, at the different points; but it is, doubtless, partly due to unavoidable error in the collection, weighing, and after-manipulation, of soil in so wet a condition.

Disregarding the irregularities, however, and interpreting the obvious direction of increase or decrease of moisture at the different depths, it is pretty clear that, down to a certain depth from the surface—which varied in the different plots according to the varying power of retention of the staple and immediately subjacent layers—the increased percentage of moisture was due to the comparatively recent rains. There was then reached the layers partially drained since the preceding rains, from which point downwards the percentage increased, until again reduced by the action of the pipe-drains.

Further, it is obvious that, by evaporation from the surface, and the consequent withdrawal by capillary action of water from below upwards on the one hand, and by the gradual descent, aided by the natural drainage of the chalk and the artificial drainage of the pipes, on the other, what may be called the normal supply of water within the soil would, doubtless, at the commencement of active growth, be considerably less than that indicated by the percentages in the saturated soils. There is also good reason to suppose that, owing to the action of the manures, or their products of decomposition, within the soil and subsoil, the manured plots would retain more than the unmanured; and further, that whilst the effects of the dung would be chiefly to increase the retention by the upper layers, those of the artificial manures would be more characteristically to increase the amount retained by the lower layers.

This brings us to a comparison of the amount of water in each plot in the two conditions of unusual dryness and of saturation or abnormal wetness, as shown in the right-hand half of the Table V.

Referring first to the unmanured soil, there is seen to be a difference of more than 17 per cent. of moisture between the wet and dry conditions of the staple, or uppermost 6 inches of soil. The difference then diminishes, more rapidly at first, until, in the lower layers, it ranges from under 8 to about 9 per cent. There is an average of about $10\frac{3}{4}$ per cent. more water in the wet than in the dry soil to the total depth examined.

The difference between the saturated and the dry conditions of the various layers of the dunged soil is much more striking still: amounting to over 35 per cent. within the first 3 inches, to nearly 29 per cent. in the second 3 inches, to more than 21 per cent. in the third 3 inches, and to nearly 16 per cent. within the next, or fourth, 3 inches. It then lessens considerably, again increases, and again diminishes to within the range of the drain-pipes. The result is that, within the uppermost 12 inches of soil, there is an increase of about 25 per cent. of moisture in the wet as compared with the dry condition; or, taking the total depth of 36 inches, there is an increase of over $15\frac{1}{2}$ per cent.

The artificially manured soil also shows, almost throughout, greater difference in the amount of water retained in the two states than the unmanured, but less than the dunged soil. In the lower layers there are, as in the case of the dunged plot, some irregularities not satisfactorily explained. The final result, to the total depth of 36 inches, is an average of nearly 13 per cent. more water in the wet than in the dry condition.

It will be useful to compare the actual amounts of water per acre, in the different soils to the total depths examined, which the percentage results represent. Reckoning, as before, the soil in the dry state to weigh, exclusive of stones, an average of 1,000,000 lbs. per acre for each 3 inches of depth, we have 12,000,000 lbs. for the weight of the dry soil to the depth of

36 inches; and allowing one-eighth more for the wet soil, we have 13,500,000 lbs. per acre for its weight to the depth of 36 inches. Adopting these figures, and the average percentage of moisture in the soil of each plot, we have the following amounts of water per acre on the respective plots in the two conditions:—

TABLE VI.

| | July, 1868. Dry. | January, 1869. Saturated. | Difference. |
|---|---|---|---|
| *Tons of Water, per Acre, to a depth of 36 inches.* | | | |
| Plot 3.—Unmanured .. .. .. .. .. .. | 666 | 1396 | 730 |
| Plot 2.—With Farmyard Manure .. .. | 591 | 1610 | 1019 |
| Plot 8*a*.—With Mineral Manure and Ammonia-salts .. .. .. .. .. .. | 694 | 1549 | 855 |
| *Tons of Water, per Acre, over (or under) Plot 3.* | | | |
| Plot 2.—With Farmyard Manure .. .. | −75 | 214 | 289 |
| Plot 8*a*.—With Mineral Manure and Ammonia-salts .. .. .. .. .. .. | 28 | 153 | 125 |

Thus we have on the unmanured plot 730, on the dunged plot 1019, and on the artificially manured plot 855 tons, more water per acre, to the depth of 36 inches, when the soils were saturated than when in the dry condition. As already said, the soils would not retain such an amount of moisture at the time of the commencement of active vegetation. But, by way of illustration, it may be stated that if they retained even two-thirds of the indicated difference prior to the commencement of the drought, and the commencement of active growth in 1868, the amount would be considerably more than would be required by the unmanured crop, and would supply a large proportion of that required by the manured crops, on the supposition that about 300 parts of water would be exhaled by the plants for 1 part of dry substance fixed by them. The soil-resources of moisture available to the growing crop would, however, doubtless extend beyond the depth to which the examinations refer. Then, again, the amount of rain which actually fell during the period of active growth, though comparatively small, would, nevertheless, be not immaterial considered in relation to the balance of the requirements of the crops.

A very remarkable point connected with these results is, however, the difference in the amount of water retained per acre to a given depth by the soils of the different plots when saturated.

The unmanured soil and subsoil, comparatively little disturbed and disintegrated by the permeation and the decomposition of roots, and not at all by the action of manures, would offer less surface and absorb less water, and they are seen to retain less than those of either of the manured plots. The soil and subsoil of the artificially manured plot would be affected by the permeation not only of more roots, but of the solution of the manures or of some of their products of decomposition,—by the latter especially in the lower layers. But it is the dunged plot, with its vast accumulation of organic matter near the surface, and its finely divided and dissolved products of decomposition permeating to a greater or less depth beyond, and, doubtless, a considerable development of root, that is seen to possess the greatest power of retention of moisture, especially near the surface.

Taking the figures relating to the saturated soils as they stand, the artificially manured plot retained 153 tons, and the dunged plot 214 tons more water per acre, to the depth examined, than the unmanured—amounts which represent, respectively, about $1\frac{1}{2}$, and more than 2 inches of rain. Or, if we take the difference between the amounts retained in the dry and the wet conditions, the dunged soil shows a still greater excess of absorption when saturated, both compared with the unmanured, and with the artificially manured soils. Further, the details show that the dunged soil, when saturated, retained, within 12 inches of the surface, an excess of water which would be equivalent to about $1\frac{1}{2}$ inch of rain more than that held to the same depth on either of the other plots.

In connection with this interesting fact, it may be mentioned, that whilst the pipe-drains from every one of the other plots in the experimental wheat-field run *freely*, perhaps on the average four or five times annually, the drain from the dunged plot seldom runs at all more than once a year: indeed, it has not with certainty been known to rnn, though closely watched, since about this time last year. At first it was thought that there must be some stoppage, or some fault in the levels. Accordingly, the soil was opened in various places, but was found to be far from saturated down to the range of the drains. It was then concluded that the result was due to the greater power of absorption and retention of moisture by the dunged soil near the surface; and even supposing the figures above given should exaggerate the difference actually occurring, there would still be a wide margin remaining, sufficient to account for the fact of no water reaching the drains excepting under the influence of an unusually large and continued rainfall. Such a fact as the one here recorded is obviously of great interest and significance. Whether

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the porosity of a clay soil be increased by the application of manure, by mechanical means, or by a combination of the two, its power to absorb and retain water, without being wet, and in an available state, will be proportionately increased, and the necessity for artificial drainage, at any rate on some soils, would be greatly obviated.

From the results adduced, it may safely be concluded, as already intimated, that the three plots would retain different amounts of water, due to the previous winter rains, at the time of the commencement of active vegetation in the spring. And although the actual amounts of excess indicated by the figures in Table VI. may not be true measures of the increased retention by the manured as compared with the unmanured soil, and although the excess at any one time may not be sufficient to meet the increased requirements of the manured crop, it must be supposed that the soils of higher retentive power would retain proportionally more of every heavy shower falling from time to time during growth; and hence may be accounted for the differences, not at first sight adequately explained, in the amounts of water retained by the different soils at the period when they had supported, and nearly carried to completion, such widely different amounts of crop.

Have we not, also, in the fact that the soil and subsoil, to a considerable depth, may frequently during the winter be saturated with water, a probable explanation, of part at least, of the less effect of a given amount of nitrogen applied in the autumn in the form of ammonia-salts, than of an equal amount supplied in the spring as nitrate of soda? For although the ammonia of the ammonia-salts is in great part absorbed by the upper layers of the soil, it is well established that a portion of the nitrogen supplied as manure in the form of ammonia becomes converted into nitric acid, and reaches the drains in the form of a nitrate; and it may be assumed that this action would, other things being equal, be the greater the greater the amount of water passing through the soil. Professor Voelcker, who has analysed many of the drainage waters collected at different times from the several plots in the experimental wheat-field at Rothamsted, has, moreover, found a greater amount of nitric acid in them the greater the amount of ammonia-salts applied as manure.

Another reason which may in part explain the frequent less effect of a given amount of nitrogen applied as ammonia-salts than of an equal amount applied as nitrate of soda, even when both are sown at the same time in the spring, may be that, as the nitric acid of the nitrate distributes more rapidly under the influence of rain than does the ammonia of the ammonia-salts, so may the development of root be the more encouraged under the influence of the nitrate; and so, proportionately, will the plant gain greater possession of the soil, and consequently be able to avail itself of a wider range of both food and moisture within a given time. Further, from the results which have been recorded on the point in the foregoing pages, it would seem that when the nitrate is applied year after year on the same plot for many years in succession, the action on the soil and subsoil of its solution, or of that of the products of its decomposition, tends to increased disintegration, and to increased power of retention of moisture, and thus, again, to encourage a greater extension of root.

## Results relating to the Growth of Barley.

Our next and last illustrations have reference to the growth of barley. This crop has been grown at Rothamsted for nineteen years in succession on the same land, without manure, with farmyard manure, and with numerous artificial mixtures each year. The fluctuations in the amount of produce dependent on season, manure, and the continued growth of the crop, being greater than in the case of wheat, it would occupy too much space to follow up the same line of illustration as that adopted in regard to that crop; and it is the less necessary or desirable to do so, as we hope to report the whole of the results after the twentieth crop in succession has been harvested.

Referring to the influence of the variation of rainfall from year to year, it will suffice to say here that extremely low produce of barley was obtained with both a great excess and a great deficiency of rain during the months of active vegetation. The bad result with excess of rain was coincident with unusually low, or unusually high temperatures; and that with deficiency of rain with high temperatures. On the other hand, the highest amounts of produce were obtained with only moderate amounts of rain during the growing period, provided there were a favourable distribution of it, and a favourable adaptation of temperature. And whilst an excess of rain, during the growing months, is adverse to the favourable growth of both wheat and barley, a great deficiency of rain during that period is found to be, as would be anticipated, more adverse to the spring-sown barley than to the winter-sown wheat.

In the experiments on barley, equivalent amounts of nitrogen, as ammonia-salts and nitrate of soda respectively, have not been employed in conjunction with mineral manures from the commencement; but where they have been employed, each separately, without such admixture, a similar result is observed as with both hay and wheat. That is to say, higher amounts of both corn and total produce have been obtained from the use of a given amount of nitrogen applied as nitrate of soda, than from that of an equal amount applied as ammonia-salts—both manures being in the case of barley sown in the spring.

In 1868 experiments were commenced in which nitrate of soda was used in conjunction with mineral manures, and below are given the results obtained in 1868, 1869, and 1870, with mixed mineral manure and 200 lbs. of ammonia-salts per acre per annum, compared with those of the same mixed mineral manure and 275 lbs. of nitrate of soda, which is estimated to contain about the same quantity of nitrogen as the ammonia-salts. As in the case of wheat, not the actual number of bushels measured, but the bushels of dressed corn calculated at an assumed uniform weight per bushel are given. For barley, 52 lbs. per bushel is taken.

TABLE VII.—Showing the effects on the Barley Crop of a given amount of Nitrogen as Ammonia-salts, compared with an equal amount as Nitrate of Soda.

| | DRESSED CORN. (In bushels of 52 lbs.) | | STRAW. | | TOTAL PRODUCE. (Corn and Straw.) | |
|---|---|---|---|---|---|---|
| | Mineral Manure and Ammonia-salts. | Mineral Manure and Nitrate Soda. | Mineral Manure and Ammonia-salts. | Mineral Manure and Nitrate Soda. | Mineral Manure and Ammonia-salts. | Mineral Manure and Nitrate Soda. |
| | Bushels. | Bushels. | lbs. | lbs. | lbs. | lbs. |
| 1868 .. | 37 | 49 | 2333 | 2868 | 4311 | 5454 |
| 1869 .. | $54\frac{3}{8}$ | $54\frac{7}{8}$ | 3853 | 4265 | 6701 | 7194 |
| 1870 .. | $41\frac{3}{4}$ | $48\frac{7}{8}$ | 2090 | 2050 | 4287 | 4621 |
| Mean | $44\frac{3}{8}$ | $50\frac{7}{8}$ | 2759 | 3061 | 5100 | 5756 |

Here, then, we have again a similar result. There is, too, proportionately a greater increase with the nitrate, especially of corn, in the two drier and hotter seasons of 1868 and 1870 —years, in fact, of summer drought.

The following Table shows the produce of barley without manure, with farmyard manure, and with mixed mineral manure and 200 lbs. ammonia-salts per acre, in 1868, and in 1870, the two recent years of summer drought; and also, under the same conditions as to manure, the average produce over the nineteen years of the experiment. As before, the number of bushels of dressed corn, reckoned at an uniform weight of 52 lbs. per bushel, is given. And, side by side with these records of produce, is given the amounts of rain at Rothamsted, in April, May, June, and July, each year, those being the months of active growth of the barley crop.

TABLE VIII.

| | Dressed Corn. (In bushels of 52 lbs.) | | | | Total Produce. (Corn and Straw). | | | | Rainfall at Rothamsted. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Without Manure. | Farmyard Manure. | Mineral Manure and Ammonia-salts. | Mean. | Without Manure. | Farmyard Manure. | Mineral Manure and Ammonia-salts. | Mean. | April. | May. | June. | July. | Total. |
| | Bush. | Bush. | Bush. | Bush. | lbs. | lbs. | lbs. | lbs. | Ins. | Ins. | Ins. | Ins. | Ins. |
| 1868 .. .. | 11⅛ | 47⅞ | 37⅛ | 32 | 1902 | 5281 | 4311 | 3831 | 2·19 | 0·73 | 0·37 | 0·37 | 3·66 |
| 1870 .. .. | 13⅞ | 52⅛ | 41¾ | 35⅞ | 1489 | 4949 | 4287 | 3575 | 0·46 | 1·35 | 0·98 | 1·12 | 3·91 |
| Average, 19 Years, 1852–1870 .. | 20 | 50¼ | 48⅛ | 39½ | 2453 | 5856 | 5786 | 4698 | 1·72 | 2·36 | 2·43 | 2·37 | 8·88 |

As there has been a decline in the produce without manure during the latter as compared with the former half of the period over which the experiments have extended, the difference indicated between the unmanured produce in the years of drought and that over the nineteen years will exaggerate the deficiency due to the deficient rainfall alone during the four growing months of the two years in question. On the other hand, the produce by farmyard manure has considerably increased during the latter half of the period, and hence the deficiency in the years of drought which the figures show for that manure is less than is due to the characters of the seasons alone. With the artificial manure the produce was, however, very much more nearly equal during the first and second halves of the total period, and the indicated deficiency in the years of drought probably more nearly represents that really due to the characters of the seasons in its case. With this manure there was a deficiency compared with the average, of 11 bushels of corn in 1868, and of $6\frac{3}{8}$ bushels in 1870; or, of total produce, of 1475 lbs. in 1868, and of 1499 lbs. in 1870. There was not far from an equal total amount of rain during the four months in the two seasons; but whilst there was more than an average fall in April, 1868, and only about one-fourth the average fall in April, 1870, there was a greater deficiency in May, June, and July, 1868, than in the same months in 1870. The result was a greater deficiency of corn, but a less deficiency of straw, in 1868 than in 1870.

We are enabled to adduce more direct experimental evidence showing the extent to which the barley-plant can avail itself of the stores of moisture within the soil, than that which was at command relating to wheat.

Before considering the results themselves, to which reference is here made, it will be well to describe briefly the circumstances under which they were obtained. With a view to the determination of what proportion of the rainfall passes to given depths in the subsoil, under different conditions of season, manuring, and cropping, a series of experiments has been commenced, for the cutting off, and the collection, of the drainage-water from the land at different depths—an essential condition being that neither soil nor subsoil should be disturbed. Leaving out of view for the present the questions of the influence of different manures, or of the growth of different crops, early in 1870 three plots of uncropped land, each of one-thousandth of an acre area, were selected, with a view of determining the amount of water passing below the depths of 20, 40, and 60 inches, respectively. The plan of operating was, to cut a sufficiently wide trench for men to work in, down one side of the plot, to a considerably greater depth than that at which the drainage was to be cut off. The plot was then carefully undermined and shored up at the depth decided upon, until a cast-iron plate, rather more than the length of the plot, 8 inches wide, and having small holes for the water to drain through, could be got in and fixed underneath. The plot was then further undermined, until another plate could be put in; and so on, until the whole was supported at the proper depth, without disturbance, by a perforated iron flooring, which finally was itself supported on three sides by brickwork, and on the fourth and across the middle by iron girders. The three as yet undisturbed sides of the plot were then trenched round; a 4½-inch brick and cement wall was built round the plot, resting on the projecting rim of the iron flooring below, and finished level with the surface above. The trench outside the wall was then filled in again. Thus, the exact area required was cut off from the surrounding soil by brickwork at the sides, and below, at the depth required, by a perforated iron flooring.

The field in which these *drain-gauges* were made, had grown wheat in 1869, and was sown with barley in March, 1870, and the drill by mistake was allowed to sow two rows of seed on the plots along one side of them. As the excavations proceeded, barley-roots were observed to have extended to a depth of between 4 and 5 feet, and the clayey subsoil appeared to be much more disintegrated, and much drier, where the roots had penetrated than where they had not. Accordingly, it was decided to make careful notes on the sections under the two conditions, and also to take samples of soil and subsoil to a depth below that at which roots were traced, with a view to the determination of the amounts of moisture at the different depths in the two cases. Portions of the barley-ground and the fallow-ground, closely adjoining the drain-gauge plots, but undisturbed by the excavations in connection with them, were selected, and from each six samples, 6 × 6 inches superficies by 9 inches deep, that is, in all to a depth of 54 inches, were taken.

The following Table shows the percentages of moisture in the different samples, including that lost during their preparation, as well as that afterwards expelled at a temperature of 212° Fahr. :—

TABLE IX.—Percentages of Moisture in Uncropped and in Cropped Land, at different depths.

Samples collected June 27th and 28th, 1870.

| Depth of Sample. | Fallow Land. | Barley Land. | Difference. |
|---|---|---|---|
| First 9 inches .. .. .. | 20·36 | 11·91 | 8·45 |
| Second 9 ,, .. .. .. | 29·53 | 19·32 | 10·21 |
| Third 9 ,, .. .. .. | 34·84 | 22·83 | 12·01 |
| Fourth 9 ,, .. .. .. | 34·32 | 25·09 | 9·23 |
| Fifth 9 ,, .. .. .. | 31·31 | 26·98 | 4·33 |
| Sixth 9 ,, ... .. .. | 33·55 | 26·38 | 7·17 |
| Mean .. .. .. .. | 30·65 | 22·09 | 8·56 |

Before commenting on these results, it should be stated that, ten days previous to the collection of the samples, about two-thirds of an inch of rain had fallen, and only three days before the collection about one-tenth of an inch; and hence, perhaps, may in part be accounted for the somewhat high percentage of moisture in both soils near the surface at that period of a season which was upon the whole one of unusual drought. Further, for a few days during the interval since the heavier rainfall, some soil, thrown out from the excavations near, had laid upon the spot whence the samples from the uncropped land were taken, and hence, again, may be accounted for part of the excess near the surface in the uncropped as compared with the cropped land.

The difference between the amounts of water retained at the depths examined by the uncropped and the cropped ground, at points only a few feet apart, is very striking; and that it should be greater in the upper portions of the subsoil, which had probably contributed more to the exigencies of the growing crop than the lower layers, is what would be expected. The percentage of water in the subsoil even of the cropped land was very high—indeed nearly as high at corresponding depths as in that in the experimental wheat-field in January, 1869, when it was supposed to be in a state of saturation; whilst the amount in the subsoil of the uncropped land was not only considerably higher than in that of the cropped land, but considerably higher also than in that of the saturated wheat soil. We shall recur presently to the difference in the percentage of moisture in the soils and subsoils of the different fields which have been referred to, but must first direct attention to the more special application of the results now under consideration.

The following Table shows the number of tons of water per acre retained to the total depth of 54 inches, or $4\frac{1}{2}$ feet, by the uncropped and the cropped land, and the difference between the two. The upper line gives the amounts calculated according to the actual weights of the measured samples of soil (exclusive of stones), and the lower line the amounts, assuming that (exclusive of stones), the dry or barley soil would weigh 18, and the wet, uncropped or fallow soil $19\frac{1}{2}$ million lbs., to the depth of 54 inches:—

TABLE X.—Tons of Water per Acre to the depth of 54 inches, in Fallow Land, and in Land Cropped with Barley.

Samples collected June 27th and 28th, 1870.

| | WATER PER ACRE. | | |
|---|---|---|---|
| | Fallow Land. | Barley Land. | Difference. |
| | Tons. | Tons. | Tons. |
| According to experimentally determined weights of soil .. .. .. .. .. | 2875 | 1951 | 924 |
| According to assumed average weights of soil .. .. .. .. .. .. .. | 2668 | 1775 | 893 |
| Mean .. .. .. .. .. | 2772 | 1863 | 909 |

On whichever basis the calculation is made, the indication is that there were about 900 tons less water per acre in the soil and subsoil, to the depth of 4 feet 6 inches, where the barley had grown than where the land was fallow. It may be, that part of the excess in the uncropped land was due to the shelter from surface evaporation since the last preceding heavy rain, by the laying of soil upon it for a few days, as above referred to. But even supposing a liberal deduction on this account, the evidence would still point to the conclusion that there had been a higher rate of exhalation by the growing crop than 300 parts of water for every 1 part of dry substance fixed; for it may safely be assumed that the dry matter of the crop at the time of the experiment would be under rather than over 2 tons per acre, which, at the rate of 300 parts to 1, would only account for an exhalation of 600 tons of water per acre. Further, since there was such a great difference in the percentage of moisture in the two cases at the lowest depth taken, it is only reasonable to conclude that the difference extended lower still.

To conclude, in reference to these particular experiments, it is clear that we have in the facts adduced sufficient evidence, and a striking illustration, of the enormous extent to which, in a time of drought, our crops may rely upon the supplies of moisture previously stored up within the soil. At the same time it cannot fail to be recognised how dependent must be the result upon the character of the soil and the subsoil with which the farmer may have to deal.

## Summary, and General Observations.

Leaving detail, it will be of interest to summarise the results illustrating the difference of effect of the drought of the past year on the different crops, and also to bring together those relating to the amount of water retained by the soils and subsoils of the different fields, under the various conditions as to season, manuring, and cropping.

It has been already said that although the summers of both 1868 and 1870 were seasons of drought, yet, chiefly owing to the facts that the deficiency of rain commenced later, and the temperatures ruled higher in 1868, there was in reality considerable difference in the characters of the periods of growth of the two seasons, and in their consequent effects upon the different crops. To save space, however, we will confine attention here to the effects on the different crops of the more continued drought of 1870.

Table XI. shows the average annual produce obtained, under selected conditions as to manure, of hay, of wheat, and of barley; also the produce of each in 1870, and the deficiency compared with the average. In the case of the hay, the average is taken over 15 years, and in that of wheat and barley over 19 years. For simplicity of comparison, the produce is, for all three crops, given in lbs.; and the figures relating to wheat and barley represent the total produce, corn and straw together—which, of course, more clearly indicates the total amount of vegetable growth, compared with that of the hay, than the records of corn and straw separately would do.

Table XI.—Produce of Hay, Wheat, and Barley in 1870 compared with the average.

| | Hay; 15 Years. | Total Produce, Corn and Straw. | |
|---|---|---|---|
| | | Wheat; 19 Years. | Barley; 19 Years. |
| **Without Manure.** | | | |
| | lbs. | lbs. | lbs. |
| Average produce per acre per annum .. .. | 2391 | 2398 | 2453 |
| Produce in 1870 .. .. .. .. .. .. .. | 644 | 2002 | 1489 |
| Deficiency in 1870 .. .. .. .. .. | 1747 | 396 | 964 |
| **With Farmyard Manure.** | | | |
| Average produce per acre per annum .. .. | 4604* | 6016 | 5856 |
| Produce in 1870 .. .. .. .. .. .. .. | 1556 | 5092 | 4949 |
| Deficiency in 1870 .. .. .. .. .. | 3048 | 924 | 907 |
| **With Mixed Mineral Manure and Ammonia-salts.** | | | |
| Average produce per acre per annum .. .. | 5794 | 6267 | 5786 |
| Produce in 1870 .. .. .. .. .. .. .. | 3306 | 5836 | 4287 |
| Deficiency in 1870 .. .. .. .. .. | 2488 | 431 | 1499 |

It is remarkable that, notwithstanding the great fluctuation in the amounts of produce of each of the three crops from year to year according to season, and also the difference in the degree in which each will vary from the average in one and the same season, still, when the average is taken over a considerable number of years, hay, wheat, and barley, are seen to yield *without manure* almost identically the same average weight of produce per acre per annum. On this point it should be mentioned that the second crop of grass is never removed from the land, being either consumed on it by sheep having no other food, or mown and left to rot as manure. The deficiency without manure, due to the drought of 1870, is seen to be 1747 lbs. of hay, 964 lbs. of barley (corn and straw), and only 396 lbs. of total produce of wheat. Thus, the deficiency was much the greatest in the hay; there being a reduction in its case by nearly three-fourths, in that

* For the hay crop, farmyard manure was only applied in the first 8 years; but the average produce is taken over the 15 years.

of the barley by scarcely two-fifths, and in that of the wheat by only about one-sixth, compared with average amounts.

For the hay-crop, farmyard manure was only applied during the first 8 years of the 15; but as the average produce was as great over the succeeding 6 years without the manure, as over the first 8 years with it, and as there was a heavier crop in 1869 than in any of the preceding 13 years, the deficiency in 1870 compared with the average, may be taken as at any rate mainly due to the drought, and but little to the cessation of the manuring. The figures as they stand show, as without manure, again, a much greater deficiency than in either wheat or barley; the crop amounting in fact to only one-third the average. Of total produce of wheat and barley, there is, with farmyard manure, again nearly the same average amount over 19 years in the two cases. The deficiency in 1870 compared with the average is also very nearly the same with the autumn-sown wheat and the spring-sown barley; amounting in each case to scarcely one-sixth. In the wheat the reduction is actually much greater, but in proportion to the average, only about the same as without manure; but in the barley it is actually less, though in proportion to the average very much less, than without manure. The greater power of retention of water which a dunged soil has been shown to possess in its upper layers, has doubtless much to do with the result.

With the artificial mixture in the case of the hay and the wheat supplying 400 lbs., but in that of the barley only 200 lbs. of ammonia-salts per acre per annum, there is not the same uniformity in the average annual produce of the three crops; the wheat giving nearly 500 lbs. more gross produce than the hay with the same amount of ammonia applied, and the barley about the same as the hay, with only half the supply of ammonia-salts. The deficiency in 1870 amounts, in the hay to more than two-fifths, in the barley to rather more than one-fourth, and in the wheat to little more than one-fifteenth, compared with the average.

Thus, then, with a drought extending over the months of April, May, June, and July, the mixed herbage of permanent meadow land suffered, under the different conditions of manure in question, very much more than either wheat or barley; and the spring-sown barley suffered, both without manure and with the artificial manure, very much more than the autumn-sown wheat. With the farmyard manure, however, the barley would appear to have been as little adversely affected by the deficiency of rain during the period of actual growth as the wheat. We need not here again refer to the special conditions already explained, under which the hay crop was as little, or less, affected by the drought than the other crops.

The difference between the conditions of growth of the chiefly perennial (or biennial) plants composing the complex mixed herbage of permanent meadow land, and those of an annual, like wheat or barley, sown at a stated period of the year in arable land, and having a fixed, and in the case of barley only a limited time for distributing its underground feeders, and so availing itself of the resources of nutriment and moisture within the soil, are obviously very great.

The perennial, or biennial, character of most of the plants composing the mixed herbage, would seem at first sight to give the grass a great advantage over the corn crops. But observation shows, that although the immediately superficial layers of the soil may be more thoroughly penetrated by the roots of the perennial grasses than by those of either wheat or barley, yet it is only a very few of the former, encouraged to great predominance only under special conditions, that seem to get anything like the same possession of the lower layers of the soil as the two corn crops. Careful examination has also shown, and it is probably generally assumed, that the winter-sown wheat secures possession by its underground feeders of a more extended range and greater bulk of soil, and consequently is better able to avail itself of the supplies of food and moisture existing below a certain limited depth from the surface, than the spring-sown barley. The wheat-plant, indeed, has the advantage of making root, more or less according to season and manure, throughout the winter months, during periods of which, at any rate, the soil will be saturated with moisture; and in the case of moderately retentive and well drained soils, it will be able to establish its independence of rain falling during the period of active above-ground growth, very much more than will a spring-sown crop like barley.

But there are other points of distinction between the growth of the corn and the hay crops. Thus, most of the grasses, which comprise the greater proportion of the latter, flower earlier than the wheat or the barley; and the mixed herbage is cut by, or before, the end of June, when very little, if any of it, has arrived at the degree of ripeness in which the corn crops are cut. These, on the other hand, are not only allowed fully to ripen, but direct experiments made at Rothamsted upon wheat have shown that a very large proportion, probably about half, of the total dry vegetable substance, or of the total carbon of the crop, is fixed in it under the influence of the greater power of the sun's rays after the time at which the hay crop is usually cut.

These facts are obviously an element in the explanation of another fact, to a certain extent commonly recognised, and which a careful comparison of the results of the field experiments at

Rothamsted, with the records of the conditions of heat and moisture under which the crops have been grown, brings clearly to view—namely, that, as compared with the hay crop, the corn crops are not only less dependent on the amounts of rain falling during the period of active vegetation, but more on a relatively high degree of temperature during that period. This is more strikingly the case when wheat is grown by means of readily soluble mineral and nitrogenous manures, than when it is grown without manure, or with farmyard manure. Without manure the produce is comparatively more dependent on the amount of certain constituents brought down by the rain, or rendered available by its means from the stores of the soil itself; and it would seem that where farmyard manure is employed, a considerable amount of rain is required during the early growing period to aid its decomposition, and so to set free, distribute, and render available, its fertilising constituents. In the case of the artificial manures, on the other hand, some of the most active fertilising constituents are supplied in a much more soluble form, and require a less amount and continuity of rain for their solution and distribution throughout the pores of the soil within a given range.

It is seen, then, that several reasons concur to render corn crops less dependent on the fluctuations in the amount of rain falling during the period of active vegetation and accumulation of substance than is the hay crop growing under otherwise parallel conditions as to soil and manure. It is quite intelligible, too, that the autumn-sown wheat, with its much longer time for the formation and distribution of root, and its tendency to develop proportionally more in the lower and proportionally less in the upper layers of the soil, than the spring-sown barley, should be less adversely affected than the latter by a deficiency of rain during the period of active above-ground growth.

Table XII. brings together at one view the percentage amounts of water retained by the soils and subsoils of the different fields, under the various conditions as to season, cropping, &c. The results so summarised relate to samples collected as under:—

1. From the experimental wheat field, just before harvest, 1868; mean of three plots differently manured.
2. From the experimental wheat field, in January, 1869, when the land was supposed to be saturated; mean of the same three plots differently manured.
3. From uncropped land, near the end of June, 1870.
4. From land cropped with barley, closely adjoining the uncropped land; samples collected at the same date, end of June, 1870.

5. From permanent meadow land, in July, 1870, after the removal of the crop; mean of three plots differently manured.

TABLE XII.—Summary of Percentages of Moisture in Soils and Subsoils from different Fields, and under different conditions as to Season, Cropping, &c.

| Depths of Samples. | EXPERIMENTAL WHEAT FIELD. | | BARN FIELD. Samples collected, June 27th and 28th, 1870. | | PERMANENT MEADOW LAND. |
|---|---|---|---|---|---|
| | Samples collected, July, 1868; Mean of Plots 3, 2, and 8*a*. | Samples collected, Jan. 6th and 7th, 1869; Mean of Plots 3, 2, and 8*a*. | Uncropped Land. | Land Growing Barley. | Samples collected, July 25th and 26th, 1870; Mean of Plots 3, 9, and 14. |
| First 9 ins. | 6·23 | 27·17 | 20·36 | 11·91 | 11·99 |
| Second 9 ,, | 11·19 | 22·70 | 29·53 | 19·32 | 11·77 |
| Third 9 ,, | 15·02 | 25·27 | 34·84 | 22·83 | 17·11 |
| Fourth 9 ,, | 16·13 | 25·65 | 34·32 | 25·09 | 19·32 |
| Mean 36 ,, | 12·14 | 25·19 | 29·76 | 19·79 | 15·05 |
| Fifth 9 ,, | .. | .. | 31·31 | 26·98 | 20·67 |
| Sixth 9 ,, | .. | .. | 33·55 | 26·38 | 21·49 |
| Mean 54 ,, | .. | .. | 30·65 | 22·09 | 17·06 |

The special application of the detailed results having been already fully considered, attention must be confined here to the more general indications only of the foregoing summary.

In the first place, it should be observed that all three fields have a subsoil of reddish yellow clay, resting upon chalk, at a varying depth, but of not many feet from the surface. All, therefore, have good natural drainage; and it is very seldom that any water collects in the furrows, and then only for a very few hours. The experimental wheat field is, however, pipe-drained at a depth of about 30 inches, and at a distance of about 25 feet from drain to drain.

It is of interest to observe that there is no wide difference in the amount of water retained at corresponding depths in the experimental wheat-field in July 1868, when the crop was nearly at maturity, and in the permanent meadow land in July 1870, after the removal of the hay crop. The percentages are, however, rather lower in the drained land; which, at the time, had probably supported a higher average amount of produce also.

Towards the end of June 1870, the undrained arable land, which then carried a crop of growing barley, representing perhaps from 1½ to 2 tons of dry substance fixed, retained only about the same amount of water near the surface as the meadow land in July 1868; but, lower down, it held considerably more than either the drained wheat land in July 1868, or the undrained meadow land in July 1870.

It is remarkable that the uncropped and undrained land, though retaining much less water within 9 inches from the surface, from that point downwards retained, in June 1870, considerably more at every stage than the drained wheat soil in January 1869, when the drains were running, and the land was supposed to be saturated. From this comparison, it is obvious that no safe conclusion can be drawn from the percentage of water in the subsoil of the uncropped but undrained land, as to the probable amount retained by the subsoil of the drained land at the commencement of active vegetation in the spring. The amount retained in the subsoil of the uncropped and undrained land is indeed enormous; but the comparison of it with that in the adjoining cropped land shows clearly enough that it was readily available for the purposes of vegetation. In reference to this latter point, the fact of the good natural drainage by the chalk must not be overlooked.

There is, upon the whole, general consistency in the results brought together in Table XII. It may, perhaps, safely be concluded that, notwithstanding the natural drainage by the chalk, the pipe-drains had contributed to reduce the percentage of moisture retained by the subsoil of the experimental wheat field, to the depth examined; but that they had, at the same time, rendered the clay more permeable by roots, and the water that was retained more readily available. The evidence is, at any rate, very striking as to the degree in which, in a time of drought, our crops are enabled to rely upon the water previously accumulated within the subsoil—provided the latter be of sufficient depth, of sufficient retentive power, and at the same time sufficiently permeable.

Before concluding, it will be well to call attention to a very important bearing of some of the results adduced. Assuming, as we may be allowed to do for the sake of illustration, that a good crop of hay, wheat, or barley, will probably exhale not less, and perhaps more, than 700 tons of water per acre during growth, we still have only about 7 inches of rain, out of an average annual fall of say 25 inches, thus directly disposed of by the growing crop; and, taking the amount retained by the soil itself as practically a constant quantity from year to year, there remains to be disposed of by evaporation from the surface, and by passage into the drains or otherwise beyond the reach of the roots of the crop, an average of about 18 inches of rain annually, equivalent to more than 1800 tons of water per acre.

How much of this large quantity of water passes off by evaporation from the surface of the soil itself, inducing by capillary action the withdrawal of water, carrying with it, it may be, essential plant-food, from the lower to the upper layers of the soil?—or, how much passes downwards, carrying in solution any manurial matters in excess of the quantity which can be absorbed and retained within the pores of the soil and the upper layers of the subsoil?

These questions cannot be so satisfactorily answered in regard even to any particular soil, or season, as is desirable; and could they be so, the answers would vary greatly with variations of soil and season. As already stated, direct experiments are now in progress at Rothamsted with the view of acquiring useful data on this subject. With regard to the results hitherto obtained, it may be remarked that, from September 1st to December 31st, 1870, that is, commencing after the unusual drought of the preceding summer, it was found that, out of a rainfall of about 10·5 inches within the same period, about 50 per cent. had passed below a depth of 20 inches, about 40 per cent. below 40 inches, and about 20 per cent. below 60 inches from the surface. Calculation further showed that, even supposing there were some accumulation during August, still, a very large proportion of that which did not so pass, would be required to bring the previously very dry soil to the point of saturation—judging this requirement from the results which have been already given bearing upon the point. That is to say, as would be expected, a comparatively small proportion of the rainfall was evaporated at that season of the year. Much more would, of course, so disappear taking the whole year round; the quantity varying considerably with the characters of the soil and the season.

Towards the end of the last century, Dr. Dalton * devised an apparatus for the determination of the proportion of the rainfall which passed off from the soil by drainage, and by evaporation, respectively. It consisted of a cylinder 10 inches in diameter, 3 feet deep, open at the top, and closed at the bottom; but having one small exit tube near the top, and another near the bottom, for the escape of water into bottles placed to receive it. The vessel was filled with earth, and sunk into the ground level with the surface, one side being left exposed for access to the bottles. He continued the experiment for three years, 1796-7-8, and found the drainage to average, over that period, 25 per cent., and the evaporation to be, therefore, equal to 75 per cent. of the rainfall. This was exclusive of any evaporation of dew, but inclusive of that resulting from vegetation, as the surface of the soil became, after the first year, covered with grass; a circumstance which, however, Dr. Dalton considered immaterial.

For eight years, 1836-1843, Mr. Dickinson, of Abbott's Hill, King's Langley, Herts,† experimented with a modification of Dalton's apparatus. The cylinder he employed was 12 inches in diameter, and 3 feet deep, but provided at that depth with a perforated bottom, and a receptacle beneath for the collection of

* Mem. Lit. Phil. Soc. of Manchester, vol. v., part 2.

† 'Journal of the Royal Agricultural Society,' vol. v.

the water; and there was an arrangement of tubes for the escape, and measurement, of the drainage water. Grass was grown on the surface of the soil in the cylinder. The drainage would doubtless be more free in the experiments of Mr. Dickinson than in those of Dr. Dalton; and the results, over 8 years, showed, with a less rainfall, a larger actual amount of drainage; the latter representing $42\frac{1}{2}$ per cent., and the evaporation, therefore, only $57\frac{1}{2}$ per cent. of the rainfall. This amount included, of course, the exhalation due to vegetable growth.

From results obtained by gauging the flow of water from pipe-drains, it has been concluded that a still larger proportion of the rainfall passes off by evaporation than that indicated by the experiments of either Mr. Dickinson or Dr. Dalton. But results obtained by deducting the amount passing through drains from the total rainfall may be judged to be quite untrustworthy, from the fact that, before the pipe-drains in the experimental wheat field had passed any water at all in the autumn of last year, the *drain-gauges* already referred to had indicated that, of the rain which had then fallen since the 1st of September, nearly 25 per cent. had passed below 20 inches, nearly 10 per cent. below 40 inches, and nearly 4 per cent. below 60 inches from the surface. It is clear, therefore, that the amount of water passing through artificial drains may be no measure whatever of the total quantity passing below the reach of the roots of growing crops.

In the admitted defect of satisfactory evidence from which may be deduced the probable average amount of evaporation from the surface of the soil independently of vegetation, we will assume, by way of illustration, that, taking the average of many soils and seasons, three-fourths of a total rainfall of 25 inches will pass off by the combined action of evaporation from the surface of the soil itself, and of the exhalation due to the growth of a good crop of hay or corn. On this supposition there would still remain more than 6 inches of rain, equivalent to more than 600 tons of water per acre, annually passing downwards, and carrying with it more or less of fertilising matters.

Fortunately, some of the most important mineral constituents of soils and manures are, in the case of the heavier soils at any rate, almost wholly retained by them within the range of the roots of our crops. Nitrogen, whether supplied in the form of ammonia-salts or nitrates, is, however, much less completely so retained, being, in whichever state supplied, carried off in greater or less quantity in the drainage water, chiefly in the form of nitrates. According to results obtained independently by Professor Frankland and Professor Voelcker, on the analysis of drainage water from the experimental wheat field at Rothamsted, that collected during the winter, from land manured in the autumn by an amount of ammonia-salts supplying 82 lbs. of nitrogen per acre, may contain from 2·5 to 3 parts, or even more, of nitrogen, as nitrates and nitrites, per 100,000 parts of water. Assuming that only 2·5 parts of nitrogen were so carried beyond the reach of roots for every 100,000 parts of water passing downwards, there would still be, for every inch of rain so passing, a loss per acre of between 5 and 6 lbs. of nitrogen, supplied in manure at a cost of not much less than 1*s.* per lb.

The above estimate of quantity must be understood to be adopted only provisionally, and by way of illustration. It is, however, a sufficiently near approximation to what must happen in the case of many soils and seasons at any rate, to show the very great importance of further investigating the reactions of various descriptions of nitrogenous manure on different descriptions of soil, and of determining the best modes, and the best periods of the year, for the application of such manurial matters, so as to reduce the loss by drainage to a minimum. This subject is now receiving attention at Rothamsted.

*Rothamsted, January*, 1871.

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## VI.—*Description of Ordinary and Improved Kilns for Burning Lime for Agricultural Purposes.* By CHARLES TURNER, C.E.

### PRIZE ESSAY.

### I. THE COMMON PERPETUAL KILN.

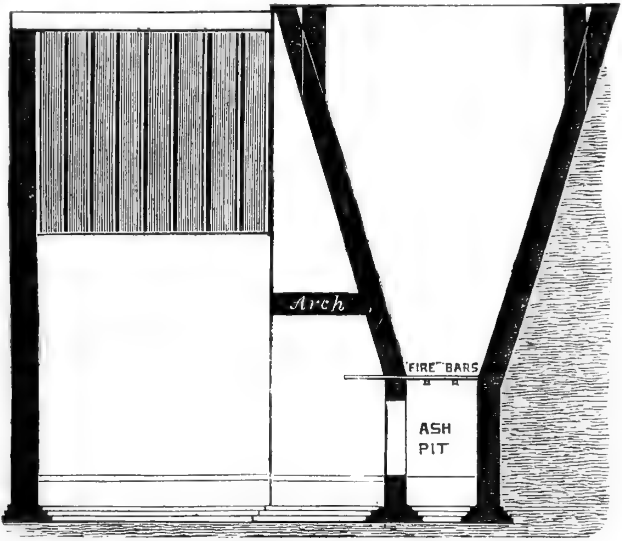
A KILN for burning lime, for agricultural purposes, is generally placed in the side of a chalk or limestone hill, to avoid expense in brickwork or masonry. The kiln itself, in its cheapest form, is an inverted truncated cone from 12 to 15 feet in diameter at the top, excavated out of the chalk or limestone rock, and lined on the inside with good hard bricks, capable of withstanding a considerable amount of fire. The lining should be from 1½ to 2 bricks thick, according to the size of the kiln, and filled in solidly at the back with hard chalk or limestone, set in mortar.

In the best kilns of this construction, the side walls are built upright for about 4 feet in depth, and then the cone is gradually tapered off to a diameter of 3 feet at the draught or draw-hole. The height of the cone is generally equal to the diameter at the top.

An arched opening is constructed in the exterior wall in front of the ash-pit, which should be sufficiently high to allow of a man standing upright, in order that he may get conveniently at the ends of the fire-bars when the lime is required to be drawn. Two strong cast-iron bars, called bearing-bars, 3 in. by 2½ in., are fixed into the brickwork in such a manner that they can readily be withdrawn when required: upon them lie the wrought-iron fire-bars (which should be circular in section, for a reason which I will afterwards explain) $1\frac{1}{2}$ inch diameter, with a space of about 1 inch between them. They should be formed with blunt points at one end, and the middle bars should have an eye at the other end, so as to enable a crowbar to be passed through them. It is better to make the middle bars about 1 foot 6 inches longer than the opening they have to cover, in order to obtain a firmer hold of them when they require to be withdrawn.

An opening should be left in the front wall of the kiln immediately above the fire-bars, which should be supported by a strong wrought-iron frame, 3 inches wide, securely built into the brickwork. This opening is for the purpose of gaining access to the interior of the kiln, in order to light the fire or to assist in removing the lime when it wedges itself together in a mass, and will not pass down through the fire-bars in the usual way.

Fig. 1.—*Section of Common Perpetual Kiln with central furnace.*




To start the kiln, a fire is lighted on the fire-bars, and as soon as it burns briskly enough, the hole already described is securely bricked up, and the fire fed with lumps of coal from the circular platform round the top of the kiln. When the fire is sufficiently ignited, lumps of chalk or limestone are, in like manner, thrown upon the fire, to a thickness of about 12 inches; and as soon as the fire appears to burn well through this layer, a layer of coal, and, shortly afterwards, another layer of chalk or limestone, are added; and, if the fire continues to burn well, the whole kiln may be filled with alternate layers of chalk or limestone and coal.

The proportion of coal to be used must be determined by trial, as it differs greatly according to the nature of the material, the size of the lumps, and the sort of coal used. On the average, chalk will burn if the proportions are 1 of coal to 7 of chalk; but, for limestone, they vary from 1 to $1\frac{1}{2}$ of coal to 6 of limestone.

When once the kiln is set properly going, it ought not to require any rekindling, but to continue in operation for months together, by supplying fresh materials at the top of the kiln as the lime is drawn away at the bottom. The kiln is usually drawn once every twenty-four hours, by drawing out the middle fire-bars; and as it is sometimes a difficult matter to start them, owing to the pressure, it is better to make them circular in section, so that, by introducing a crowbar through the eyes at the ends, they can readily be turned round, and partly freed from the pressure.

If the lime does not fall out easily it can be loosened by a bar, with the end turned up, which is introduced between the fire-bars and drawn backwards and forwards; or a few of the bricks can be withdrawn from the opening above mentioned for lighting the fire, and the lime forced down with a heavy bar. The lime is then drawn to the front of the archway with an iron hoe, and left till it is cool enough to be measured and run into the store-shed or carted away.

The drawing being completed, the fire-bars are driven back again into their places and left for another twenty-four hours, during which time the filling is continued on the top, as above mentioned. For this purpose it is desirable for the kiln to be so placed that a tramway may be laid over the top or along one side of it—preferably the latter, as it gives more opportunity for properly spreading the alternate layers of coal and calcareous material. It is better also to have a broad platform round the top of the kiln, to give room for depositing a quantity of coal, as it can seldom be unloaded direct from the truck.

Some kilns have been constructed with an inverted truncated cone placed, by way of a shaft, upon the under cone (Fig. 2), in order to retain the heat, and an arched opening in the outer wall for the purpose of feeding the kiln. From experience obtained in carrying out the same principle with brick-kilns, I am of opinion that very little advantage is gained by such an arrangement, unless an inner flat crown, pierced with holes, is also constructed upon the under cone before the upper cone is carried up (Fig. 3). It would, however, be extremely expensive, and, in fact, almost impossible, to carry out the proper system of loading a kiln of this description with such an arrangement.

Kilns have also been constructed of an elliptical instead of a conical section, or, to speak more correctly, of an egg section with the two ends cut off. This section has no doubt some advantages, as it conducts the heat better to the top of the kiln, and also, to some extent, assists the descent of the lime; but it necessitates the construction of two draught-holes, one at each end of the ellipse, which are not always easy to arrange when the kiln is built in the side of a hill. The same object may be obtained by constructing the upper part of the internal walls perpendicular, as above mentioned, and slightly diminishing the inclination of the cone just above the fire-bars.

Fig. 2.—*Section of Common Perpetual Kiln, with Shaft of inverted truncated cone.*

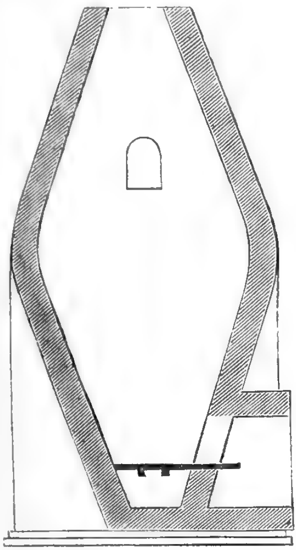
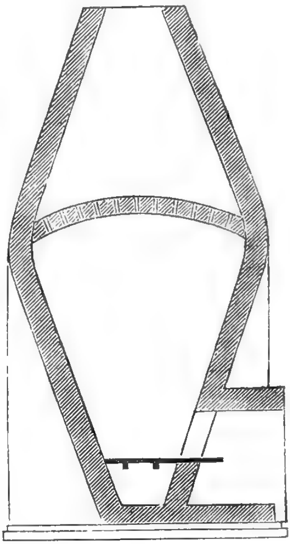


Fig. 3.—*Section of Common Perpetual Kiln with inner crown.*



The advantages of the common perpetual kiln may be stated to be:—

1st. The simplicity and economy of its construction.

2nd. The small amount of skilled labour required in managing it, as, after the proportion of fuel to material has been once ascertained, the subsequent working is merely a matter of rule.

3rd. The saving of fuel, by the kiln being kept constantly hot;

4th. The man who attends to the kiln is only required to spend a portion of his time there, and can in the interim attend to other business.

The disadvantages are:—

1. The difficulty of calcining the lime sufficiently without a great additional expenditure of fuel.

2nd. The impossibility of using wood fuel for the purpose.

3rd. From the nature and construction of the kiln, it is only applicable when a large quantity of lime is constantly required.

4th. That in agricultural districts some portion of the lime is generally required for building purposes, and that lime burnt in this manner is generally not well suited for such purposes, as it usually contains cinders and other refuse from the coal.

I have found in practice that it is better, instead of merely trusting to a brick lining to the conical hole cut in the chalk or limestone, to build five counterforts round the kiln, and to fill in the spaces between them with lumps of chalk or limestone built in mortar, as, unless the hill is of an unusually solid character and impervious to water, the conical brick lining is very apt to expand and crack with the heat.

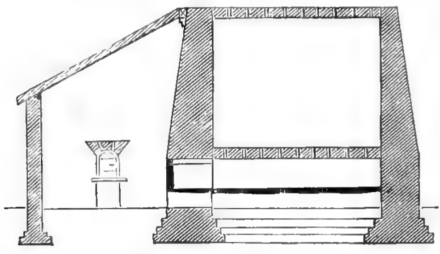
## II.—The Intermittent Kiln.

In this description of kiln the fuel is not mixed with the material used, but is placed in a furnace either at the side or bottom of the kiln, and always laid upon a grating of fixed fire-bars, being replenished from time to time, until the whole of the material in the kiln has been properly calcined.

As soon as the kiln arrives at this state it is allowed to cool down gradually, and the whole of the charge is withdrawn when it is cool enough to handle.

These kilns are built of various forms, and are generally, like the "Perpetual Kilns," constructed, if possible, on the side of a hill. They are most commonly rectangular, similar to the "Brick Kiln," about 14 feet wide, 12 feet deep, and from 9 feet to 10 feet high, internally, from the floor to the top.

Fig. 4.—*Section of Intermittent Kiln.*



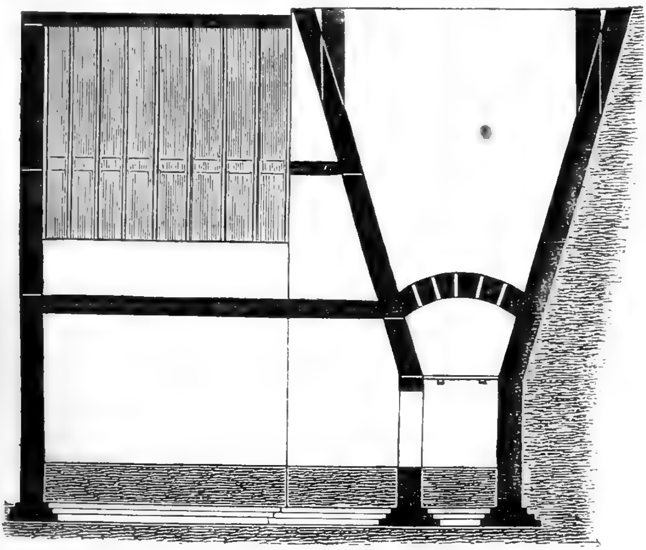
The walls should be 3 feet thick, lined on the inside with fire-brick. The outer wall need not be solid, but may be constructed with 3-feet buttresses in brickwork, an 18-inch lining on the inside, and the space in the outside between the buttresses filled in solidly with lumps of chalk or limestone set in mortar. Three fire-holes are constructed from front to back of the kiln, 1 foot 6 inch. wide, 1 foot 6 inch. high from the bottom of the ashpit to the under side of the bearing-bars, and 1 foot 9 inch. high from the top of the bearing-bar to the under side of the arch. The bearing-bars should be of cast iron, 3 inch. square, and 1 foot 6 inch. apart from centre to centre. The fire-bars should be 3 feet long, $2\frac{1}{2} \times 1\frac{1}{4}$, and $\frac{3}{4}$ inch apart. There should be a cast-iron door fitted into a wrought-iron frame 3 inch. wide, to close the mouth of the fire-holes. The arch over the fire-holes should be 9 inch. thick, with holes left at the top and sides at intervals of 14 inch., 3 inch. wide, $4\frac{1}{2}$ inch. long on the inside of the arch, spreading as they approach the floor of the kiln. Other courses of open work are built on the top of these holes, so as to convert the floor of the kiln into a chequer of holes with $4\frac{1}{2}$-inch work between them.

The kiln is filled by packing lumps of chalk or limestone over the floor, taking care to leave as wide spaces as possible over the holes, so that the fire may draw well through the mass. These courses should be about 6 inches thick at the bottom, diminishing to 4 inches after five or six courses have been laid; when the kiln is about two-thirds full, the remainder of the charge may be tipped in from the top, and spread over the surface.

A kiln of this size requires about thirty-six hours to get to the full heat, 12 or 14 hours full heat, and 36 hours to cool down before the lime can be drawn.

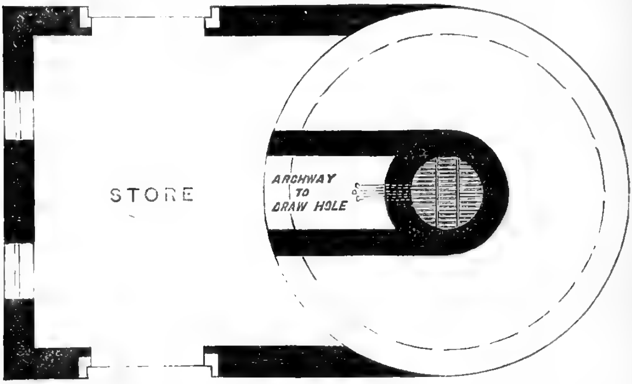
It is better to cover over the top of the kiln with two courses of burned bricks, leaving sufficient draught-holes for the heat to escape; but with every precaution it is scarcely possible to burn the uppermost 12 inches of the charge to the proper pitch, and it is usually burnt over again in the next kiln.

Fig. 5.—*Section of Circular Intermittent Kiln with central furnace.*



A better form for this description of kiln is, in my opinion, one similar in section and size to the "Perpetual Kiln," making use of a circular open grating, cast in segments as a fire-grate, for one central furnace domed over to form the floor of the kiln, with brickwork 9 inches thick springing 15 inches above the fire-grate and rising 1 foot 9 inches. The furnace should be 3 feet diameter at the top of the fire-grate; and the dome or the floor should be pierced with radiating holes, $4\frac{1}{2}$ inches by 3 inches, to allow the fire to pass through.

Fig. 6.—*Plan of Circular Intermittent Kiln with central furnace.*




The bricks would be required to be made on purpose, and should all be laid heading. The kiln should be filled and packed in the same manner as that last mentioned, and covered over on the top with two courses of burnt bricks in a similar manner.

I have never tried a kiln constructed in this manner; but I feel sure that it would answer well, and I think it would save one-third of the fuel, as compared with the last mentioned kiln, besides burning the lime much more evenly.

Both of the last described kilns may be roofed or domed over, but in both cases the expenditure would be very much greater, without, as far as I can see, any corresponding advantage; and the labour of filling the kiln would be very much increased.

If the kiln is built entirely into the side of a hill, it is necessary to construct a floor over the kiln pit to form an approach to the hatchway; and if this floor is roofed over it will form a dry and commodious lime store.

Wood fuel may be used instead of coal in these kilns, and when used it is not necessary to have any fire-grate, as the wood fuel requires but very little draught.

The advantages of this description of kiln may be stated to be :—

1. That the whole of the lime, with a very small exception, is thoroughly calcined.

2. That no stones, cinders, or other impurities, are found mixed up with the lime.

3. That if the kiln described, with the central fire, is used, the saving of fuel will be fully one-fourth over the best "Perpetual Kiln."

The disadvantages are:—

1. That the upper 1 foot 6 inches of the lime can never be properly calcined.

2. That the labour of setting, burning, and drawing these kilns is considerably greater, and, therefore, more expensive than that required for the perpetual kilns.

3. That when a large and constant supply of lime is required, the quantity produced is very much less than by the perpetual kilns.

4. That the cost of building these kilns properly is considerably greater than that of the perpetual kilns.

### III. The Intermittent or Perpetual Kiln.

The third description of kiln used for lime-burning is one much less generally known than the two already described. Properly speaking it is a perpetual kiln, but it is heated by furnaces from beneath. It can be most advantageously used as a perpetual kiln, by supplying the material to be calcined at the top, and withdrawing it at the bottom; but, in a form I will describe, it may also be used as an "Intermittent Kiln" by filling the kiln, and withdrawing the charge, when the burning is completed, altogether through the hatchway.

These kilns cannot be built in the side of a hill, but they must be so constructed as to be accessible on all sides. They usually have a circular or hexagonal shaft in the centre, from 40 to 60 feet in height, varying from 7 feet to 10 feet in diameter, and tapering from the top to the middle, and again from the middle to the fire-grate. From 3 to 5 furnaces are constructed round the outside of the shaft, the fire-grates, which are generally constructed of perforated fire-tiles, being made sufficiently large to span from wall to wall, or being supported on iron bearers. The fire passes out of the furnace through a hole in the end wall into the centre shaft.

The withdrawing holes, or hatchways, are situated between and below the ash-pits of the fire-holes; and are closed by cast-iron doors to prevent unnecessary cooling of the kiln. The floor to the fire-chamber forms the roof to the withdrawing floors. The hatchways are widened from the centre towards the outside, and are also inclined outwards to facilitate the withdrawal of the lime. Iron doors are made in the ash-pits, through which the ashes are allowed to fall on to the floor on which the lime is withdrawn. Ventilating pipes should be carried from this floor, through the firing-chamber, to relieve the workmen from the great heat while the lime is being withdrawn. The fuel used in these kilns is wood, 1 lb. being required to burn 3 lbs. of lime; but coal is also used in the variety of kiln possessing a combustion-chamber. The kiln is charged by filling it with lime up to the height of the draught-holes, in which the fire is lighted and kept burning, and, when this charge is thoroughly burnt through, the kiln is completely filled, the limestone being first packed in courses and then thrown in from the top. The fire is then drawn back from the draught-holes on to the fire-grates, and the work of the kiln proceeds, the limestone being thrown in from the top, and withdrawn from the bottom when burnt.

These kilns are usually drawn every 12 hours, a similar lapse of time being required to enable the lime to cool down sufficiently to allow it to be removed. They are sometimes constructed with one fire-grate and a combustion-chamber, where a considerable amount of air is supplied by draught-holes behind the bridge, and the fire is brought to a very great intensity before it enters the shaft of the kiln. In some kilns the withdrawing floor for the lime is constructed at such a level that a railway truck can pass underneath it to be loaded with lime.

In all cases it is necessary to construct a bridge, with a tramway laid upon it from the chalk or limestone hill to the top of the shaft, to supply the materials to the kilns; and a good road should be formed, at the level of the withdrawing floor, to convey away the lime and ashes, and to bring in the fuel, which can be raised by a simple lift to the floor above.

## IV.—Improved Perpetual Kiln.

I will now describe a kiln of my own invention, not specially designed for the purpose of burning lime, but for the purpose of drying clay previously to grinding for fire-brick making. A few slight modifications, however, will adapt it to the purpose of lime-burning, and I will describe it with such alterations.

It will be seen that it answers to the sort of kiln I referred to in commencing the description of the perpetual kilns heated by fires from beneath; and that it can either be used as a perpetual kiln, from which a large and continuous supply of lime can be drawn, or as a perpetual kiln with a moderate supply, or, in like manner, as an intermittent kiln, from which either a large or moderate charge can be drawn.

The form and dimensions are particularly shewn in Figs. 7

and 8, and a perspective view, shewing the general arrangement, is given in Fig. 9.

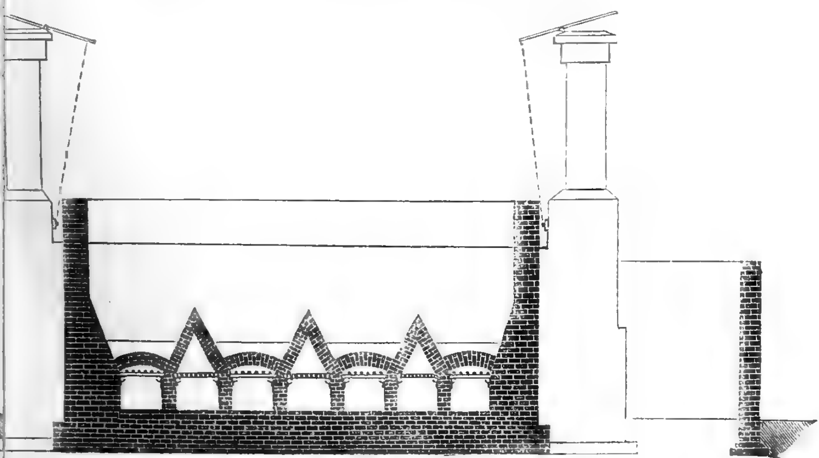
It will be seen by the drawing that the kiln cannot be built in the side of a hill, but must have a free passage all round it.

The kiln is of a rectangular form, with angular buttresses at the quoins and centre buttresses at the ends; the chimney-flues form the buttresses at the sides, and the end buttresses support the roof of the kiln-pit, with archways through them on one side leading to the lime store; this extends along the one side of the kiln, with sliding doors in the centre to allow a cart to back inside it to load in the dry. The other side of the kiln is occupied by the approach road, or tramway, from the chalk or limestone hill, and the kiln-pits extend across both ends. The width of the kiln depends upon the number of fire-holes, *e. g.*, a three-hole kiln requires to be 17 feet 6 inches wide. It should never be more than 13 feet 6 inches deep, as it is inconvenient to draw the fire-bars if they are more than 4 feet long. The height of the kiln should be from 7 feet 6 inches to 9 feet above the fire-grate. The walls should be 2 feet 3 inches thick, and should be held together by two wrought-iron bands with adjustable couplings.

It will be seen, from Fig. 7, that for a three-hole kiln there are four withdrawing holes, situated between the fire-holes.

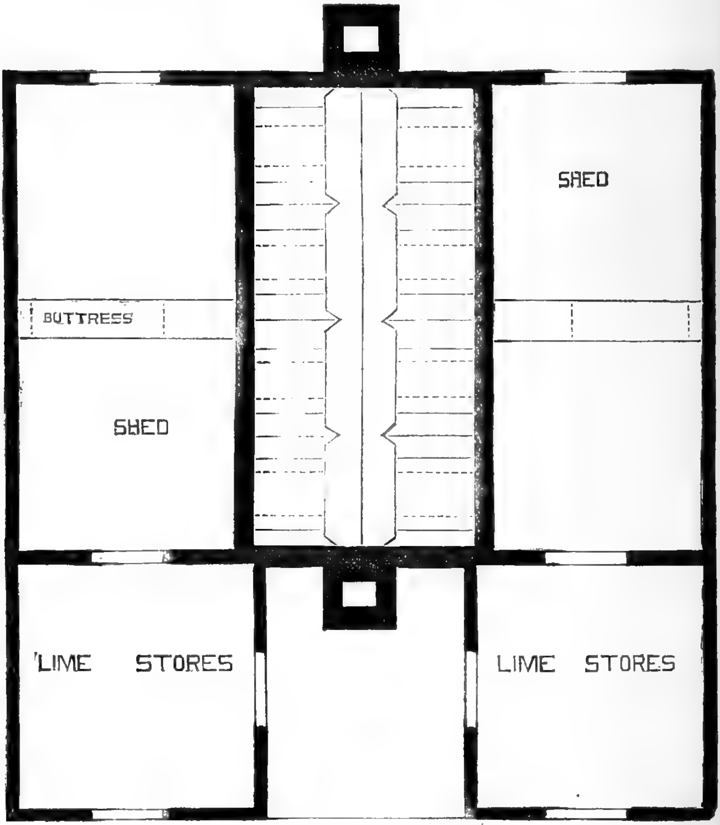
The fire-grates for the fire-holes are constructed with cast-iron, rectangular, fish-bellied fire-bars, resting on bearing-bars as in the fire-grates for the intermittent kilns before described. The withdrawing holes are constructed of wrought-iron circular fire-bars, $1\frac{1}{4}$ inch diameter, 1 foot apart, resting on cast-iron bearing-bars, which, except the centre ones, are parallel, and on which are cast a series of lugs perforated with circular holes through which the

Fig. 7.—*Section of Improved Perpetual Kiln.*



fire-bars pass, and are guided in withdrawing them and driving them back. In front of the outer bar is also a cast-iron plate, supported on brackets, on which the fire-bars rest when drawn forward. The openings to the fire-holes and the withdrawing holes are closed by double cast-iron doors, hung in wrought-iron frames.

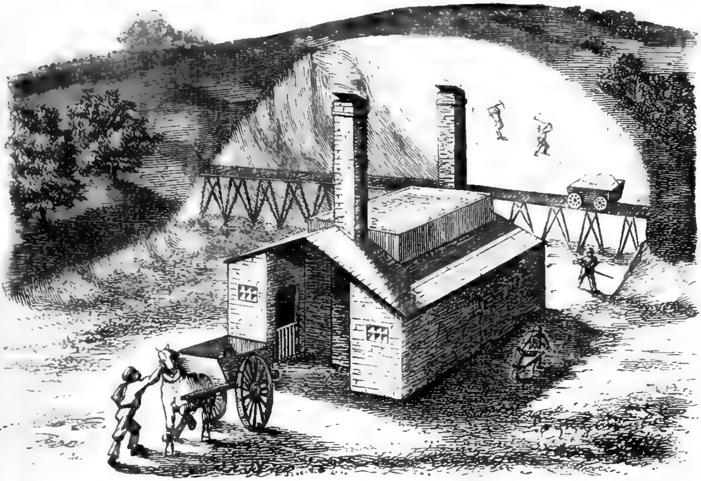
Fig. 8.—*Ground-plan of Improved Perpetual Kiln.*




Cast-iron skewback plates are laid upon the walls separating the fire-holes and withdrawing holes, to prevent the spreading of the fire-lumps which cover the fire-holes. These lumps are formed in one piece, 30 × 18 × 4 inches, with half-circular holes 2 inches diameter on their edges, so as to form draught-holes 2 inches diameter when jointed together. Each lump is either formed with a tenon or a mortice at the end, so that they may joint securely together when fixed in place.

The centre flue is covered with fire-lumps in a similar manner, except that the lumps are of larger size. The ends open into the chimney-flues, which are 2 feet square at the bottom and 2 feet 3 inches square at the top. The skiveplates are 2 feet 6 inches square, and the chain attached to the skiveplate lever is carried over a roller in the kiln-pit, and is so arranged that the skiveplate can be opened or closed at either end of the kiln.

Fig. 9.—*View of Improved Perpetual Kiln.*



The kiln is lined with firebrick, 9 inches thick, for 4 feet above the fire-bars, and the whole of the work about the fire-holes is built with fire-brick. The kiln-pits should be constructed with lean-to roofs, with louvre openings at the highest part to let out the heat while the lime is being drawn. A T iron bar should be carried across the pits, supported at both ends; on this a double roller runs backwards and forwards, carrying a link at the end of the spindle and terminating in a hook, from which is suspended an iron-wire basket, into which the lime is loaded to remove it to the store. The basket is drawn backwards by an endless line, and would be arranged to tip itself in passing over the partition between the kiln-pit and the store-shed. A similar bar and travelling carriage would also be used for loading the carts from the store-shed.

The kiln is set in a similar manner to a perpetual kiln, more limestone or chalk being added at the top to replace the burnt lime, which is continually withdrawn at the bottom. It may also be set and burnt as an intermittent kiln, the whole charge being withdrawn by the hatchway at one time. Either a large or small constant supply may be drawn from the kiln, when acting as a perpetual kiln, by regulating the fires. The kiln can be kept going very steadily for many hours, or even days, by light stoking, opening the skives only a small distance and closing them as soon as the smoke has burned off; or by frequent heavy stokings, opening the skives wide, and keeping them open for a short time after the smoke has burned off.

The fires may be raised from a low red heat to a heat sufficient to calcine lime in a very few hours. The kiln may be drawn every 6, 12, 24, or 36 hours, and the lime will take 12 hours to cool before it can be removed or stored.

The proportion of fuel consumed to lime produced would be, as nearly as I can calculate, as 1 to 10 for chalk lime, and 1 to 7 for stone lime.

The advantages of this form of kiln would be:—

1st. That all the lime would be thoroughly calcined.

2nd. That no dirt or cinders would be found amongst it.

3rd. The easy way of regulating the fires, and the quantity of lime to be produced in a given time.

4th. The probable large economy of fuel.

The disadvantages, as compared with a common perpetual kiln, would be:—

1st. The increased cost of the first erection, though this would be very small as compared with other perpetual kilns heated from the bottom.

2nd. The extra trouble and time required in attending upon the fires.

## V.—Conclusion.

I have now completed my description of the various sorts of kilns applicable for burning lime for agricultural purposes, and have only to draw attention to one or two of the chief points in connexion with the application of the lime to the land, so as to give agriculturists the means of calculating the cost, and thus enable them to decide whether it would be better for them to purchase the lime, or to construct kilns for burning lime for themselves.

These points are, 1st., and by far of the greatest importance, the description of material yielded by the various lime districts, the weight per bushel, the number of cubic feet per ton, the proportion of lime produced to fuel consumed, the price per bushel at the nearest station, and other useful items.*

2nd. The best way of slaking lime for agricultural purposes, which would be best ascertained by instituting a course of experiments in different districts. I think it is perfectly clear

* I propose to collect statistics on this subject, and to publish them in a cheap form.—C. T.

that there should be an arrangement for slaking lime in connexion with every agricultural limekiln. As far as my experience goes, the water should not be thrown in quantities over the lime, but the lime should be placed in baskets, and dipped into a reservoir of water, allowing sufficient time for it to take up as much water as it can absorb, which experience will soon decide. It should then be removed, emptied out upon a dry bed, and carefully covered over, so as to exclude the air.

3rd. It would be very desirable also to decide, by a course of experiments, the best way of applying the slaked lime to the land. I think that the lime should be in a state of powder, but not sufficiently dry to fly about; that it should be placed in a hopper carried upon suitable wheels, the hopper having a communication with a cylinder pierced with holes in the upper part. These holes should be made adjustable in size, and suitable wings or guides should be fixed on the outside of the cylinder to distribute the lime. A fan, fixed to revolve in this cylinder, turned by the revolution of the carrying wheels, would, in revolving, blow the lime-dust through the holes in the circumference of the cylinder.

There are various other points connected with the application of lime as a manure, such as the proportion in which it may be advantageously used in connection with other manures; the chemical action of lime upon soils, either alone or combined with other manures; and many others, each of which would require a separate essay to develope it properly.

## VII.—*Report on some Features of Scottish Agriculture.* By H. M. Jenkins, F.G.S.

The following Report may be regarded as a continuation of the series commenced eighteen months ago with descriptions of selected English farms. It was considered by the Council that the Essays on the Agriculture of the several English counties, already published in the 'Journal,' might be usefully supplemented by detailed descriptions of successful practice in different districts, whether at home or abroad. The Members of the Society have already been enabled to contrast the methods pursued on characteristic farms in some of the English counties, with the various aspects of Belgian farming, and with the modes of cultivation brought to light by the Farm-prize competition in connection with the Oxford meeting. The next step in the development of this plan was entrusted to me by the Council last summer, when I was requested to obtain materials for a Report on the prominent features of Scotch farming. The subjects to which my attention was particularly directed were the following:—

(1) Lowland farming, including arable farming in the East and West of Scotland.
(2) Dairy-farming for the supply of milk to large towns.
(3) Aberdeenshire cattle-feeding, including arrangements for supplying the London market.
(4) Highland sheep-farming, and West Highland cattle-breeding.

It was considered that these features might be better described through the medium of the practice pursued on one or two farms of each class; and it was thus hoped to preserve the connection between details of management and conditions of soil and climate, which often furnishes the key to peculiarities that might otherwise be difficult of explanation.

In my endeavour to illustrate these features of Scottish agriculture I have attempted to fulfil yet another function, without in any way losing sight of the main object of this Report. Of the two East Lothian farms which have been described, one may be regarded as a noteworthy example of the culture of rich land, for which a very high rent is paid; and the other as a more typical Lothian farm, in which agricultural and commercial success has been chiefly due to the ability and enterprise of the farmer. Similarly, on the west of Scotland, the farms described were selected as proving that, in a humid climate, it is possible to use with profit very large quantities of artificial manures, especially for the root-crop. The two farms placed in contrast to one another show some differences which will be recognized as distinguishing English from Scottish modes of cultivation; but, in other respects, they illustrate the same principle. Indeed, the four lowland farms are described to show the various methods by which good crops may be produced under different circumstances, whether by good land, good cultivation, or liberal manuring. The sections of the Report treating of the Aberdeenshire cattle-feeding and Highland stock-farming are illustrative of two aspects of the important question of the production of meat, whether on land under the plough, or in its natural concondition of hill-pasture; and the description of the Glasgow Dairy shows at least one means of supplying milk to large centres of population.

Before plunging *in medias res* one other word is necessary. The cordiality with which I was received in Scotland, and the readiness with which I was enabled to see everything for myself, must be prominently recorded if only for the purpose of showing that any misconceptions that I may have formed on the subject of this Report are not the result of any want of effort to enlighten me in the "Land o' Cakes."

## I. Lowland Farming.

The descriptions of the farms illustrating the prominent features of lowland farming require to be prefaced by such a general sketch of Scottish agriculture as will enable them to be understood as examples of the bearing of certain parts on the working of the whole system. The variations in the arable farming of Scotland depend chiefly upon climate, and the condition of climate may be easily resolved into three elements, viz.: —distance from the coast, height above the sea, and longitude (which means amount of rainfall). The other conditions which influence the operations of agriculture have, of course, their due weight; but that weight is light in comparison with what is due to the elements just enumerated. Even latitude, which is prominent as a climatic element in English farming, has small influence on the climate of Scotland, as compared with the height of the farm above the sea-level. It is, therefore, no unusual thing to find a farm whose natural harvest-time is a good fortnight in advance of one not more than two miles off. In East Lothian, for instance, the earliest region is that which skirts the coast; its elevation is small, and its naturally mild climate is ameliorated by the softening influences of the sea. A little further inland the country is more elevated, and the land becomes stronger, losing much of its "kindness;" here the harvest is from ten to fourteen days later, and one may look down from a field where the reaping-machines have just commenced, to a belt of country which is being rapidly denuded of its ripened sheaves. The hills form the background of both these areas; but there, owing partly to the configuration of the surface, partly to the nature of the soil, and partly to the roughness of the climate, which is strictly in keeping with the ruggedness of the country, agriculture assumes a purely pastoral character.

The juxtaposition of hill and plain in Scotland has been turned to good account by the enterprising farmer, who has found it profitable to rent a certain amount of "hill" as a sheep-breeding adjunct to his feeding establishment in the plain. This system has of late assumed such proportions that, owing to the increased facilities of transit, it is no unusual thing for an occupier of arable land in the east to hold a sheep-farm in the west. He finds it more profitable, and in other ways more satisfactory, to breed his own "wedders" than to trust to the chances of markets and prices for supplying the wants of his home-farm. Here, therefore, we have the explanation of a very striking feature, viz., that sheep are not often, except as a matter of fancy, bred on the arable farms of Scotland, particularly on land of high fertility.

No such broad generalization can be drawn with regard to cattle. In the Lothians cattle are not bred, nor are they in the strip of arable land on the west coast; but in Aberdeenshire and the Angus district, as well as in the more or less elevated regions of Galloway, Ayrshire, and the Highlands, the different native races are bred in considerable numbers. Herds of pure Shorthorn blood are distributed about the country, but they have more influence on the quality than on the number of the feeding cattle raised in Scotland. It has been justly remarked by an agricultural writer that, while many Scotch farmers prefer to buy cattle in England, English feeders, on the other hand, often prefer to get their supplies from the north side of the border. Lothian farmers, however, are still chiefly supplied with lean cattle from the northern districts, though not so abundantly as heretofore; they are, therefore, more dependent on supplies of imported Irish cattle, and on what they can buy at the northern English fairs. Two causes have combined to produce this result:—firstly, more cattle are fattened all over Scotland, especially in the north, than was formerly the case; and, secondly, fewer cattle are bred in consequence of their displacement by sheep.

The paucity of breeding flocks and herds on the arable farms of Scotland is accompanied by a rarity of permanent grass. The two features can hardly be associated together as cause and effect, in consequence of their existence not being coincident in all cases. Even in Aberdeenshire, where, as I shall show, a large number of beasts are annually bred on arable farms, there is comparatively little old grass except in private parks. The reason is simply that it pays better to keep the land under the plough, allowing the seeds to remain two years, and in some cases three. But it does seem remarkable that in Aberdeenshire these "seeds" can keep heavy bullocks in good and improving condition, while in the Lothians, on the contrary, they are distinctly more profitable when pastured by sheep.

The dependence of arable farmers on hill farms, for their supply of feeding sheep, is to a certain extent counterbalanced, in some districts, by the dependence of hill farmers on occupiers of arable land for winter keep for hoggs. The system will be described more particularly under its proper heading; but it is necessary here to mention that most hill farmers find it desirable to send their hoggs on some lowland grass during the first winter, at a certain price per head for the season. This consideration has a great influence on the price of farms both on the hills and in the plains, the want of "hogging" land in the former being a certain source of outlay, and the convenience of access from a hill-farm in the latter being an equally certain source of income.

To the cultivation of their arable land Lowland farmers are indebted for the reputation which they now possess throughout the British islands. It is impossible to give any decisive summary of the characteristic features of this division of Scottish agriculture, for clean farming, thorough cultivation, and liberal manuring, are happily not confined to Scotland. One point, however, is very striking, viz., that across the border it is preferred to apply nitrogenous manure direct to the land, in place of giving large quantities of artificial food to stock, and thus making farmyard manure of the highest quality. My inquiries into this question produced a twofold answer, one aspect of which was that the feeding qualities of the roots and straw were sufficient to fatten stock without the aid of large quantities of artificial food, which are held to be unremunerative; and the other was that the stimulating influence of the manure of large numbers of cake-eating stock rendered the crops too luxuriant to stand the rough usage of the Scottish climate. Whatever may be thought of this reasoning in England, there is no doubt that the Scotch farmer has the results of successful practice on his side; and when these are dissected, we find that if he is careful not to give too much cake to his cattle and his sheep, he uses a quantity of nitrogenous and phosphatic manures, which under an English sky would be regarded as far exceeding a paying quantity.

There are other points in the cultivation of the soil in which Scotch practice differs from English, such as the comparative absence of autumn cultivation for roots, the lateness of wheat sowing, some peculiarities in the cultivation of the potato, and other matters which will not fail to strike the agricultural reader of the following pages. With regard to the prevalent mode of preparing the land for roots chiefly in the spring, Mr. James Caird, C.B., informs me that the additional humidity and coolness of the Scotch climate render autumn cultivation a matter both of less importance and greater difficulty than in England, where the rainfall is much less and the drying power of the sun in spring is much greater.

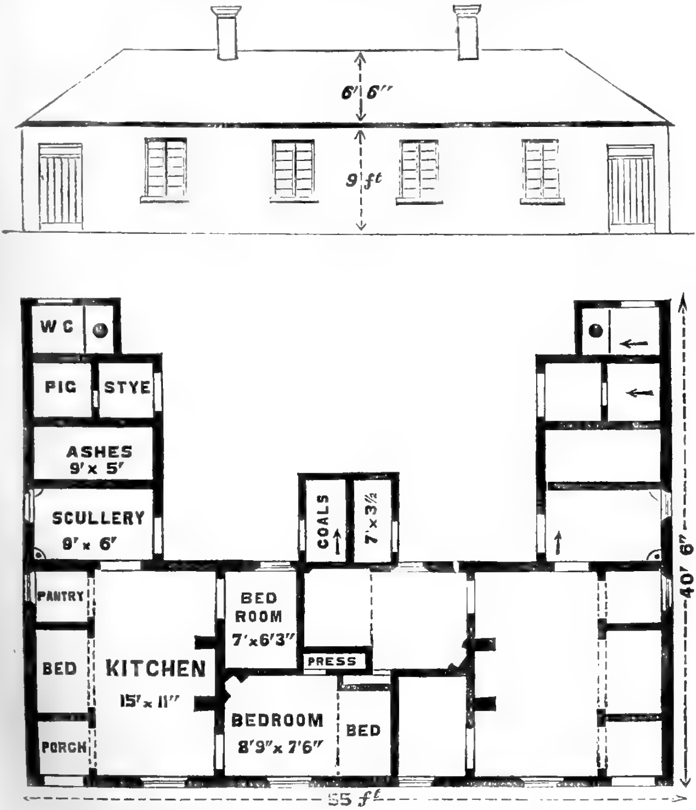
The labourer in Scotland presents some features in contrast with his English representative. He is hired for either six or twelve months, is lodged free, and is paid to a great extent in kind. The degree in which the good in this system neutralizes or overpowers the attendant evil, or *vice versâ*, depends partly upon the landlord, and partly upon the tenant. The most common result is bad cottages on one floor, frequently with only one room, or at most two. In cottage accommodation for agricultural labourers, Scotland is, on the whole, far behind the generality of English counties. The dislike to live on more than one floor is so strong that it may be regarded as characteristic of the Scotch labourer, but it by no means follows that the cottages built on that plan should be deficient in the accommodation necessary to preserve health and encourage morality. As an example of the force of this dislike, however, I may mention one instance which came under my notice, where a benevolent landowner, who had built an experimental pair of semi-detached two-floor cottages, was at last obliged to make a door in the party-wall, both upstairs and down, and let the cottages as two "flats"!

In the following pages, illustrations are given of admirable one-floor cottages on the two sides of Scotland; but the labourer's cottage is very frequently a structure which is worthy of no better name than a hovel. In East Lothian, the garden of Scotland, where the land is let at a high rent, the labourers often live in cottages built in long rows close to the road, not remarkable for either external or internal cleanliness, and as they have no garden-ground in front, the place of flowers and vegetables is usurped by ash-heaps and their repulsive accompaniments. Unhandsome as these appear to an English eye, they are, however, far better than the tumble-down, antiquated huts which are too often met with on the west coast; for whatever æsthetical defects the Lothian cottages may have, they generally possess the merit of keeping out the wind and the rain; and the want of cleanliness is more the fault of the labourer's wife than of his cottage. But in Ayrshire, and other counties of the west of Scotland, the cottages are too often dilapidated to the last degree, and "scarcely to be rivalled by the mud cabins of Connemara." The Commissioner for the 'Glasgow Herald' (Mr. Allan), who wrote for that paper a series of clever essays, embodying the results of his 'Inquiry into the State of Agriculture in Scotland, including the past and present condition of Farmers and Farm-servants,' thus describes some cottages in the south-west:—

"On both sides of the roadway, for miles, there is the same striking contrast already referred to, viz.: fine farms, good farm houses, and miserable hovels for the married ploughmen and cottars. They are all much alike in outward appearance, and in all the stages of decay and dilapidation—eyesores, in short, to the passing traveller, sources of much expense to the farmer, and dismal abodes for the poor inhabitants. The walls and gables in some cases are threatening to fall out or in, and are supported by stone buttresses or cuttings of trees. The roofs are mostly rotten thatch, if it be not renewed at the farmer's cost; the floors are clay or mud, and invariably worn into holes; the partitions in a number which we inspected were neither more nor less than the backs or sides of the box-beds; while the ceilings consisted of empty guano bags stretched across the rafters"!

Whatever may be thought or said of this description, either in England or Scotland, I feel bound to state that, having walked for some miles along the roadway referred to, and visited some of the farms, farmhouses, and cottages, I feel perfectly justified in quoting it as a fair picture of what is but too frequently to be seen in that district.

Fig. 1.—*Plan and Elevation of a pair of Cottages built by Alexander M'Neel-Caird, Esq., at Genoch, Wigtonshire.*




The arrows show the slope of the roofs of the outhouses.

Fortunately there are some examples of a better condition of things, as may be seen by the annexed plan and elevation of a pair of cottages built in 1868, at Genoch, Wigtonshire, by the proprietor, Mr. A. M'Neel-Caird. It is to be hoped that his much-wanted example will soon be extensively followed by his neighbours in the south-western counties.

I must now briefly describe the prevailing tenure of land in Scotland, as in some respects it has a direct bearing on the course of management pursued on Scotch farms, which are generally let on a 19 or 21 years' lease. As an abstract proposition nothing can be more satisfactory to the farmer, because there is *pro tanto* security of tenure. But, unfortunately, the Scotch system of leases labours under the disadvantage of being hampered by two important drawbacks. One of these is known as the "Law of Hypothec," analogous to our law of distraint; and the other is the custom of inviting tenders for farms, the leases of which are drawing to a close.

In Scotland, as a broad general rule, when a farm is to be let, the highest bidder becomes the occupier, unless anything serious is known against him. The landlord is sure of his rent, owing to the operation of the law of hypothec, and, therefore, he is often more careless in his enquiries as to the capital and reputation of the tenant than English landlords are under our system of yearly tenancy. Two results follow: Firstly, a large proportion of farms are over-rented; and, secondly, a comparatively small proportion of tenants "sit out" their leases. Readers of this Journal will doubtless ask, as I did, How does the system survive under these circumstances? Common report states that, in a large number of cases, the landlord is obliged to reduce the rent of an over-rented farm after a few years of the lease have expired. Be this as it may, I can only say that nothing in Scotland impressed me so much as a drive through a portion of East Lothian in company with Mr. Hope, of Fenton Barns—a vigorous advocate for the lease system—who showed me, with admirable honesty and impartiality, how small a proportion of farmers in his district did contrive to "sit out" their leases. Although Mr. Hope, and a few other farmers of the highest reputation, would doubtless not hold a farm without a lease, many very good farmers, who have not that public reputation which would induce their landlords to keep them as tenants, except under the condition of offering the highest rent in an open competition, assured me that they would much prefer a tenant-right agreement. One great reason for this opinion is that the termination of a lease often means a large increase of rent; it also means a sense of insecurity for a number of years, and a probability that the home must be broken up unless more is offered for the farm than it is actually worth at the time when the tenders are invited.

These considerations influence the system of cultivation pursued on most Scotch arable farms, and they are, therefore, my reason for referring to the subject. The Scotch farmer, when he enters on a farm, has a problem to solve which does not often present itself to the mind of an occupier of land in England. He has made a strictly commercial bargain with his landlord, and, as a man of business, he immediately sets himself to work to make the most of it. The landlord does the same; and this is one reason why the game question is such a sore point across the Border. But this by the way. The farmer finds his land in as poor a condition as his predecessor could possibly reduce it to, having due regard to the conditions of his lease. His experience has taught him that the most profitable thing to be done is to put "condition" into his land as fast as he can do it without endangering any crop, and then to keep up that condition until the commencement of his last shift of 5 or 6 years, as the case may be, when he steadily and scientifically devotes himself to the task of taking as much out of the land as he dare, in the face of the restrictive covenants of his lease. It is not that he has any particular desire to rob the land, but he wishes both to recoup his own outlay, in view of the contingency of his lease not being renewed, and also to reduce as much as possible the competition for the farm.

It will thus be seen that when a man of capital becomes the occupier of a farm under the Scotch system of leases, a considerable national benefit is one result; because, for 15 or 16 years out of 21, the farm is managed with a view to its yielding the greatest amount of produce, without injury to the land, that can be obtained by means of the most advanced practice and the most accurate science known to the farmer. The main drawback is that for the first few years, and the last 5 or 6, the produce is not so great as it should be, because, at the commencement of a lease, a farm is almost always poor in condition, and towards its termination the efforts of the farmer are directed towards its reduction to its original poverty.

The difference in the competition for farms left in a tolerably high condition, as compared with those left in a more or less exhausted and dirty state, is greater than appears at first sight; and this is one of the gravest charges laid against the hypothec law. A man of straw, with nothing to lose, will bid an extravagant rent for a farm in good condition. The hypothec law has no terrors for him; and he can, at any rate, get a few years' living out of the farm. On the other hand the landlord lets the farm, resting on the security of the law of hypothec, and not unfrequently he is said to obtain his rent at the expense of those who have given "credit" to the farmer on the strength of his being the occupier of a certain number of acres.

Such is, in brief, the manner in which the Scotch system of land-tenure affects the landlord, the tenant, and the nation. But the labourer belongs to another class of the community on which it also has a distinctive effect. The landlord invites tenders for a farm, and if the rent offered by the highest bidder is satisfactory the lease is frequently drawn out without any stipulations as to the erection of new cottages. Generally speaking, the steading is in good order; but, if not, the landlord announces in the first instance what repairs or improvements are to be made; because, as a rule, the farm-steading is a very great item in calculating the rent-value of a farm across the Border. But, as regards labourers' cottages, the case is different, and, as already stated, they not rarely remain to be patched and repatched by the incoming farmer, or his ploughman, as the case may be.

## East Barns.

The literature of Agriculture abounds in records of the manner in which natural difficulties have been overcome by farmers; but the methods by which natural advantages have been turned to account have attracted less attention. This feature of Agriculture I shall endeavour to illustrate by the following description of East Barns, in the occupation of Mr. James Murray. The farm is three miles east of Dunbar, and lies on both sides of the high road to Cockburns-path, between the Lammermuir Hills and the sea. It is wonderfully sheltered from extremes of climate, and the winter temperature is so mild that it makes a great difference in the period at which some agricultural operations are carried out. There is, however, something more than degrees of temperature or inches of rain to be noticed. The soil is a rich red loam, which has been formed by the decomposition of the more or less subjacent Old Red Sandstone; it is about nine inches in depth, and is endowed with remarkable natural fertility. But natural fertility requires to be sustained, and even this is partly done by Nature, for Mr. Murray's lease includes the privilege of hauling "sea-ware" from about a mile and a half of coast, which is equal to a heavy dressing of farmyard-manure for from 25 to 40 acres of land, according to the season.

The farm consists of about 500 imperial acres of arable land. It is held on a nineteen years' lease, under Alexander Mitchell-Innes, Esq., of Ayton Castle, at an annual rental of 2400*l*, and the current lease is the second which has been taken by the present tenant. Considering the nature of a small piece of about nineteen acres of pasture, and the fact that the arable land includes about five acres of "links,"—a poor sandy soil—it is clear that the natural advantages which have been referred to require to be turned to the best possible account to enable the tenant to obtain a profit after paying a rent which averages nearly 5*l.* per imperial acre. From this point of view, it is hoped that the following description of Mr. Murray's farming operations will be invested with considerable interest. The appearance of the farm, which must be seen to be appreciated, bears evidence of the most studied and careful management, the most thorough and even fastidious neatness and cleanliness; and it shows that, great as is the annual expenditure as rent, the item of labour must also be very large in comparison with the acreage.

The following shift is adopted instead of the ordinary six-course that is most prevalent in the Lothians, partly in consequence of the absence of permanent pasture, and partly on account of the importance of the potato-crop:—

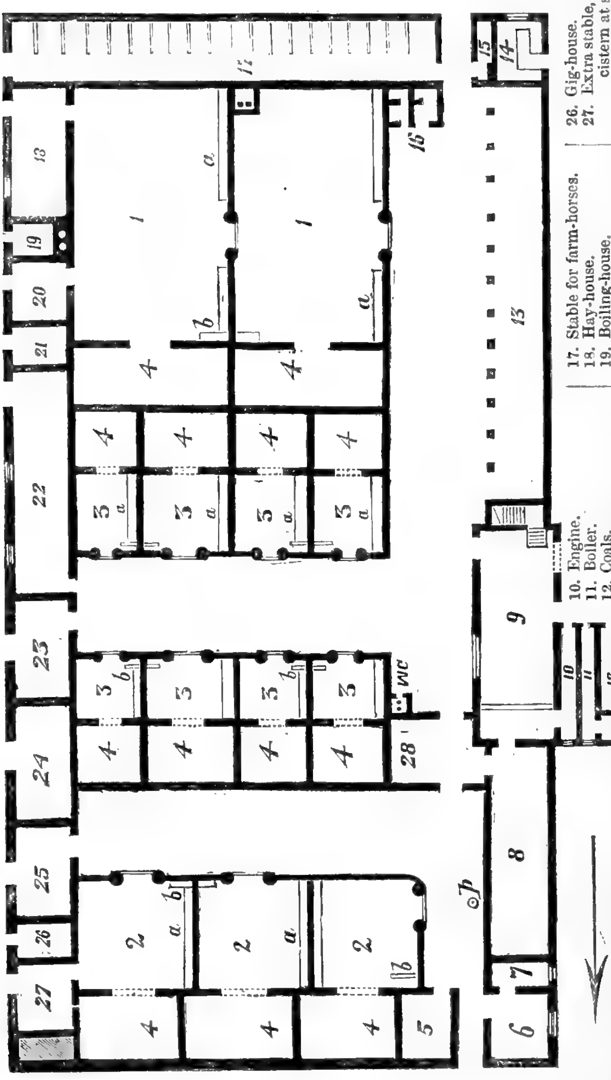
1. Turnips.
2. Barley (occasionally a little wheat) with seeds.
3. Seeds—a part mown, and part grazed.
4. Seeds—grazed.
5. Half oats and half potatoes.
6. Potatoes after oats, and pulse after potatoes.
7. Wheat.

The pulse in the sixth year, after potatoes in the fifth, consists of beans on the stronger land, and of a mixture of beans and peas on the lighter. As a rule, therefore, the farm is annually divided as follows: — one-seventh turnips, one-seventh potatoes, two-sevenths seeds, two-sevenths wheat and barley, and the remaining seventh is equally divided between oats and pulse. The stronger land breaks consist of about 65 acres each, and the lighter land fields of about 70. The former yield as much as the latter, and require as much labour, so that the division is fair in each aspect.

## Crops.

1. *Roots.*—The wheat-stubble is ploughed from 7 to 9 inches deep, according to the land, when convenient during the autumn; it is then left until after the spring corn has been sown—generally until the middle or end of April, when it is ploughed along the previous ridges. Occasionally cross-ploughing is adopted, but not often. In dry weather, the harrow follows immediately after the plough, to keep the moisture in the soil; and the land is rolled as soon as the surface is dry enough for a roller to work clean. In the interval between the time of ploughing, harrowing, and rolling the land and the preparation of the seed-bed—

Fig. 2.—*Ground-plan of the Farm-steading at East Barns.*



1–3. Fold-yards.
4. Shelter-sheds.
5. Cow-byre.
6. Stable.
7. Harness-room.
8. Large straw-barn.
9. Corn-barn, with fixed threshing-machine and chaff-cutter.
10. Engine.
11. Boiler.
12. Coals.
13. Cart-shed, with granary above.
14. Poultry.
15. Tool-house.
16. Piggery.
17. Stable for farm-horses.
18. Hay-house.
19. Boiling-house.
20. Cake-house.
21. Killing-house.
22. Servants' cow-byre.
23 and 25. Turnip-houses.
24. Machine and tool-house.
26. Gig-house.
27. Extra stable, with water-cistern at side.
28. Small straw-barn.

*a, a.* Food-troughs.
*b, b.* Water-troughs.
*p.* Pump.

generally from three weeks to a month—there is time for the nascent crop of annual weeds to make a braird, of from half an inch to double that length, in the well-pulverised and now mellow soil. These weeds are entirely destroyed by subsequent operations, and a weed in flower is rare to see on Mr. Murray's farm. Four or five ploughs are set to open about a dozen drills to begin; they are followed by carts with manure, and by women who spread the manure in the furrows; for swedes, to the amount of about 25 Scotch cart-loads per imperial acre, and 4 cwt. of dissolved bones, or other artificial manure. When there is more farmyard manure available, the quantity of artificial is proportionately diminished. The return-ploughs cover the manure, and are immediately succeeded by two following drills, each of which distributes, at a different depth, 1lb. of seed per acre in drills 27 inches apart, and is followed by a light roller. Turnip-sowing commences about May 10th with swedes, which are all in by the 20th, and immediately after hybrid and white turnips follow, the whole being got in by the beginning of June. The young plants are horse-hoed once, and hand-hoed and singled by women working daywork, and the crop is again horse- and hand-hoed in the course of another fortnight and three weeks.

What with clean land in good condition, a soil naturally fertile, and a growing climate, the turnip-crop is never a matter of anxiety in the commencement of the season. It is, however, the most precarious crop on East Barns; but the difficulty is not in securing a braird, nor in the ravages of the "fly." The anxious time is the latter end of summer and the early part of autumn, when, should dry weather set in, the root-crop sometimes falls short. Mr. Murray stated that if he could secure a fair amount of rain in the autumn, he could be certain of a good crop. About one-third of the break on East Barns is sown with Drummond's Purple-top Swede, and the remainder with hybrid and white turnips. No Aberdeen yellows are grown. Mr. Murray is of opinion that the seed should be two years old, and his system is to buy new seed, say in 1868, to be sown in 1870, in 1869 for 1871, and so on. His conviction is that the plants bulb better than from new seed, and do not run so much to top.

2. *Barley.*—As soon as convenient after the turnips are cleared off the light land, it is ploughed from 6 to 7 inches deep, and harrowed down fine as soon as the weather will permit. In this state it remains until the annual weeds have made a braird, when the skim-plough is put over the land, cutting about 1½ inches below the surface, and destroying the pestiferous wild crop. In the course of another day the land is again harrowed, and is then ready for drilling. Usually not more than 24 hours intervene between the harrow and the drill. From 1½ to 2 bushels of

seed barley, according to the richness of the land, is drilled, lightly harrowed in, and the land rolled. The seeds are then sown, the land lightly harrowed, and finally well rolled.

The strong land for barley, or sometimes wheat, does not require so much preparation, as it is not so likely to produce the adventitious crop of annuals, which is the object of Mr. Murray's especial solicitude. It is ploughed when the roots are cleared off, and, if dry enough, harrowed immediately; but otherwise it is left until fit, when the harrow and drill follow in close succession, and the seeds are sown as before.

3. *Seeds.*—A large quantity of seeds are usually sown per acre, the mixture being:—3 pecks Italian rye grass (one-half English and one-half foreign) ½ bushel perennial rye grass,* and not less than 20 lbs. of different clovers, viz. 6 lbs. red, 6 lbs. Alsike, 5 lbs. white Dutch, and 3 lbs. trefoil; also a small quantity of plantain and parsley, not more than 2 lbs. of each. The system of management commences soon after the barley is carried, by pasturing with sheep to the extent that the young plants are strong enough to bear. The first year from one-third to one-half of the break is mown, and the aftermath is fed. Two-year-old seeds are entirely pastured, the sheep getting white turnips on them for two or three weeks before they go entirely on roots. Clover sickness is rare.

4. *Oats.*—As wheat is never taken after seeds, the ley is not broken up until the end of January or beginning of February, when it is ploughed to the depth of 6½ or 7 inches. Immediately before drilling the land is harrowed, and if there is any appearance of annual weeds the crop is also horse-hoed when sufficiently advanced. Black Tartarian oats are usually grown, the climate being too dry to suit the white sorts, and about 11 pecks of seed is generally the quantity used. The whole of the crop is consumed on the farm, as well as the straw.

5. *Potatoes.*—Potatoes are taken after seeds and after oats. In the former case the ley is ploughed as for oats, and, as a system, hitherto no manure has been applied on land that has been two years in seeds. Recently, however, Mr. Murray has applied a little artificial manure, and he thinks that the result justifies a continuation of this practice, although in former days manure was thought to render the tubers more liable to disease. The oat-stubble for potatoes receives a heavy dressing of either farmyard-manure or town-manure in the autumn, which is ploughed in sooner or later, as may be convenient, or as the season may require, sometimes not until after the lapse of several weeks. Whole potatoes are never planted, and those selected for the sets

* Pacey's is never used now, as it was found to get short, dry, and hard.

are of a medium size, neither too large nor too small. The sets are made by cutting slips off the tuber, each slip containing but one eye, or, if more than one, the superabundant ones are scooped out. The "rose-end" of the tuber is left until last; it is then split and all the eyes but one scooped out of each part. The object is to have each potato-plant, if possible, with but one stalk, as the crop is then more even in size and almost wholly fit for the London market. There may not always be so great a weight of potatoes as under the other system, but the farmer naturally looks more to £. *s.* *d.*, than to tons, cwts., and lbs. The sorts usually grown are Walker's Regent and Victoria, about half a ton of potatoes being required to plant an acre under this system. Some time after planting, the land is harrowed when the annual weeds are well up; and as soon as the plants appear they are horse-hoed and cleaned with the hand-hoe once or twice, as may be required. When thoroughly clean and beginning to get bushy, they are earthed up by the double-mouldboard plough and two horses. When ready for lifting, which is generally from the middle to the end of October, but sometimes not until the first week in November, the double-mouldboard plough is again used, with an addition which throws the potatoes well out. The crop is pitted as soon as taken up, the potatoes being laid in long heaps on the surface of the land, about 5½ feet wide at the base and not more than 3½ feet high. Great care is required to prevent "sweating;" it is therefore desirable to cover with straw first, and a light covering of earth, leaving chimneys at intervals of 3 feet, and finally, to keep out wet and frost, the covering of earth is increased as may be deemed necessary.

The largest potatoes go to the London market, the seconds are pitted anew and sold for seed, and the smalls are sold or used for cattle-food, or are purchased by starch-manufacturers. Last year the small potatoes sold for 35*s.* per ton on the spot for feeding purposes.

6. *Pulse.*—The potatoes after seeds are followed by beans on the heavier land, and by a mixture of beans and peas where the land is not so strong. In either case the potato-land is ploughed during the winter from 7 to 9 inches deep; and in the spring, just before sowing time, the land is harrowed down and left for a day or two previous to ridging, which is done by six ploughs, in the same manner as for turnips, 27 inches apart. The bean-sowing machine deposits the seed in the intervals between the drills before the return-ploughs, distributing from 2 to 2½ bushels of beans per acre, or a mixture of 2 bushels of beans and half a bushel of peas. In two or three weeks annual weeds have got a good braird, and are then destroyed by thorough harrowing. Horse- and hand-

hoeing is done when the beans are well up, and the crop is cut with the hook.

7. *Wheat.*—This crop follows potatoes and pulse. In the former case no manure is applied to the land, but in the latter it receives a good dressing either of farmyard-manure or of sea-ware. The whole of the break for wheat is ploughed from 7 to 8 inches deep after the potatoes have been taken up, say the middle to end of November. The land is harrowed and the wheat drilled at any time from the 22nd November until the end of December, according to the weather. Before drilling, the land will have at least one double and one single harrowing, and afterwards merely a single tine to cover the seed and level the land. Rather less than 2 bushels of Woolly or Rough Chaff wheat are sown per acre. The after management consists of one horse-hoeing wherever annual weeds appear, and of a top-dressing to such portions of the potato-land wheat as may seem to require it, perhaps the whole; but no stimulant is applied to the manured wheat. The top-dressing consists of a mixture of 1 cwt. each of nitrate of soda and guano, put on broadcast in April when the wheat-plant is fairly growing. Reaping generally begins about the middle of August; but this year it commenced on the 9th of the month.

The white crops are usually cut by machine: generally three machines are working together, but a fourth is kept on the farm as an adjunct, or in case of accident.

Until the last one or two years, however, the reaping-machine did not come into favour with Mr. Murray; his crops were very heavy, and overpowered the machines which he had tried; but recent improvements have nearly removed his objections, and he now uses machines for most, if not all, of his grain-crop. Wheat is cut early, before it exhibits the "sere and yellow" leaf and stalk. A shorter or longer period, according to the season, is necessary to put the cut grain into proper order for stacking. Sometimes three or four days are sufficient; at other times fourteen or fifteen days are not too much. In carrying, four stackers are generally set to work, each having two carters, and they one forker; the stacker has a stout boy on the stack, to put the sheaves to the hands of the stacker, and otherwise assist him. A few extra hands are always required in harvest. Formerly, a great many Irish reapers were employed, but now the machines are in use a small number only are needed. Everything is done by day-work.

*Seed.*—The best Scotch farmers are very particular about their seed, and Mr. Murray's practice in this matter is by no means exceptional across the border. He gets wheat generally every year from the south, as this crop does well coming from a slightly warmer climate. Seed-oats, on the contrary, are invariably obtained from a colder climate, as experience has shown this practice to yield the best results.

A few cabbages and carrots are grown; this year about half an acre of the former and less than 2 acres of the latter.

*Produce.*—In an article in 'The Farmer,' for September 5, 1866, the following information is given on this subject. "The produce of the Tartarian [oat] is from 90 to 100 bushels per imperial acre, weighing from 40 to 41 lbs. per bushel; and of the potato variety from 50 to 60 bushels per acre, weighing 45 lbs. per bushel. Barley is a more important crop than oats at East Barns, the variety grown being the Chevalier, of which the produce ranges from 55 to 60 bushels per imperial acre, weighing from 57½ to 59½ lbs. per bushel." . . . "Last year [1865] the wheat crop at East Barns produced 60 bushels per imperial acre, but this year [1866] from the influences of the season, it is much inferior, and probably will not yield more than 40 bushels. The average yield is from 48 to 50 bushels, weighing from 64½ to 65 lbs. per bushel, and occasionally somewhat more."

## Stock.

Neither cattle nor sheep are bred on the farm, and the number of each bought annually for feeding purposes varies according to the root-crop and the "seeds." If the seeds are very good, a larger number of sheep than usual will be bought in; and, consequently, as these are finished off on turnips, the proportion of cattle will be smaller.

*Cattle.*—Mr. Murray likes to feed about 70 shorthorn steers, as heifers cannot be got. Half of these are three years old, in good condition, and the remainder six-quarters old and of the best quality. They are bought, if possible, at the newly established Linton market, not later than the middle of October, or else at the October Falkirk tryst. The older steers commence with whole turnips and hay, or oat-straw, for about three weeks, when they get a little barley meal and bran with the roots as a preparation for cake. The allowance of cake commences with 2 lbs. per head per diem, and is gradually increased, as found desirable, to about 6 lbs., to feed the beasts off as fast as possible. The younger animals get their turnips sliced, and do not taste artificial food until the end of January. A small quantity of cake is given to begin with, and this generally produces looseness, when the mixture of meal is administered as a corrective. The ration of cake is cautiously increased, and the beasts are sold off fat about the end of May or in June. From 35 to 40 tons of cake are consumed annually on the farm, the whole of it being, as a rule, given to the cattle. Mr. Murray is not so particular as some farmers about giving his beasts fresh-threshed straw, as he finds it keep well enough in his barn for six or eight weeks; but the straw should be damp, and there is a regular supply of water in troughs in the foldyards and courts.

*Sheep.*—Mr. Murray has annually from 65 to 70 acres of two-year-old seeds, the whole breadth of which is grazed; and the same quantity of one-year-old seeds, of which from one-half to two-thirds are also pastured, as well as the aftermath of the remainder. Now, as it is found that cattle do not thrive on the seeds, possibly because the land is too hard and dry, the whole of them are consumed by sheep; and from two-fifths to one-half of the roots are also fed on the land. Considering the crops which East Barns is said to bear, it is evident that a large number of sheep are required to consume the seeds in summer and autumn, and a certain number to be finished off on the roots in winter. No sheep are bred; and Mr. Murray, like many other East Lothian farmers, may, therefore, be said to have a "shifting" flock, continually coming from the hills in good feeding condition, and as continually going away fat, chiefly to London. The number of sheep on the farm at different periods of the year is thus entirely dependent on the amount of sheep-food, and it is almost unnecessary to say that last year was exceptionally unfavourable as an index of what the farm could produce. Indeed it was remarkable to see the condition in which 300 sheep had been kept for two months, to be finished off on roots, on seeds which looked like brown paper; but in that district it is said that sheep do well on "roast meat."

In a good year the first purchase of sheep will be made about the end of March or beginning of April, when as many as 400 or more half- or three-quarter-bred, or sometimes cross-bred wethers in good condition will be put on the seeds, and fed off without any artificial food in the course of ten or eleven weeks. The next purchases will be made during the latter end of July and the beginning of August, when either lambs or older sheep are kept on the seeds until the end of September, when they go on turnips. Two-shear Cheviots from the islands on the west coast are liked for this purpose; they are as forward as three-shear Highland sheep, and are good feeders. The number of sheep bought for wintering depends on the amount of autumn food and the prospects of the turnip-crop. Taking the average of years, from 500 to 600 is about the number, but as many as 900 have been kept, although it is unusual for the number to go beyond 800. These sheep get with the roots either hay or pulse-straw; they begin to go off in January, weighing from 18 to 22 lbs. per quarter, having never touched cake or corn. Thus there are two principal purchases in the year, but there is no fixed system, except that sheep are being bought in and sold off all the year round, after the autumn lot have been kept from twenty to twenty-two weeks in the manner described. Folding on grass is not liked, nor are the sheep allowed to have a frequent change of pasture. Both systems have been tried, but the one now pursued has been found to produce the best results.

When the newly-purchased sheep arrive they are immediately dipped in a mixture of soft soap, tobacco-juice, and spirits of tar. Shearing is done on a reciprocity system, as in the Highlands, by the shepherds on the neighbouring farms; and a good man will shear from 20 to 23 in a day. Fleeces vary considerably, but average 4 to the stone of 24 lbs., although sometimes as many as 6 are required to turn the scale.

*Horses.*—Until recently, 9 pairs of horses were kept; but now they have been reduced to 8 pairs. The end of spring and beginning of summer they are kept on hay and cut grass until after turnip-sowing, when a part of them are turned out, and remain in the field until after harvest. They then get 3 feeds of oats per day, with hay or straw. If the latter, they get a mash of bran or grey barley, generally twice, but sometimes three times, per week. As a general system when the horses get no grass, they have one or two feeds of roots per day, either turnips, small potatoes, or carrots. Oat-straw is always reserved for the cattle, the horses getting either wheat or bean straw, never barley-straw. Occasionally the older horses get a little Indian corn (whole), or beans and peas, with their oats, especially if the latter should run short, or the other food be cheap.

## Labour.

Probably there is not a farm in Scotland on which the labourer is better cared for. The principal lot of cottages are built round three sides of a square, the centre of which is ornamented with a refreshing clump of evergreens; they gained the Highland Society's Gold Medal in 1848, and I therefore give ground-plans of these and two other varieties of them. The married ploughman gets his cottage rent-free, an annual payment in kind of $\frac{1}{4}$ acre of potato-ground, 66 bushels of oats, 18 bushels of barley, and 8 bushels of pulse, with keep for a cow and pig, as well as coals, and a certain amount of money.

In the 'Fourth Report of the Commissioners on the Employment of Women, Young Persons, and Children in Agriculture, 1870,' (p. 54), Mr. George Culley, one of the Assistant-Commissioners, gives the following synopsis of Mr. Murray's labour-arrangements :—" There are attached to this farm (including groom's and gardener's cottages) 24 cottages, and from these Mr. Murray obtains a staff of 23 men and lads, and 22 women. Nine of these cottages are occupied by cottars supplying 14 female workers (of whom 13 are single women and one a widow); the remaining 15 cottages, as it were, under a voluntary system, contribute eight female workers.

" Mr. Murray's system is a family one, in every sense of the word; not only do his female house-servants all belong to the families of his farm-servants, but there were at the time I visited the farm six cottar houses occupied by the widows and daughters of men who had died in his service.

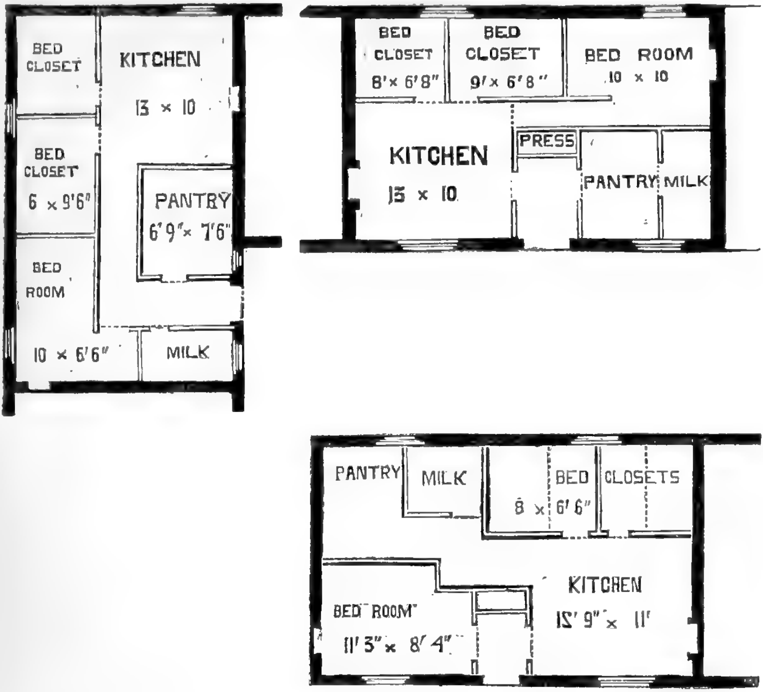
" It may be that Mr. Murray conducts his labour arrangements on what to most farmers would appear too benevolent a scale; but the enormous rent he pays from ordinary agricultural produce serves to contradict this, as well as to justify his boast, that during the quarter of a century he has occupied East Barns farm, no labourers of his or any members of their families have received parochial relief."

In reference to education, Mr. Murray, in reply to the schedule of questions issued by the Commissioners, states that—" Boys and girls are kept at school until they are 12 or 13 years of age, by which time it is understood that their education is finished. Occasionally, after a year's interval, they are again sent to school for a few months to revise their stock of learning. Evening schools also exist, at which the young people from 15 to 20 years of age have an opportunity of an additional revisal, of which they readily avail themselves. As far, therefore, as we are concerned, I see no necessity for interfering either with the labour of children or women." *

These satisfactory conditions, which are very unusual, not only in degree but in kind, exhibit the Scottish system of labour under a most favourable light. Many of the labourers on the farm were born on it, and if the labourer of the last generation does not still survive to do odd jobs and admire his grandchildren, it is most likely that he has left behind him the old wife, whose unconquerable activity finds vent in knitting stockings and general tattle. Thus we account for the fact that the inhabitants of the numerous cottages on the farm sheltered seven grandmothers and four or five grandfathers, and the whole population amounted to nearly 150.

* Appendix, part ii., to 'Fourth Report, 1870,' pp. 112 and 113.

*Fig. 3.—Plans of Cottages on the farm of East Barns.*

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## Fenton Barns.

Fenton Barns, the well-known occupation of Mr. George Hope, has already figured several times in agricultural publications: in this Journal, in the 'Transactions of the Highland Society,' and more than once in the different agricultural newspapers. The account given in the following pages is therefore less full than it would otherwise have been, especially in those particulars which have already been dealt with in detail by Mr. Stevenson, in his able Report on East Lothian Farming,* and by Mr. Algernon Clarke, in his Report on Steam Cultivation.†

Mr. Hope's occupation consists of 660 acres at Fenton Barns, and 230 acres at Dirleton. The whole of this is arable land,

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* 'Journal of the Royal Agricultural Society,' vol. xiv. p. 317.

† *Op. cit.*, 2nd series, vol. iii. p. 329.

with the exception of 3 acres on the home farm; but Mr. Hope rents the grazing of about 60 acres of old grass in Dirleton Park, besides the run of 400 or 500 acres of "links." He also, like many other Lowland farmers, has a sheep farm in the Highlands.

*Fenton Barns.*—On Fenton Barns the soil generally rests on interbedded felstone, but in parts intrusive greenstone or columnar basalt comes to the surface. The subsoil on two-thirds of the farm is composed of stiff retentive clay mixed with stones. On the southern portion of it, along its boundary, the Peffer burn, there is a vast bed of alluvial clay of great depth, mostly covered with slightly elevated banks of sand of the colour of dark raw sugar, though the clay comes to the surface in a few hollows. At the close of the last century this portion of the farm, extending to about 150 acres, was uncultivated: it lies from 25 to 35 feet above the level of the sea, which is three miles distant. Though the whole sandy portions had been early covered with clay, and the clay sanded, its cultivation was unprofitable until tile-drained; which rendered it fit for the growth of turnips. Nearly one-half of the remainder of the farm is composed of excellent loam, and the other half of heavy and lighter clay-land, the last portion being the least productive of the whole. As remarked by Mr. Stevenson, "the whole soil originally was more or less retentive, but has been changed in character by furrow-draining and a long course of liberal manurings." I learned from Mr. Hope that the whole farm has been drained with tiles six yards apart, and almost every ditch has had large tiles placed in it and covered up, giving the fields a warm and comfortable appearance.

*Dirleton.*—Mr. Hope's father tried the cultivation of about 150 acres of the Dirleton sands, for they are little else, more than half a century ago; but he found the crops so liable to be blown into the air that it is more than forty years since he gave up the attempt. Sixteen years ago, when the adjoining 120 acres came into the possession of the present occupier of Fenton Barns, he found that for about a mile along its northern boundary there was a bed of fine clay varying in width from 25 to nearly 100 yards. The whole of the surface of this, to the depth of 18 inches, Mr. Hope carted away, and spread the material on the sandy portions, at the rate of from 80 cartloads per acre to as much as 300 on the lightest parts, the carts taking back sand to improve the clay. Since the claying was done there has been very little blowing until last summer, when an acre or two of turnips were blown out of the ground after they had been singled, and only a very few plants were left. This circumstance is an indication that it will soon be necessary to give the land a second dressing of clay; but Mr. Hope thinks that even the worst parts will not this time require more than 50 or 60 cartloads per acre, and that such a quantity will last a considerable time, although of course the larger the quantity given the better it will be for the soil. The land, which had previously grown little or no herbage, was first sown with turnips, after having received a heavy dressing of Peruvian guano, dissolved bones, and bone-dust. The roots were eaten off by sheep, getting 1 lb. of linseed cake each per diem, and they were followed the next year by turnips again, treated precisely as before both in cultivation and consumption. These root-crops were followed by barley sown out with rye-grass and clovers, the seeds, which took well, being pastured for two years. Oats and rye followed the ley, and were succeeded by turnips again. From 10 to 15 acres of potatoes are grown annually at Dirleton, the seed being always brought from the west of Scotland and from off moss-land. The produce is used for seed in the following year at Fenton Barns, and the change is found highly beneficial. These potatoes are planted at Dirleton sometimes after turnips and sometimes after oats, as may be found most suitable.

The cultivation of the soil at Dirleton is all performed with horses. The ground is generally prepared for the various crops in the same way as at Fenton Barns, except for barley after turnips, which is merely grubbed to the depth of 2 or at most 3 inches, to allow the drill machine easily to cover the seed. This grubbing is done, if possible, in wet weather, which leaves the soil in small balls, and only one turn of the harrow is given after the seed has been sown. None of the sandy soil is ever rolled, even when open more than is desirable, as this operation invariably increases its tendency to blow.

*Courses of Cropping.*—Although many points of interest will be brought out by a comparison of the management of Fenton Barns with that pursued by Mr. Murray on the far richer soil of East Barns, it is fortunate for the reader of this and previous reports that Mr. Hope changes his mode of cropping from time to time. We may, in fact, consider that he has, during a series of years, striven to give a more perfect realization than usual to the idea embodied in the practice of adopting a given rotation. If it is desirable to change annually the nature of the crop which is grown on the land, and to grow a given number of crops in a certain order, to be repeated again and again,—Mr. Hope holds that it is equally desirable to change this order of cropping from time to time, to prevent a result which, though less disastrous than that produced by growing the same crop year after year on the same land, has still an undesirable influence on the general yield.

The course of cropping, however much it may vary from time to time, in order to prolong the interval betwixt grass and grass, is always subordinate to one principle, viz., to maintain a certain *proportion* between the various crops. At present, two courses are pursued: the first, which is the general course in East Lothian, on two-thirds of the arable land, and the second on the remainder:—

| No. 1. | No. 2. |
|---|---|
| 1. Seeds. | 1. Seeds } pastured. |
| 2. Oats. | 2. Seeds } pastured. |
| 3. Potatoes or Beans. | 3. Potatoes. |
| 4. Wheat. | 4. Wheat. |
| 5. Turnips. | 5. Turnips. |
| 6. Barley. | 6. Barley. |

In addition to the change which can thus be made by allowing the seeds to remain a second year, instead of taking a crop of oats, another alterative has been resorted to. Every field on the farm, with the exception of one, has once, but generally twice, been under potatoes after turnips, followed by wheat, and afterwards by seeds. This course was adopted in the first instance because the farm was literally overrun with wild oats; indeed, Mr. Hope once found it necessary to take three green crops in succession, for the purpose of cleaning a field. The potatoes taken after turnips perhaps scarcely yield so large a crop as those taken in the ordinary course and dressed with farmyard-manure; but this depends mainly on the proportion of turnips consumed on the land by sheep, also on the allowance of linseed cake they have received, and the state of the weather when the sheep were folded on the land. The succeeding wheat crop is invariably excellent, while the seeds, particularly the red clover, grow with a vigour unexampled after any other preparation. One 30-acre field of grass, which had been three times subjected to this cleaning process, carried more stock last year than any 60 acres on the farm.

## Crops.

1. *Oats.*—A strong furrow is now preferred for oats, although for many years Mr. Hope ploughed shallow. The ley is ploughed by steam, to the depth of 9 or 10 inches, in December or January, and the oats are sown in February if possible. Several experiments have been made on the farm in reference to the quantity of oats which it is most desirable to sow, and it has been found that about two bushels per imperial acre will generally give the best result, taking quantity and quality together. If the seed is sown too thin, there is lack of quality, and with too thick sowing the quantity is deficient. About nine

pecks is the quantity generally drilled on Fenton Barns; it is got in as early as possible, and the land is then harrowed, according to the season.

Cutting is done by the usual farm labourers with reaping machines; and it is not found necessary, as a rule, to employ any extra men. Last year, reaping was commenced with the wheat about August 1st, and carrying about the 12th, by which date nearly the whole of the oats and barley had been cut. As a rule, cutting takes about three weeks, as it is rarely that a whole field can be finished off without an interval. Ten days after reaping is over the whole of the carrying should be done.

2. *Beans.*—The oat stubble is dunged with about sixteen cart-loads per imperial acre, and the manure is ploughed in by steam with a very strong furrow. The land is harrowed down in February, and Fowler's grubber is put through it to the depth of 12 inches immediately after. The seed is distributed on the flat by a Ransome's drill, which has had every alternate spout removed, making the rows $16\frac{1}{2}$ inches apart. A mixture of beans and vetches is generally sown, the proportions being $2\frac{1}{2}$ or 3 pecks of tares to 4 bushels of beans. About 9 pecks of the mixture are drilled per imperial acre as soon as the weather will allow, generally about the end of February. Mr. Hope considers that by this system he gets a larger crop, and keeps his land cleaner, because covered, than by the 27-inch ridge system. He prefers vetches to peas, because they yield a better price and because cattle prefer tare-straw. Tare-straw and bean-straw are also given to the lambing ewes in spring, when turnips are getting short. When the bean-plants are well above ground they are horse-hoed once or twice, and hand-hoed and weeded once between. The produce of the crop of 1870 will be above 4 quarters of beans and 2 quarters of tares per imperial acre. The relative proportions of these grains vary with the seasons, there being generally fewer tares and more beans. A few acres of tares mixed with oats are sown for cutting green, and are found useful for most kinds of stock in dry seasons.

3. *Potatoes.*—The land is steam-ploughed as soon as possible after harvest, and grubbed in the spring after barley-sowing. It is then drawn off in 27-inch drills and dressed with from 16 to 18 tons of farmyard-manure per imperial acre, as well as 7 cwts. of artificial manure, chiefly Peruvian guano, and the remainder superphosphate and cotton-cake. Mr. Hope finds the cotton-cake answer extremely well; but, in his opinion, nothing can approach guano: he has used potash, but has given it up. Half-a-ton of potatoes are required to plant an acre. The setts are cut tubers, with one, or at most two, eyes. If the tuber is small, it is sufficient to cut off the "rose" end, and throw it away,

planting the remainder in one or two pieces. Mr. Hope's observation as to the effect of a number of eyes confirms that already stated. Some farmers have the extra shoots carefully pulled out. The after-management depends somewhat upon the season, as it is considered ruinous to touch potatoes in wet weather. As a rule, the land is rolled down immediately after planting, and then harrowed before the stems appear above ground; the crop is then carefully hand-hoed, and, when the plants are strong enough, the land betwixt the drills is deeply grubbed with two horses, and by and by it is ridged up with the double-mould-board plough; finally a narrow grubber is used when the stems are nearly touching each other (provided the weather is dry), the double-mould board plough again following. Harvesting is done with the ordinary potato-plough; and most of the crop is sent to London, as is usual in East Lothian.

One-third of the potato-course is on a two-years' ley, the seeds having been pastured by sheep and young cattle getting cake and turnips. In January, the ley is turned over with a furrow of not more than 4 inches, one of Howard's wheel-ploughs, with two horses, being preferred, as steadier than a swing-plough. This is followed by a strong furrow of 12 inches, done by three horses; and it is calculated that if the ley is broken at Christmas both these operations should be finished by the first week in February. The land then gets a dressing of 4 cwt. of guano and 4 cwt. of dissolved bones, or cotton or rape cake, and the further management is precisely the same as for potatoes after oats. Very little labour is necessary on this course during the summer, the land being thoroughly clean. Any couch-grass or weeds are exterminated by the shallow ploughing being followed immediately by the deeper furrow, which covers and buries the sod; and as the land becomes covered with potato-haulms early in the season, it has no chance of getting foul.

4. *Wheat.*—The bean stubble is ploughed with a shallow furrow immediately after the beans are harvested, and in a month or six weeks afterwards the land is ploughed a second time to the depth of, say, 10 inches. This affords time for the springing of any beans or tares lost in the cutting and harvesting, which are thus worked over and buried; but, above all, it in some way destroys the eggs or larva of a minute white grub with a black head, which in spring eats down the centre of the wheat plants, and thins and frequently altogether destroys the crop, rendering it necessary to re-sow the same. This had happened so frequently to Mr. Hope that he had resolved to sow no more wheat after beans; but learning from a friend that a second furrow, as described, was an effectual remedy, he tried the experiment some years ago and it has always met with perfect success.

After this the whole wheat-break is treated alike, whether after beans or after potatoes. It is steam-ploughed with a deep furrow about the end of October or beginning of November, and, in the course of a week or two, is sown with 2 bushels of Fenton wheat per imperial acre. Mr. Hope likes to sow on a stale furrow, and he would not get his wheat in until December, if he could be sure that the weather would allow of its being done then. He finds that the quality of the crop is better, and that it is ready for cutting a week sooner, by sowing as much as 2 bushels per acre than by using a smaller quantity of seed. After the seed has been harrowed in, it remains until March or the beginning of April, and when well up it is harrowed and rolled, and then generally Dutch-hoed by hand. The wheat, whether thick or thin on the ground, is invariably harrowed once; and when thick a second turn of the harrow is given, which prevents any over-crowding of plants. Sometimes it is horse-hoed; but generally there is sufficient strength on the farm for hand-hoeing. As a rule, wheat is not top-dressed; but a bad piece would get some nitrate of soda and guano mixed. Top-dressing is not much in favour at Fenton Barns, the theory and practice adopted being in favour of manuring heavily the previous green crops. The average produce runs from 5 to 6 quarters per imperial acre.

5. *Turnips.*—All the manure made previous to the ploughing of the wheat-stubble is applied at the rate of 16 cart-loads per English acre, as far as it will go; and the whole of the turnip-break is steam-ploughed in the autumn. The manure thus applied is not found to have quite the same effect on the crop as an equal quantity of as good dung applied in the spring; but Mr. Hope thinks the loss sustained in this way is not so great as would accrue to the manure if it were kept in a heap during the winter, and, besides, it saves a great deal of labour in the more busy months. In the spring, the land is harrowed, grubbed once or twice, and drawn into ridges, winter-made manure being then put into the drills, on that portion of the land which had received no farmyard-dung in the autumn. A good allowance of artificial manure is then sown previous to splitting the ridges, namely, from 6 to 7 cwts. of a mixture consisting of 4 or 5 cwts. of Peruvian, or a mixture of Peruvian and Ichaboe, guano, and the remainder superphosphates. The Ichaboe guano imported into Leith, for some years past, has been of excellent quality, and relatively cheaper than Peruvian. Preferably two-thirds of the roots, or at least the larger half, are Swedes; and the remainder consist of Fosterton Yellow Hybrid and either Greystone or White turnips, the quantity of seed sown per acre being about 2½ lbs. The after-management consists of two horse-hoeings, and one hand-hoeing after the plants have been

singled with the hoe. The root-crops generally range from 20 to 25 tons per imperial acre.

Not more than one-third of the roots are now fed on the land. Formerly as many as one-half were thus consumed, but it has lately been found necessary to reduce the quantity, owing to the high condition of the land making the following crop of barley so strong that it destroyed the seeds. The land is rather heavy for sheep, so that it is frequently impossible to keep them on turnips continuously. In such cases they are taken on seeds, and one inducement to draw turnips is the opportunity of feeding them on seeds, and thus improving the succeeding crop of potatoes. Wheat is still grown after turnips, but only on the land where sheep have consumed part of the crop on the ground, and which can be sown in good order before Christmas; but barley is preferred for spring sowing, as it always commands a very high price and meets with a ready sale.

6. *Barley.*—The land for barley is ploughed to a moderate depth as soon as the turnips are off and the sheep have run over to pick up the leavings. It is liked to get as much land as can be cleared exposed to winter and spring frosts for as long as possible. Spring cultivation consists chiefly of harrowing; but a piece of rough ground would be grubbed and gone over with a Norwegian harrow until a good tilth was obtained. About the 8th of March, or as soon after as the land is fit, it is drilled with Chevalier barley, about 9 pecks of seed being used per imperial acre. As soon as the barley is brairded, the mixture of seeds is sown with a broadcast machine doing 18 feet at a time and hoed in by hand with a Dutch hoe; and, if the barley is strong enough, the land gets a turn with the harrows. Some farmers prefer to sow the barley broadcast and use the harrows afterwards, thus getting rid of wild mustard. The barley-crop will average from 6 to 7 quarters, but some fields yield more.

8. *Seeds.*—The following is the mixture of seeds which is to stand for one or two years only, the quantities being per imperial acre:—7½ lbs. red clover, 3 lbs. white clover, 1½ lb. trefoil, 1½ lb. alsike, and 2 pecks of mixed perennial and Italian rye grass; but sometimes the quantity of rye grass is increased. No white clover is sown for cutting, but the quantity of red is increased to 9 lbs., and the rye grass is either about 1½ peck of perennial or 2 to 2½ pecks of Italian, or generally part of each, the quantities of trefoil and alsike remaining the same in both cases. The seeds which stand only one year are fed with sheep and a few cattle running together, and as a rule getting cake, especially if the stock is intended for the butcher. On the seeds intended to stand another year it is essential that the stock should consume cake on it. From 20 to

25 acres are annually mown for hay and stall-feeding; the aftermath is also cut, and in the autumn the land is grazed with sheep, which usually get turnips and cake for a time to ensure a full oat-crop.

## Stock.

*Sheep.*—At present Mr. Hope keeps at Fenton Barns a breeding flock of not more than 80 Border Leicesters; but formerly he had an additional score. His original flock was bred from the Buckley blood, but it was afterwards crossed with Border Leicester tups. The ewes run with the ram in October on the best seeds, getting either turnips or cabbage if the bite is not very good; afterwards they go on the two-year-old grass until lambing time, getting turnips, as before. If roots are scarce their place is supplied by meal and wheat-chaff, or by meal and beanstraw. Lambs begin to drop about the middle of February, but the beginning of March is a more favourite time. As the ewes lamb they are put on young seeds until the end of March, shelter-sheds being erected in the fields, in which they get turnips and cake, or meal; oats and bran are also esteemed good food at this time. The meal at present given to sheep is the refuse from the manufacture of starch from Indian corn, and the quantity given varies from 1 to $1\frac{1}{2}$ lb. per day, which is given mixed with chopped straw damped with water and a little salt.

Lambs are weaned about the first or second week of July, except in the case of those ewes to be drafted, whose lambs are taken away three or four weeks earlier. Weaning is done by sending the ewes to Dirleton links for a month or six weeks, which prevents their getting fat, the lambs remaining and getting the same food as before. Lambs are dipped soon after weaning, and again about the end of November or beginning of December. Shearing is commenced about the end of May, and is done by the two shepherds, assisted by three or four of the ordinary farm labourers, who get their food in addition to their usual wages while the operation lasts.

About 25 gimmers are annually introduced into the Fenton Barns flock, and the remainder are sold to the butcher when sheared. The crop of lambs is generally large, but it depends to some extent upon the food given to the ewes for a certain time previous to lambing. If cabbages have been given to them in any quantity, the lambs are most likely to number 175 for every 100 ewes. The hoggets are folded on turnips, the tup-hoggs getting cake, but not the females.

From 7 to 8 scores of Cheviot ewes are brought from Peebleshire to Dirleton farm links, and put to the ram. The lambs are partly sold in the autumn, and the remainder after being on turnips and cake for from three to four months.

About 200 three-quarter bred lambs from Dirleton Park and Farm are also annually fed on turnips, which are generally given on the seeds; or the lambs are, to a certain extent, folded on the roots and get 1 lb. of cake each daily. They are sold to the butcher as shearlings in May and June, generally weighing about 16 or 17 lbs. per quarter. The fleeces of these sheep weigh about $6\frac{1}{2}$ lbs. each on the average, but those of the Leicester flock will commonly weigh about 8 lbs. It is found, however, in the climate of Fenton Barns and its neighbourhood, that extra feeding has a great influence on the weight of the fleece, and as much as from 12 to 13 lbs. of wool may be grown by a highly-fed Leicester hogg.

About 200 Cheviot Dinmonts, from the hill farm in Peebleshire, are put as lambs on Dirleton links, and during the winter they go for two or three hours daily to a turnip-fold. In the summer they are grazed entirely on the links, and about the 1st of October they go on turnips. At the turn of the year they begin to get cake, and they are generally sold about the 1st of March.

*Cattle.*—The East Lothian system of paying labourers in kind necessitates a certain amount of provision for cow-keeping on the part of the farmer. Mr. Hope employs from 12 to 14 men, each of whom has the privilege of keeping a cow; he therefore keeps a pure-bred bull, and, as he generally buys the calves, he keeps about 4 cows to rear them, the number annually brought up running from 16 to 20. As there are from 4 to $4\frac{1}{2}$ calves to each nurse-cow, they are given porridge or bruised linseed-cake with milk-and-water, and are soon taught to eat oats and cake. Ultimately, they are put with the stirks, and fed-off with them. Half-Ayrshire and half-Shorthorn is the cross generally preferred in the east of Scotland for milch cows, but feeding beasts are liked the better the nearer they approach to a pure Shorthorn. October is the best month for buying beasts to feed on turnips, and Mr. Hope generally secures about 20 two-year-old Shorthorn steers from England, if possible, as well as about 30 yearling stirks, at this time. He also purchases in spring from 30 to 35 two-year-old cattle, which are grazed from home, but brought to Fenton Barns about the end of September and fed-off; thus making a total of from 90 to 95 cattle fed-off on Fenton Barns every year.

The steers are put up on turnips, with a little meal and salt; and in about 6 or 8 weeks they begin with 3 lbs. of cake per day, increasing ultimately to 6 lbs. They are frequently given as many small potatoes as they can eat, so they do not consume a very large quantity of turnips. Mr. Hope has in this way sometimes consumed nearly 300 tons of potatoes in a season. The stirks get from 10 to 15 lbs. per day of pulped turnips, with either 3 lbs. of linseed-cake, or 6 lbs. of meal, or 4 to 5 lbs. of cotton-cake, and chopped straw. By this treatment they are got into good condition for grazing the following summer, in the park already mentioned, until the first week in August, when they are put up in strawyards to be fed for the London market. Their food at the finish includes, besides turnips and from 6 to 7 lbs. of oilcake, either cut straw or wheat-chaff and bean-meal.

The stirks are always wintered at Dirleton, where, by the assistance of cake, they convert the straw into a fair manure with but few turnips, nearly the whole of this crop being eaten on the ground by sheep. Besides the purchase of upwards of 1000*l.* worth of artificial manures annually, for many years the bill for cakes and feeding stuffs has run from 1200*l.* to 1500*l.*

### Dowhill, near Girvan, Ayrshire.

This farm occupies a situation on the west coast of Scotland almost exactly parallel to that held by East Barns on the Lothian side. The soil, though very much poorer than that near Dunbar, is distributed in nearly the same manner; but the rainfall is at least double that of the east coast.

Dowhill is held under the Marquis of Ailsa by Mr. Bryce Wright, who is now commencing his second lease. His name is well-known in the south-west of Scotland as that of a race of first-rate farmers; and at least one of his brothers has carried the family reputation with him across the border to Beal, in Northumberland, where he now farms over 1000 acres by steam-cultivation, as already described in this Journal by Mr. J. Algernon Clarke.*

Of the 500 imperial acres comprised in Mr. Bryce Wright's occupation, about 30 acres are very light sandy land, one field of which is continually under potatoes, followed the same year by a fodder or root-crop; and the remainder is worked on a system to be presently described. The rest of the farm is nearly equally divided between light and heavy land; the latter occupying the lower-lying portions near the sea, and the former the higher ground farther inland.

The heavy land is farmed on a six-course shift, viz., oats, turnips, wheat, beans, wheat, and seeds; and the light land on the following five-course rotation:—oats, turnips, wheat, and seeds for two years.

The following description of the tillage-operations will probably be interesting on account of the wetness of the climate,

* 'Journal of the Royal Agricultural Society,' 2nd Series, vol. iii. p. 324.

the average annual rainfall being 48 inches,—a condition which is probably one reason why such large quantities of artificial manures can be applied to certain crops. In connexion with this subject it may be remarked that, in addition to large quantities of "sea-ware" annually applied to the land, the yearly expenditure on artificial manures is at least 700*l.*, the greater proportion of which is paid for guano, dissolved bones, and nitrate of soda; and in illustration of the extent to which "sea-ware" is used, I may mention that the dressing which had been applied to one field for swedes last year was no less than 70 cartloads per Scotch acre of that natural fertiliser, besides 7 cwt. per acre of a mixture of dissolved bones and Peruvian guano.

The comparison instituted between East Barns and Dowhill will not hold good in reference either to farm-buildings or labourers' cottages; but the landlord is about to erect a new farm-steading at Dowhill, and will doubtless complete his scheme of improvement by building some new cottages for married labourers, of which the whole district is sadly in need.

The ordinary farm-labourers are engaged by the year; they get a house and garden rent free, also carting of fuel, and $10\frac{1}{2}$ bolls * of meal, with a money payment of from 18*l.* to 22*l.* per annum. If they work satisfactorily, they are given a certain quantity of potatoes in excess of their bargain.

The yearly expenditure for labour is nearly 30*s.* per imperial acre, in addition to the perquisites already mentioned, of which it is difficult to estimate the money value.

*Oats.*—The ley is not touched until about the 1st of February, when it is ploughed to the depth of $5\frac{1}{2}$ inches on the light land, but with a stronger furrow on the heavier soil. Oat-sowing commences about April 10th, from 4 to 5 bushels per acre of white oats being distributed with Sheriff's broadcast machine, which is followed by harrows according to the strength of the land. The oat-harvest generally commences with the month of September; the ordinary farm-labourers working the reaping-machines, and extra hands doing the other work, with the exception of sheafing, which is done by girls at 2*s.* per day without food. The extra harvestmen are engaged for the whole harvest-time, one month's employment being guaranteed at 15*s.* per week and their board. Leading is not generally finished until the beginning of October.

*Turnips.*—The stubble is turned over immediately after the oats are off, the plough going as deep as two horses can work it. It then remains during the winter until the spring-corn, beans, and potatoes are all in, which is about April 20th.

* A Scotch boll is equal to four imperial bushels.

The land is then harrowed, cross-ploughed as deeply as in autumn, and harrowed again, and the heavy land is gone over with a peculiar wooden implement, locally called a "slipe." This apparatus consists of a heavy rectangular frame, with iron-shod cross-bars beneath; when weighted with stones and dragged over the land it assists in the process of pulverization. The principle of its construction is the same as that of the Belgian "traineau." When a sufficiently good tilth has been obtained, the drills are made by a single-wrest plough going and returning. Three ploughs are kept going together, and each is followed by a man sowing artificial manure, no farmyard manure being used for turnips as a general rule. One seed-barrow, doing two drills, follows the manure, and will about keep up with the three ploughs during the day. The manure for roots will amount to as much as 4 cwts. of guano, 3 cwts. of dissolved bones, and 10 bushels of ground bones per imperial acre. If the ground bones are omitted, the total quantity of the other substances is increased to 11 or even 12 cwts. Skirving's Purple-top swede and Hybrid Yellow turnip are the sorts generally used, 5 lbs. of seed being required to ensure a braird, except near the sea, where not more than half the quantity is sown as a rule. A few White Globe turnips are occasionally grown if keep is deficient, or else a small quantity of Greystones for young stock.

As soon as a good braird has appeared, a two-horse grubber is passed along the drills, and this is followed by a light harrow. The plants are singled, by hoe and hand, to 14 or 15 inches apart, and hand-hoed afterwards as may be required. The winter climate being too wet to allow of roots being fed-off on the land, the whole crop is drawn, topped, tailed, and stored in pits. Turnips are lifted by New Year's Day, and swedes during the month of January. About three-fourths of the roots grown are swedes, and an average crop of them will weigh about 20 tons per imperial acre.

*Wheat.*—As the turnips are drawn the land is ploughed to a depth of not more than 5 inches, being already loose from having been deeply grubbed during the growth of the roots. One-third of the strong land on the farm being annually in wheat, there is not sufficient foldyard manure* for the whole of it; therefore, after it has been exhausted by applying it at the rate of 25 to 30 loads per acre previous to ploughing, the remainder of the wheat-course is dressed with from 3 to 4 cwts. per Scotch acre of Peruvian guano directly after the seed is sown. Immediately after ploughing, viz. some time in January, white wheat (generally Archer's Prolific) is sown broadcast by hand, the wetness of the

* For wheat a compost of farmyard manure and sea-ware is generally prepared during the summer and autumn.

climate requiring the use of as much as 4 bushels per Scotch acre; but if the land is dry enough the broadcast machine is preferred. The harrow follows the seed, and the guano is applied at the same time. About the 1st of April a top-dressing of from 2 to 3 cwts. per acre of dissolved bones is sown on the braird, if it is thought desirable; for observation has taught Mr. Wright that while guano enables the plant to "come away" during the winter, dissolved bones give firm straw and better grain. After top-dressing the plant is harrowed and then remains until ready for the reaping-machine, which is generally about September 1st. Harvesting is done as already described for oats.

*Beans.*—If the wheat-stubble is clean, the manure for this crop is placed directly upon it; but if the land is not clean enough the stubble is turned over and the manure is put into the drills in the spring. The manured stubble is ploughed deeply in autumn and broken down with harrows in spring; it is then marked out by a plough in 12-feet stetches to suit the broadcast sower, which follows immediately, sowing the beans on the surface. The seed is ploughed in with a light furrow, a light harrow follows, and finally the land is smoothed down with a roller. These operations are performed about the middle of March, following one another as rapidly as possible.

The method pursued on the land which has not been manured in the autumn is the ordinary system of drills, 27 inches apart, as will be described below when treating of potato-culture.

The after-management of beans is the same as that of turnips. They are harvested after the grain-crops are in, the cutting being done by reapers after each drill has been gone over by hoers to bury stones, and thus prevent injury to the machines. Bean-straw is used only for litter.

*Wheat after Beans.*—The bean-stubble requires to be turned over, grubbed, harrowed, and thoroughly worked immediately after harvest, to destroy the insect that harbours in the bean-stalk, and that would otherwise frequently attack the roots of the wheat-plant. As soon as possible after New Year's Day the land is ploughed, sown, and otherwise managed in the same manner as in the other wheat-course.

*Seeds.*—The mixture used consists of 1 bushel of perennial rye-grass, 1 peck of Italian rye-grass, 4 lbs. of red clover, 3 lbs. of white clover, and 2 lbs. of alsike; and on the hilly land 1 lb. of trefoil is added. The seeds are sown about the middle of April by the broadcast machine, a heavy harrow preceding it on the strong clay land to prepare a tilth for their reception.

Sheep generally get a run over the young seeds for a few days in the autumn, care being taken that they do no injury. Early in the following spring a top-dressing is applied, consisting of a mixture of Peruvian guano with either nitrate of soda or sulphate of ammonia, the quantity being about 3 cwts. per Scotch acre. Seeds are seldom mown, but when this is done the aftermath is fed. As a general rule, four-fifths of the first year's seeds are grazed by sheep, and cattle are soiled with the remainder. About two or three cuts are obtained for soiling, a second top-dressing of nitrate of soda being given after the first cut. Hoggs are put on the pastured seeds, getting cake or corn, and are sold off by the 1st of July; and, in about a month's time, lambs, newly bought in, are put on the same land until autumn, when they are transferred to the fields which had been cut for soiling during the summer.

*The Thirty Acres.*—This land is too light and poor to be managed in the ordinary way; it is therefore farmed on a five or six course, comprising only one white crop, viz. wheat, followed by seeds for three or four years, and succeeded by early potatoes and a catch-crop of turnips or green food. One field has for many years been in potatoes every spring, followed the same year by rye-grass; but this year the catch-crop was turnips.

The catch-crop having been removed to be fed by cattle, the land is prepared and wheat is sown in the same way as on other portions of the farm after turnips; and the same mixture of seeds described already is sown in the spring. These seeds, after remaining three or four years, are broken up in November by ploughing 5 inches deep with a broad share. In February the land is cross-ploughed, grubbed, and harrowed, and drawn out in drills by a double-mouldboard plough. Not less than thirty cartloads of farmyard manure per imperial acre, as well as 5 cwts. of Peruvian guano upon it, are put in the drills, and upon this pabulum the early potatoes are planted, 17 cwts. of cut setts being used per acre. After the ridges are split by the double-mouldboard plough, the crop is treated in the same manner as swedes. The potatoes are sold, generally for the Glasgow market, at a certain price per acre, which includes carting the crop to the nearest railway station; but the purchaser is at the expense of lifting, and contracts to do this by a certain date, generally about the 22nd of June.

After the potatoes are off, the land is sown with either turnips, rape, or grass-seeds. If the last-named crop is selected, the haulms are removed, the land is harrowed, and sown immediately with 3 bushels per imperial acre of Annual Rye-grass. If turnips or rape is to be grown, the land is ridged, the haulms are put in the drills, and the seed is sown in the usual manner. In both cases a dressing of artificial manure is given, generally about three cwts. per acre, or even four, of a mixture of dissolved bones and guano. This light sandy land will not bear turnips often, as it has a tendency to become turnip-sick very soon; but on the field which had been potatoes, followed by artificial grass for several successive years, I saw last autumn a catch-crop of white turnips which was the largest crop of roots, if not the heaviest, that came under my notice anywhere last year. The only question in my mind was whether such enormous bulbs were sound to the core; but I have since been assured by Mr. Wright that my doubts were entirely unfounded.

*Sheep.*—Until recently no sheep have been bred at Dowhill; but last year Mr. Wright commenced keeping a breeding flock. This system having been so recently tried cannot yet be looked upon as more than an experiment, so the following description is given as illustrative of the practice during a series of years, when a feeding flock was alone dealt with.

The annual purchase of sheep for feeding generally consisted of half-bred lambs to the number of from 300 to 500. They were bought on or about the 20th August, and put on seeds that had recovered their growth after having been fed by the previous flock. About the 1st of December they were folded in some sheltered fields, and given sliced turnips, with either Indian corn, peas, or oilcake—about 1 lb. each per diem—until the middle of April or May Day, when the ewe and wether hoggs begin to go off, being sold alive in their wool. Some are kept until the 1st of June, or later, being put on new seeds in the mean time, and still getting corn or cake until fit for market. These are clipped immediately before being sent away, shearing commencing, as a rule, about the 1st of June. Shearing is paid for as day work, and it is thought desirable to get rid of every sheep off the farm by the 1st of July.

*Cattle.*—From 30 to 40 two-year-old bullocks—generally shorthorn crosses—are bought in the beginning of March, and put into boxes and yards; tying by the neck not being an article of faith with Mr. Wright. Their food will consist of swedes or potatoes, with about 3 lbs. per day each of cake or corn; generally the former. They begin with swedes, roughly cut, and continue them as long as they last, afterwards getting washed potatoes. In about two months soiling is commenced, the cattle being kept single as much as possible, and in loose boxes. At the commencement of soiling, the grass is cut morning and evening as required, and given fresh immediately after each cutting; but in the summer one cutting per diem is considered sufficient, if the quantity required for the second meal is protected from the sun. In addition to the grass the beasts get at least 3 lbs. of cake each per diem, and plenty of straw; and they are fed thus three times a day at regular hours, being also well supplied with water, which is very necessary to soiling animals. These beasts generally go off during July, or by the 1st of August at the latest, and their places are supplied by drafts of another lot of between 30 and 40—which are bought in April as they can be picked up—and are kept in fold-yards until places can be found for them in the boxes. Mr. Wright has thus about 70 beasts on the farm at one time, and of these from 10 to 12 are always fit for the butcher should a good offer be obtained. Mr. Wright considers that by the soiling system, under his circumstances, and especially in his climate, he can feed three times the number of beasts that he could by pasturing. There is no waste of grass, and the extra expense of cutting and feeding is very trifling. Another consideration is the increased value of the dung-heap formed by cake-eating beasts under the soiling system, especially as cake is not stinted if it is found that the cattle will eat it in larger quantity. The soiling treatment of the second lot continues until turnips come in, because additional cuttings of "seeds" can always be obtained in a moist climate by judicious top-dressings. It is always preferred to get beasts that have passed the previous winter in strawyards; and after soiling it is necessary to begin turnips with caution. Bean meal is used occasionally, especially for milch cows.

*Horses.*—As the surface of this farm is very hilly, and some of the land very heavy to work, it is found necessary to keep from 18 to 20 working horses. In summer they rarely go out to grass; but they get a good allowance of oats, with clover cut the day before and tossed about to dry it a little, as it is preferred not to give it quite green. In winter they get a night mash of boiled swedes and potatoes mixed with Indian meal, and during the day are well fed on oats and straw.

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## Holmston and Friarland.

These farms, in the occupation of Mr. James Drennan, are situated a short distance from the county town of Ayr. The methods of arable cultivation pursued on them are given as showing what may be done in a district a little farther from the coast than Dowhill, a little less shut in by hills on the land side, and presumably a little less moist in climate. The average rainfall during the last 15 years has been nearly 35 inches. Possibly these differences may account for certain English features in Mr. Drennan's practice, *e.g.*, his autumn cultivation for roots and his early period of sowing wheat.

The extent of the Holmston farm is 240 acres; nearly 200 being a light or medium loamy soil, and the remainder a heavier land more comparable with Friarland. The latter occupation is essentially a dairy farm, and consists of about 122 acres of land under rotation, and 28 acres of permanent grass, 21 of which have been laid down within the last ten years.

The light land at Holmston is farmed on the five-course shift prevalent in the district, viz., oats, roots, wheat, and seeds for two years; the seeds are all pastured, and sometimes on the weaker land potatoes are taken on the ley instead of oats: they are succeeded by roots, and the remainder of the rotation follows in the usual order. The heavier land at Holmston is worked on a four-course shift, oats being taken after seeds and wheat after turnips; but sometimes beans are taken instead of seeds, so as to double the interval between the clover-crops.

Friarland being held chiefly as a dairy-farm, the ordinary five-course shift is extended for the purpose of allowing the seeds to remain three years instead of two. They are mostly cut the first year, and entirely pastured the two following seasons.

*Oats.*—Ley-ploughing is done between New Year's Day and the middle of March, as opportunities may offer; a good harrowing is then given, and the seed is drilled, if possible. But in a fickle season, when time is precious, the broadcast sower is used as being more expeditious. Finlay oats are generally sown by Mr. Drennan, as well as by most farmers in the west of Scotland, though they are not liked in the Lothians and other eastern districts north of the border; but the western farmers possess the confidence which is bred by experience, and although they have often tried other kinds, they have invariably gone back to their old and valued servant. The Finlay is a white oat, a little later than the potato, being also longer and thinner, and consequently lighter; but the great point is that it stands the wet climate of the west better than any sort that has been tried in its stead. It is preferred to finish oat-sowing by the end of March, if possible; and the quantity of seed used is $3\frac{1}{2}$ bushels per acre by the broadcast machine, and about half a bushel less by the drill.

*Roots. Autumn Cultivation.*—As soon as harvest is over the oatstubble is grubbed two or three times. The first time it is merely scarified to the depth of about 4 inches, and when the land is dry enough it is grubbed deeper: sometimes it is gone over a third time, but both the second and the third grubbing are done with a Finlayson drag as deep as four horses will work. The plough follows about November, and it is liked to give a well-turned furrow of 9 inches or thereabouts with Fowler's double-furrow plough. Some of the heavy land may not receive the autumn cultivation just described, which is exceptional in Scotland, though it is practised to a considerable extent in the early district near Ayr; but if the season will not permit it, the farmer has to be content with giving a single ploughing.

(*a*) *Turnips.*—The turnip-land is generally the heavier portion of the root-course, the lighter land being reserved for potatoes, mangolds, and carrots; it therefore requires a great deal of cultivation in the spring. After a good tilth has been obtained by grubbing and harrowing, the land is drawn out in drills in the ordinary way and manured with about 25 cubic yards of farmyard-manure, or its equivalent in town-manure from Ayr. The quantity of the latter is increased in accordance with its want of quality, being generally not so rich as well-made farmyard-manure. Most of the manure on the farm is used for potatoes, and what is made after potato-planting is used for turnips at Holmston, as far as it will go. In addition to this dressing, swedes get about $1\frac{1}{2}$ cwt. per acre of Peruvian guano, 4 cwts. of superphosphate, and about 4 cwts. of half-inch bones. Common turnips receive less guano, but the same dressing of bones and superphosphate. As soon as the manure is covered, from $2\frac{1}{2}$ to 3 lbs. per acre of seed is drilled, the sorts preferred being Dickson's and Purple-top swedes, and Purple-top Yellow and Aberdeen Yellow turnips. At least as much seed is sown for turnips as for swedes, because the former being sown later, there is more risk of fly. A little Greystone turnip is also sown for early use by the dairy stock. Swede-sowing commences about the middle of May, and ends preferably about the 24th or 25th, though sometimes it is not finished until the end of the month. Yellow turnips should all be in by the 10th of June, as in ordinary seasons the chance of a full crop diminishes very rapidly after the first week in the month, if the seed is not all sown by that time. Greystone turnips are sown earlier, about the last week of May, so that they may be ready for the dairy cows to begin upon. The proportions of the kinds of turnips grown vary considerably, according to the nature of the land that is available for the shift.

The after-management of turnips consists of grubbing, as often as may be necessary, to keep the land clean and open between the drills, singling by hand when ready, and hoeing, the plants being set out to 12 inches apart for swedes and 11 inches for common turnips. The whole of the crop is drawn and put into pits, and in a good season all the roots on Holmston will be up about the beginning of December; but at Friarland they cannot be drawn quite so early. Twenty tons per imperial acre may be considered an average crop of swedes.

(*b*) *Potatoes.*—Thirty acres of potatoes and carrots are grown annually. The system of treating the land in spring is essentially the same as that described for turnips; but, being lighter land, and generally well prepared in autumn, it does not always require the grubber. The drills having been made by the double-mouldboard plough, a dressing of 32 cubic yards per acre of farmyard-manure is laid in them. Upon this is sown the following mixture of artificial manures, the quantities being per imperial acre :—4 cwts. of Peruvian guano, 4 cwts. of a mixture of superphosphate and American crushed bones, 4 cwts. of half-inch raw bones, and, last season, about 2 cwts. of German kainit. In reference to the last-mentioned substance, and also to muriate of potash, it is worthy of record that Mr. Drennan has found that if it be freely applied to the land the potatoes exhibit an increased tendency to become diseased. Less manure is used when the potatoes are planted after the first week of April.

The setts are partly cut and partly small potatoes, the latter being preferred if they have been raised before they are quite ripe enough for market. Mr. Drennan retains these small unripe potatoes when raising for the early Glasgow and Newcastle markets. About 12 cwts. of potatoes are required to plant an acre. The setts having been covered by splitting the drills with the double-mouldboard plough, this implement is used again in the course of two or three weeks, having been preceded by a light chain-harrow. When the plants begin to peep through, generally early in May, a light saddle-harrow is used for the purpose of lightening their covering, and making them a little earlier if possible,—a great point when early potatoes are grown. After this, about the 20th of May, a drill grubber is passed through them, and then the plants are hoed; and about the beginning of June, or a little earlier in a forward year, they are earthed up with the double-mouldboard plough. If the crop is to be raised in July for the early market, the plants remain undisturbed from this time until the roots are lifted; but if it is decided not to raise them until the middle of August or later, they are earthed up once more, in the same manner as before, to keep down annual weeds and prevent green potatoes from peering through the surface. Mr. Drennan prefers the latter system, as with highly-manured land he gets a larger crop of potatoes, and, remarkable though it may seem, a much better crop of wheat the following year. The common explanation of this circumstance is, that with early raising the manure is wasted by exposure to the sun during the hottest part of the season. For the early crop the drills are 26 inches apart, but for the later the distance is increased to 27 or even 28 inches. As the rule, no catch-crop is taken after potatoes; even the early potatoes have not been lifted in time for several seasons.

Potatoes are harvested with Hanson's patent potato-digger. The early crop may yield from 4 to 6 tons per acre, according to the time of raising; but at the season of the year when they are raised the growth of the tubers is very rapid, and if left until the latter half of August the same crop may be doubled in weight under favourable weather. As on other farms in the district, all the tillage operations are performed by the yearly labourers or as day-work.

(*c*) *Mangolds.* — A few acres of this crop are grown every year, the land being cultivated and manured in the same manner as for potatoes; the seed is drilled, and the plants are hoed and singled as swedes. The headlands of the potato-fields are also cropped with mangolds transplanted from a seed-bed, the great secret of success being to raise the young plants carefully so as to preserve the small roots. If this be done properly, the plants are not thrown back more than a few days; and in 1869, although they were transplanted in very hot dry weather, a full crop was got by watering plentifully as they were put into the ground; while the expense of lifting the young plants, planting out, and watering, was not more than 1*l.* per imperial acre.

(*d*) *Carrots.* — The spring cultivation for carrots is precisely the same as for potatoes. Seed to the quantity of 10 or 12 lbs. per acre is rubbed and riddled, and sown with a seed-barrow, having outlets larger than for turnips. Seed-time commences before the middle of March with Intermediate carrot, and finishes about the end of the month with Altrincham. Two rows are placed on each drill, and by this method the crop is nearly doubled. Carrots require a great deal of hand-weeding, and cannot be dealt with to any great extent by the hoe; they are set out to about 3 or 4 inches apart, and it is considered essential to have them at regular intervals. When they are grown at greater distances they become coarse, and are not so marketable. The crop is harvested either by digging or pulling up. The Intermediate sort goes to the Glasgow market in bunches about the end of August or the beginning of September; and the Altrincham is sometimes stored in pits, but sometimes left in the ground all the winter, where they will keep very well in ordinary seasons, with a little covering of earth put on by the drill-plough. They are not safe in the ground, however, with such severe weather as was experienced towards the end of 1870.

*Wheat.*—The potato-land is ploughed, with a shallow furrow of about 5 inches, in October; and the turnip-land is similarly treated as soon as the roots are stored. Wheat is sown very soon after; a drill is preferably used if the land is in good order, but a broadcast sower is generally resorted to on the heavier land. Until the last few days of October, about 2 bushels of white wheat, generally Woolly Rough Chaff, or sometimes Red Chaff, is distributed per acre, and then a light harrow is passed over the land just to level the surface. As the season advances, or when the land is not in the most satisfactory condition, the allowance of seed is increased. When turnips are not stored soon enough for autumn sowing, wheat is not got in until spring. Top-dressing is not often practised, for land that has been well manured for the preceding green crop is regarded as being already in a sufficiently high condition.

*Seeds.*—The general mixture of seeds for pasturing is 1 bushel of perennial ryegrass, ½ bushel of Italian ryegrass, and 7 or 8 lbs. of mixed clovers, containing alsike white clover and cowgrass with a little trefoil. Red clover is not sown for pasturing; but on the land under a four-course rotation it is sown to the exclusion of any other clover-seed, the mixture being 1½ bushel of perennial and Italian ryegrass and 8 lbs. of red clover. In either case the seeds are sown about the first week in April.

*Beans.*—When beans are taken instead of seeds the wheat-stubble gets a light dunging in autumn, or during a favourable time in winter; and it is ploughed with a 7-inch furrow when it is in fit condition, being mostly heavy land. There is seldom time for drilling beans in spring. The seed is sown broadcoast on the furrows, about the beginning of March if possible, and is immediately covered by harrowing; and the crop is cut with a reaping-machine.

*Dairy Cows.*—The most of the grass is eaten by Ayrshire cows in summer. Twenty-five are kept on Friarland. They are let in what is called a *bowing* in the dairy districts of Scotland. The cattle, the food, the dairy furnishings, and other things required for the management, are supplied by the farmer. The *bower* does the work, disposes of the produce, and pays a stipulated rent for each cow. In addition to hay and oat-straw, stated quantities of bean-meal and turnips are given as winter food. Young grass is brought forward by top-dressings for cutting early in summer, and clover and tares are used as auxiliary food farther on in the season. When grass begins to fail in autumn, cabbages or soft turnips come in. It is considered profitable to feed well all the year round.

About forty cows are kept on Holmston. They are not let, and, of course, their auxiliary food may be varied as price and other circumstances may make it expedient to do so. The cows have generally a good bite of grass about the middle of April. The seeds come early, and the growth is quickened by a top-dressing of guano, which, unfortunately, is now becoming too dear for profitable application. With his light land, Mr. Drennan is inclined to depend more upon a liberal use of raw half-inch bones in the root-course for sustaining growth throughout the rotation. During the greater part of the year the whole of the milk is churned. The butter is sent to Glasgow, and the butter-milk is retailed in Ayr. But part of the milk is made into cheese for three months in summer, at the time when milk has its highest value for cheese-making, and when butter and butter-milk are cheaper than during the rest of the year. The cheese is made according to the Cheddar system, which Mr. Drennan and Mr. Cunninghame, of Chapelton, acting for the Ayrshire Agricultural Association, were instrumental in introducing to Scottish farmers in 1854.

*Young Cattle.*—Eight or ten calves are reared annually, to keep up, in part, the dairy stock. They graze away from the farm, on rented fields, in their second and third summers. Some of them come in as dairy cows in the back end of the season, when they are a little more than 2½ years old. They give supplies of milk in winter, and generally have calves afterwards about the same period of the season. The rest come in as three-year-old in spring.

*Fatting Cattle.*—The cows are fed on the farm when it is thought desirable to remove them from the dairy stock on account of age, inferior milking qualities, or other causes. As they are generally in good condition, they are not put up long before they become ready for the butcher. The Ayrshire cow is a small animal; but she is valuable for transforming food into milk, and if her price at the end is not very high, she is put away without much expense. A few cattle are purchased for feeding in autumn, or about the beginning of winter, according to the supplies of food or the state of the markets. Altogether, about 30 have been fattened this season.

*Sheep.*—About a hundred cross-bred lambs are annually bought in the autumn. They get the aftermath on Friarland; and the seeds, which come up rapidly amongst the wheat-stubble on warm land in a moist climate, give further supplies of food. From about Christmas they get a little grain, and if the winter is favourable, they are sometimes fit for the butcher about the beginning of March.

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## II. Harvey's Dairy Company.

The establishment about to be described is situated on the very top of Hundred Acre Hill, at Port Dundas, Glasgow. Whatever *rôle* Nature may have intended for Port Dundas, it is now about the most unlikely spot in the world for the locality of a monster dairy. Rope-walks and anchor foundries, dirt and dry docks seem in their element. But the Dairy is also there, and, until the outbreak of the Cattle-plague, a very notable establishment it was. From 800 to 1000 cows in milk were then the usual number, and were the *raison d'être* of a series of long wooden sheds that stand, as black as coal-tar can make them, in long parallel rows, with their gables abutting against an open space in front of an engine-house. The latter structure belongs to a distillery, to which the Dairy is most extensively indebted. By means of its engine, liquid manure from the cow-sheds is pumped into tanks erected on the highest eminences on the farm belonging to the Dairy Company, and the distillery refuse is a nutritious and milk-producing food, which is used in considerable quantity.

The following description, extracted from the late Mr. H. H. Dixon's 'Field and Fern,' will give an idea of what this dairy was a few years ago:—

"Mr. Harvey's byres are distinguished by different names—'The Parlour,' 'The Thistle,' 'The Halloween,' 'The Waterloo,' 'The Malakoff,' and so on. There were some 1700 cows and queys in all, and about 1000 of them in milk, and feeding on turnip, cut straw, and distilled grains. The bulls, which stand with them, are mostly shorthorns, and so are 300 of the milch cows; the rest are Ayrshires, with the exception of a few polls and recently a sprinkling of Dutch. They stand in long ranks tail to tail, and the scourings fall into the gutters behind them, which are duly flushed down. Hence each beast has to be very accurately told off, on her arrival, into a byre, whose stallage exactly suits her length. In some of the byres there is only one line of cows, and the calves are in small partitions opposite them.

"About fifty of the queys are kept each year, and go as yearlings and two-year-olds to parks down the Clyde, and the rest are dismissed as 'slink veal' (to adopt the term of the trade) to the butcher soon after they are calved. Thirteen cows are allotted to each milker, seven of whom live on the spot, and the rest arrive at milking hours from Glasgow."

Since the Cattle-plague, the Dairy has dwindled but not decayed. Not more than 150 cows are now housed in the home shippons; but the Company contracts with the neighbouring farmers for the supply of a very large quantity of milk, which raises the total amount of the saleable commodities up to the estimated produce of 800 cows. Ayrshire cows and shorthorn bulls are preferred at the home-steading.

Cows are bought just previous to calving to replace those which have gone to the butcher; and in 1869, about fifty passed through the manager's hands in this way. Those of their own breeding are kept on for four, five, or six years; and those that are bought are retained according to the age at which they come in. March, April, and May are the months most preferred for bulling, as they suit the winter trade; but great care is taken to have a sufficient number of late calvers, as many of the earlier cows run dry suddenly towards the fall of the year. A cow should become dry at least five or six weeks before calving, and the late calves should all be dropped by the middle of May. No cows are put to the bull in September and October, nor in the early part of November, as June and July calves are not wanted; therefore the season preferred commences about the end of November or beginning of December.

Calves get 2 gallons of milk each every day for about five or six weeks, and then skim-milk for the same length of time. In summer they are turned out very early, but a large proportion are winter-calves and require the above treatment, especially as the Ayrshire and shorthorn cross gives a heavy calf that requires a good deal of feeding.

In some years, when food is plentiful or milch cows are dear, a certain number of stirks are bought; and similarly when feeding-stock is cheap the cows are kept longer.

The cows are milked three times a day, and about one-half of the produce is set for cream. As the Dairy Company do a "family trade" a large quantity of cream is sold in the ordinary course of things; and there is a good demand for skim-milk among the working classes. On an average, the quantity of milk to be dealt with is 1500 gallons daily, of which about 800 are set for cream. The morning milk is all sent away warm, the afternoon yield is about half set, and cream is taken from the whole of the evening produce. This practice is necessary because, although twelve salesmen are employed, there are but two deliveries daily, although there are three milkings, and the last delivery is over by four o'clock in the afternoon. Wooden tubs, as shallow as possible, are preferred to set the milk in; and it is liked to let the milk remain as long as possible, in the shallowest possible tubs, so as to obtain the maximum yield of cream.

In June and July, a certain proportion of the produce is churned, as about this time of year there is a slack demand for milk during six weeks or thereabouts. Milk, cream, and skim-milk are mixed together before churning, this being considered the most profitable method. All the milk is soured, and about 1 lb. of butter to 3 gallons of milk is regarded as an average return. Three of the old-fashioned Scotch churns are used, if necessary, and about 300 gallons can be dealt with at one time. The butter comes in about an hour and a half, including the time occupied in taking off the butter once or twice and brashing; the actual churning, therefore, does not occupy more than about an hour.

About the first ten days of October, it is reckoned that the grass-land requires the cows to be taken off, and after that time they remain entirely in the shippons until about the latter end of April or the beginning of May. During these seven months the daily food commences with draff (distillery refuse) about four or five o'clock in the morning, mixed with bean, pea, or Indian meal, but preferably the first-named, unless beans are too dear, when mixed kinds of meal are substituted. Linseed cake is occasionally given at this time to cows beginning to run dry, and also in spring to those that require a little laxative. After the first milking, viz., about seven o'clock in the morniug, as much distillery refuse as they can take is freely given; and at eight o'clock either oat-straw or hay (if possible). The latter is generally rye-grass hay off the irrigated fields to be described presently. The next feed consists of raw turnips or cabbages, given about ten o'clock, and at eleven the cows are milked for the second time. The afternoon meal is given at two o'clock, and consists of steamed meal, turnips, and draff. At four o'clock some fodder, generally straw in the afternoon, is placed in the mangers, and between four and five more draff is run in. Some turnips are always put in the steamed food. At five o'clock the cows are milked for the third time, and are afterwards made up for the night.

During the summer the cows get nothing in the shippons except a little draff in the morning, when they come in to be milked, except towards the fall of the year. They are then allowed some fodder at midday; and in a bad season they get a little meal with their draff in the morning. They are kept on the pastures all day, but are brought up to the steading to be milked at about eleven o'clock, as well as at night.

The solid manure from the shippons is sold to the neighbouring farmers; but the liquid manure is pumped to a fountain-head a few feet above the highest part of the farm, and distributed by gravitation to auxiliary tanks by two branches, which run east and west from the main receptacle. The pipes ($2\frac{1}{2}$ inches in diameter) run underground, and are furnished with stopcocks, so that the manure may be shut off from any portion of the farm and diverted to any other. The engine begins pumping in the morning after churning, and continues as required. Irrigation is done on the well-known Kennedy system, which at one time took some hold in the south of Scotland, and is probably better known, as it is certainly more favoured, in France and Belgium than it is in England. The method is briefly as follows:—An iron pipe is connected with the nearest tap to the portion of land to be irrigated; and to this $\frac{1}{2}$-inch iron pipes, in lengths of 6 feet, with spike and faucet joints, are connected so as to reach the farthest point to be dealt with. To the last piece of tubing a hose and jet are attached, the sewage is turned on, and the land "watered" by the man in charge, who has a boy with him to carry pipes to and fro, lay them in their places, turn taps on or off, and do other odd jobs. When the land within reach of the hose has been sufficiently saturated, a certain number of lengths of pipe, generally about 100, are detached, and the terminal length with the hose shifted accordingly. By this system a man and a boy can irrigate two acres per day of ten hours, the expense for this portion of the work being 1*s.* 6*d.* per acre.

The great objection to the Kennedy system is the large initial outlay in underground pipes, and laying them down. Another objection, which would be more serious on an ordinary farm than it is there, is the expense of pumping the sewage every day to the fountain head. The interest on the first outlay, added to the continuous expenditure included under the second head, probably requires a larger margin of profit to cover them than can be reckoned upon, except under special circumstances.

Nearly 500 imperial acres are held in connection with the dairy, and are farmed under the following rotation: (1) oats, (2) roots, (3) wheat, and (4) seeds left for two or three years, or sometimes four. There are about 300 acres of seeds and grass, and the extent of land in corn and roots ranges from 160 to 170 acres. The wheat crop is sold, and the straw used for litter. A large quantity of the oat crop is required for the horses, of of which about 25 are kept, on dairy and farm; the remainder is ground and sold as oatmeal, and the oat straw is used for fodder.

Irrigation commences with the oat-stubble, which gets two runnings in the autumn, one before and one after the autumn ploughing. In the spring a running is again given after the spring ploughing, and for turnips another at seed-time if possible. Potatoes are not irrigated after autumn, as it tends to make them soft. The root-course is generally one-sixth cabbages, one-half turnips, and one-third potatoes. The latter is crop sold off the farm, with the exception of the small and diseased tubers.

The green crops being grown on the ridge, the last irrigation is done by running the liquid manure down the furrows. The turnip-land is generally left strong enough for wheat; and even the potato-land, unless it happens to be a very poor field, gets nothing from the last irrigation before the potatoes are planted until the February after the wheat is harvested.

In February, the liquid manure is turned on the ryegrass for cutting, say about 50 acres; it is then sent on to the land being cropped, and during the summer it irrigates the pasture-land in rotation, one or two fields being done at a time. From 30 to 50 acres of hay are got every year, three cuttings being obtained if required; but pasturing is always preferred as far as it is practicable. The mixture of seeds generally sown is about 3 bushels of perennial ryegrass, and from 3 lbs. to 4 lbs. each of red, white, and alsike clovers per imperial acre. Italian ryegrass is too soft for dairy cattle, and is therefore never sown.

## III. Aberdeenshire.

There are some features of the agriculture of Aberdeenshire which require general description, in order to invest the system pursued on the example farms with due significance. This county has a lower mean annual temperature than any in Scotland, and an exceptionally late spring; wheat is not grown, therefore, except to a very small extent in the most sheltered nooks. The five-course shift is generally pursued, viz.: oats, after two years' seeds; then roots, followed by barley, or bere in the more exposed situations. But the distinguishing feature of Aberdeenshire farming is its cattle-feeding, and all the operations of husbandry are subordinate to the requirements of the byre.

I am indebted to Mr. J. F. Beattie, of Aberdeen, for the statistics which enable me to give something like an accurate idea of the Aberdeenshire cattle-trade and the contribution of this one county to the meat-supply of London. It is computed that 42,000 head of cattle are annually fed: of these about 5000 are required by the city of Aberdeen, 1500 by the small towns and villages in the county, and 1000 by the rural districts, leaving 34,500 head of cattle for exportation. These are all sent to the south, and chiefly to London; 4463 head go by rail alive, and 3145 by sea, making a total of 7608 head of cattle which leave the county as live stock. The remainder, 26,892 head, are killed in Aberdeen and forwarded to London or other large towns as dead-meat, their computed weight being 8500 tons. In addition to this quantity, about 800 tons of meat, not fed in the county, pass through Aberdeen on the way south, chiefly cured beef, pork, &c., in barrels.

This dead-meat trade is a most important feature in the city of Aberdeen, and is yearly increasing at the expense of the stock sent alive to London. The beasts are killed, and the carcases split into sides; they are then left hanging until a certain amount of firmness of flesh has been attained, generally for about forty-eight hours. The fore-part of each side is then cut off just behind the shoulder, the particular rib being a matter of choice with different butchers. Of late years, however, it has been preferred to cut farther back than formerly; for, although less meat is left on the hind-quarter, a proportionately better price per pound can be obtained for it. The hind-quarters are then sewn up in canvas, and sent to London by the daily meat-train, being packed vertically in the meat-trucks. The fore-quarters are chiefly sold to the meat-preservers, by whom they are cooked, tinned, and hermetically sealed. This is the great source of the best qualities of bouilli, boiled beef, roast beef, spiced beef, and other varieties of "preserved beef." There is also a domestic demand for the fore-quarters, and especially for the one or two ribs that may be cut off them; and it even suits the trade of some butchers to keep very little beef beyond the fore-quarters. In such cases there will always be a residuum of odd-looking lumps of meat that have not received the distinction of separate names; these and some of the fore-quarters are dry-salted, and sent to Newcastle to victual the colliers engaged in the London coal-trade. The other portions not retailed find their way to the preservers' boulli-pots, and thus we get rid of the last remnant of "dead-meat." There now remains the offal, consisting of hides and hearts, tails and tripe, tongues and tallow, and other *rejectamenta*, the uses of which are well known. But in Aberdeen there is a special trade connected with the head which deserves a short description, especially as it owes its origin to the wife of a leading Aberdeen butcher, who for several years kept it in her own hands. It is now carried on by Mr. Lyon, of George Street, Aberdeen, and I saw the process on his premises, which, however, is not now the only place where this business is pursued. The heads are simply boiled down, the bones taken out, then chopped fine, cooked with the feet, and seasoned with spices and salt; the cooked mass is then run into shallow square open tins, holding about 6 lbs. each, in which it solidifies into a firm jelly, crusted over with a thin covering of fat. These tins are chiefly sent to Dundee to an agent, who sells them, first hand, at 1*s.* 1*d.* per tin, to a dealer, who retails the material at 4*d.* per pound, his chief customers being factory-girls. This is one of the most wholesome and nutritious, and, at the same time, one of the cheapest articles of food that can possibly be bought at the present time.

The national importance of the agriculture of Aberdeenshire cannot be better illustrated than by the following extract from a letter which Mr. J. F. Beattie was so good as to write to me in special reference to this subject:—

| | £. |
|---|---|
| Estimated value of live cattle and dead meat from Aberdeenshire, exclusive of offal, exported from Aberdeen south, chiefly to London .. .. .. .. .. .. .. .. .. | 835,200 |
| Add value of hides, tallow and offal on 26,892 cattle from this county, a large proportion of which is sent south in the trade of the meat-preservers and others, curers .. | 60,507 |
| Value exported .. .. .. .. .. .. | 895,707 |
| Value of 7500 cattle used at home, towns and county .. | 157,500 |
| Total .. .. .. .. .. .. .. .. | 1,053,207 |

Equal 42,000 cattle, at 25*l.* per head.

| | £ | s. | d. |
|---|---|---|---|
| Hides and hair, at .. .. .. .. | 1 | 0 | 0 |
| Tallow and suet .. .. .. .. .. | 0 | 15 | 0 |
| Tongues .. .. .. .. .. .. | 0 | 2 | 0 |
| Heads .. .. .. .. .. .. .. | 0 | 2 | 6 |
| Feet .. .. .. .. .. .. .. | 0 | 0 | 9 |
| Tails, kidneys, back vein .. .. .. | 0 | 2 | 6 |
| Tripe and yearning .. .. .. .. | 0 | 0 | 10 |
| Hearts .. .. .. .. .. .. .. | 0 | 1 | 6 |
| | 2 | 5 | 1 per head. |

*Sheep: Total Sheep disposed of from Aberdeenshire.*

| | | |
|---|---|---|
| Number conveyed by rail to Aberdeen .. .. .. .. .. .. | | 33,922 |
| Off from beyond the county .. .. .. .. .. .. .. .. | | 7,808 |
| | | 26,114 |
| Add, travelled to Aberdeen, say .. .. .. .. .. .. .. | | 886 |
| ,, travelled from the Highlands across the mountains south, say | | 5,000 |
| ,, for small towns and country consumption .. .. .. .. | | 2,500 |
| | | 34,500 |
| Deduct, home consumption, Aberdeen .. .. .. .. .. | 9500 | |
| ,, County, &c. .. .. .. .. .. .. .. .. .. .. | 2500 | |
| | | 12,000 |
| Exported .. .. .. .. .. .. .. .. | | 22,500 |

*Estimated value of Sheep: disposed of as Mutton from County.*

| | |
|---|---|
| 22,500 sent south, at 35*s*. .. .. .. .. .. .. .. .. .. .. | £39,375 |
| 12,000 consumed at home, at 35*s*. .. .. .. .. .. .. .. .. | 21,000 |
| Total value .. .. .. .. .. .. | 60,375 |
| There are few pigs or calves raised for meat in the county, but say value exported .. .. .. .. .. .. .. .. .. .. | 2,000 |
| Home consumption .. .. .. .. .. .. .. .. .. .. .. | 1,000 |
| | 3,000 |

| *Summary.* | Home Consumption. | Exported. |
|---|---|---|
| Value of cattle from county .. .. .. .. | £157,500 | £895,707 |
| Value of sheep .. .. .. .. .. .. .. .. | 21,000 | 39,375 |
| Value of pigs and calves .. .. .. .. .. | 1,000 | 2,000 |
| | | 937,082 |
| | | 179,500 |
| Value annual supplies .. .. .. | | 1,116,582 |

There are about 350 markets where the butchers make purchases—say 6 or 7 weekly—and there may be 150 buyers weekly. The meat and cattle are forwarded directly to London salesmen, who make the returns immediately. A few of the farmers forward their cattle direct to London, particularly for the Christmas week.

As previously mentioned (p. 148), there is very little old grass in the county, notwithstanding its high position as a cattle-feeding district. On this head, therefore, I cannot do better than quote the following from the last volume of the Highland Society's Transactions:*—

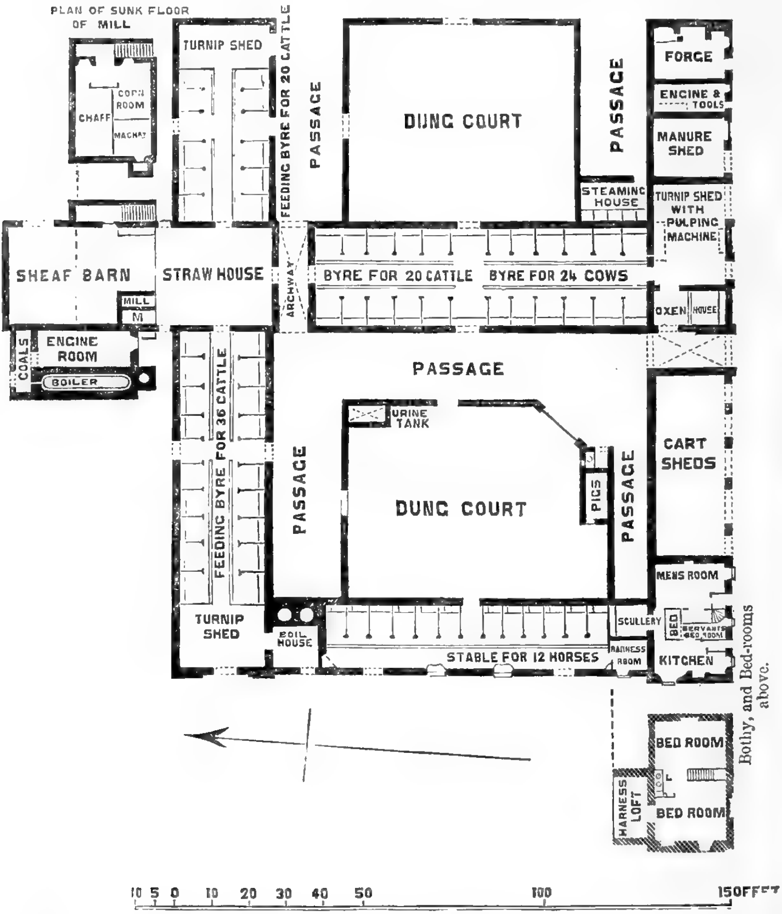
"Nine-tenths of the pasture lands consist of artificial grasses under rotation, only one-tenth being permanent pasture, and a large part of that is confined to proprietors' home-farms. It is rare for a farmer to have an acre of permanent pasture on his farm. Such is the custom, and by his lease he is bound to have all his land under rotation. Instead of having a field of his own, he is sometimes, for the convenience of fences and a regular supply of grass, under the necessity of attending a sale and securing a field at a price above its value. It is true that a large portion of the light land of the counties is better adapted for tillage than for permanent pasture; but, if properly laid out, a part of the heavier soils would continue to grow good grass, and would prove extremely convenient for the farmer. At present he is at a disadvantage in grazing; the pastures being all artificial, consist chiefly of rye-grass, which is apt to run to seed; and as red clover generally fails, pastures get very bare and brown before the month of August. If the stock are sufficiently numerous to keep the rye-grass from running to seed in June, a part of them must be sold or otherwise provided for in August on account of want of grass. Rye-grass is in season for grazing only about one month in the year; so that when the clover-plant fails, stockholders having nothing but rye-grass are at a loss how to keep their cattle improving. It not unfrequently happens that cattle sell for less after being grazed than they would have brought when put out to grass. This is due partly to the difficulty of maintaining a continuance of good grass on artificial grazing, and to the open and shelterless condition of most fields. Rain and cold winds have a most injurious effect on cattle grazing in exposed situations. This state of the pastures is the reason why so many of the cattle are fattened and sold at two years old. On many farms their improvement on grass after that age is so slight that it is unprofitable to graze them. The reporter is of opinion that a part of each farm should be kept in permanent pasture."

Aberdeenshire farmers keep a very large quantity of stock in proportion to the size of their farms, as will be seen by the following sketch of the method of the stock-farming pursued by Mr. William Murray on his farm known as Tipperty, near Aberdeen. This farm is 500 acres in extent, including roads and fences; it is all arable land, and is worked on the usual five-course system. Not less than 170 head of cattle of every

* 'On the Agriculture of Aberdeenshire and Banffshire.' By John Milne, Mains of Laithers, Turriff. 'Trans. Highland and Agri. Soc.,' 4th series, No. 6, 1871, p. 378.

description are kept on it every year, and the seeds are let from November until February for wintering 500 hoggs. The tenant was formerly a successful butcher, and exporter of fat stock and dead meat. The annexed ground-plan of the steading, which

*Fig. 4—Ground-plan of the Farm-steading at Tipperty, near Aberdeen.*




was designed by Mr. Beattie, will give a good idea of the arrangements on a modern Aberdeenshire farm, specially devoted to the breeding and feeding of cattle.

Seventy feeding beasts are bought, as ten-quarters-old steers, in February, and kept on until the next winter. About 20 queys are also bought every year, and after one calf has been taken from them they are fed off with the steers. Six dairy cows are kept, and their calves, as well as the others, are kept on until they are fattened for the butcher at three years old. Calves begin to drop in January, but some are as late as May. The calves from the dairy cows are brought up by hand, the others suck their dams for about eight months, and are then weaned on oilcake and straw, but are not setoned. The young beasts are fed in winter on pulped turnips and chaff, the calves getting 2 lbs. of cake in the morning for about two months. The first feeding beasts go into the byres about the middle of August, and get tares three-fourths ripe with straw until the turnips are ready, when they get whole turnips, with their "shaws" on, and straw three times a day, and at night a feed of mashed grain and potatoes. For the last two months they get oilcake, beginning with 2 lbs. each per day, and increasing to 4 lbs. at the finish. The following rules for the guidance of the horsemen and cattlemen will give further details on this subject, and also show the careful manner in which matters are regulated on this farm:—

*Rules for Cattlemen on the Farm of Tipperty.*

| | | | | | |
|---|---|---|---|---|---|
| | | | | | A.M. |
| 1. Clean out the stalls .. .. .. .. .. | until | 10 | minutes | past | 6 |
| 2. Turnip the cattle .. .. .. .. .. .. | ,, | 20 | ,, | to | 7 |
| 3. Clean out the byres .. .. .. .. .. | ,, | 10 | ,, | past | 7 |
| 4. Clean down the rumps of cattle .. .. | ,, | 30 | ,, | past | 7 |
| 5. Straw the cattle .. .. .. .. .. .. | ,, | 15 | ,, | to | 8 |
| 6. Bed up the cattle .. .. .. .. .. .. | ,, | | .. | .. | 8 |
| 1. Pull turnips .. .. .. .. .. .. .. | until | | .. | .. | 11 |
| 2. Turnip the cattle .. .. .. .. .. .. | ,, | 30 | minutes | past | 11 |
| 3. Bed up the cattle .. .. .. .. .. .. | ,, | 15 | ,, | to | 12 |
| 4. Straw the cattle .. .. .. .. .. .. | ,, | | .. | .. | 12 |
| | | | | | P.M. |
| 5. Interval .. .. .. .. .. .. .. .. .. | ,, | | .. | .. | 2 |
| 1. Clean the cattle thoroughly .. .. .. | until | 30 | minutes | past | 3 |
| 2. Clean stalls and turnip .. .. .. .. .. | ,, | | .. | .. | 4 |
| 3. Clean out the byres .. .. .. .. .. .. | ,, | 30 | ,, | past | 4 |
| 4. Straw the cattle .. .. .. .. .. .. | ,, | 15 | ,, | to | 5 |
| 5. Bed up the cattle .. .. .. .. .. .. | ,, | | .. | .. | 5 |
| 6. Interval .. .. .. .. .. .. .. .. .. | ,, | | .. | .. | 7 |
| 1. Give the cattle oilcake or bruised oats, &c. | until | 30 | minutes | past | 7 |
| 2. Bed up the cattle .. .. .. .. .. .. | ,, | | .. | .. | 8 |

P.S.—Each Cattleman to wash his cattle once a fortnight, and to keep the dung pit well levelled down, and to turn out his cattle every fourteen days, and also to attend the thrashing mill when working after 8 o'clock, A.M.

***Rules for the Horsemen on Tipperty.***

1. Each horseman on entering on his services at Tipperty, will have his horses handed to him with cart and plough harness, comb and brushes, carts,

shelvings and frame, plough, shovel, graip, and key of press and corn chest, all complete; and he will have to hand the same over on leaving.

2. All horsemen to enter the stable at 15 minutes to 5 o'clock, A.M.; stable cleaned out, dung pit well levelled down, and horses led to the water, fed, and cleaned until half-past 5; breakfast from half-past 5 until 6 A.M.; and when horses are not working from 6 to 6, barn work, &c., until yoking time.

3. Horses returning from the yoke to be well rubbed down for 15 minutes, and fed; dinner until 15 minutes past 12 o'clock; horses receive oats on entering the stable, and cleaned.

4. Horses on returning at 6 o'clock P.M., are cleaned down for 15 minutes, afterwards, being watered and fed, a few Swedish turnips given.

5. Stable entered at 7 P.M.; horses cleaned well down, afterwards watered, receive oats or bait, and suppered up; stable closed at 8 P.M. No horses to be allowed to leave the stable without a stall collar on.

*Rules for Sabbath.*

All horsemen to attend in the morning and evening on their horses, and in no case to be absent without appointing a substitute approved by the Manager, and one horseman to have charge all day by turns, commencing with the Foreman.

These rules are pasted up in the bothy at Tipperty—an institution which is intimately connected with the condition of the agricultural labourer in Aberdeenshire. This subject has been very much discussed, and the mere name of a "bothy" has been made almost sufficient to conjure up visions of dirty ploughmen and ill-clad women. One result is, that Scotch farmers—who thoroughly appreciate the result of giving a dog a bad name—now designate as "barracks" those bothies which are used as bedrooms, and as "kitchens" those in which the labourers get their food and spend their evenings. Whatever want of orthodoxy my opinion may possess, I cannot help thinking that the faults in the bothy system which are held up to public reprobation are to be seen as frequently in the cottages of East Lothian as in the bothies of Aberdeenshire. Therefore, it seems more just to lay these faults at the door of the labourer himself than at that of the system under which he is housed and fed. The Aberdeenshire system is to have a "kitchen" for the unmarried ploughmen in a convenient position attached to the steading, or situated near it. This is a room furnished with a long table, three or four benches, some stools, and a separate locker for each labourer, in which he keeps his "household gods." It is generally the duty of an old woman to cook the food for the labourers, and to keep the room and furniture in a condition that is supposed to be clean. As a rule, the labourers sleep in attics over the byres and stables, and spend their evenings in the "kitchen." So far as the "kitchen" itself is concerned, I look upon it very much as a humble kind of club.

The system of constructing dormitories over byres and stables is not æsthetically defensible; but, practically, it is liked by the men, especially in the winter, when it is piercingly cold outside and comfortably warm within.

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## Tillyfour, Dorsell, and Bridge End.

These farms are all in the occupation of Mr. W. M'Combie, M.P. for West Aberdeenshire, and together comprise about 1200 acres of arable and pasture land, besides between 200 and 300 acres of valuable hill pasture. Tillyfour measures about 600 acres, of which 120 are in permanent pasture; Dorsell includes 325 acres of arable land, and the hill pasture just mentioned; and Bridge End consists of 225 acres, which are exclusively arable. Mr. M'Combie also rents 50 acres of probably the best grass land in Aberdeenshire from Sir W. Forbes, of Craigie Var. It is almost unnecessary to state that on these farms the whole management is arranged with a view to breeding and feeding a large number of cattle, chiefly of the polled black Angus or Aberdeenshire breed.

Permanent grass land, as already stated, is by no means abundant in Aberdeenshire; but, without it, there would be great difficulty in keeping on, in improving condition, a large feeding stock from the time that the seeds begin to fail, viz. about the middle of July, until turnips are ready to commence upon. Even with the advantage of this grass, it has been found desirable to tie up the most forward beasts before the early turnips are ready, and it is probable that Mr. M'Combie's success as a feeder is due in no inconsiderable degree to the judicious manner in which this gap has been filled up.

Some of the grass land is of remarkable feeding quality, and will carry bullocks of any size, making them fat, so as to fetch prices ranging from 30*l.* to 50*l.* per head, without any adjunct, whether roots, cake, or corn. The beasts are always bought in good condition, and the best land, in a favourable year, will feed nearly one beast per acre, so as to bring it into this first-rate marketable condition.

The old grass is never cut, being far too valuable for pasturing. Most of it was laid down about twenty years ago, in exactly the same manner as seeds are now sown in the usual course of cropping; and about ten years afterwards it was top-dressed with a compost of lime and earth.

The three farms are situated on the somewhat steep sides of the valley of the Don and its tributaries, at a height of 750 to 800 feet above the sea-level. The climate is therefore too rough for the profitable cultivation of wheat, and barley not unfrequently gives place to the more hardy bere on the stronger land. The subsoil consists of the well-known Aberdeenshire granite, the decomposition of which results in the formation of a fertile, but somewhat heavy soil.

The farms are worked on an alternate five- and six-course system, the former being oats, turnips, barley, and seeds for two years; the six-course is an extension of the same, by keeping the seeds down another year. A small breadth of tares is sown every year, either in the oat-course, or instead of turnips; these are cut when three-fourths ripe, and given with clover to the forward beasts until the early turnips are ready. A portion of the new grass is pastured in the early part of the season for a few weeks, after which it is relieved so as to be ready for cutting by the end of July, and thus produce the valuable fodder given with the tares.

## Crops.

1. *Oats.*—After harvest, the first operation is to plough the oat-stubble, and, when that is finished, the clover ley is broken up by a strong furrow of from 7 to 10 inches in depth, the whole being finished by Martinmas, if possible. The climate being very backward in spring, a large quantity of seed is required; and, in a bad season, as much as 5 or even 6 bushels per imperial acre may be deemed necessary. As a rule, the seed is sown broadcast on the furrows; but in some seasons it is possible to go over the land with harrows, and afterwards to drill the seed. After the seed is in, a plain roller is drawn over the land to prepare it for the scythe or the reaping-machine, thus completing the operations of seed-time. Harvesting oats generally commences about the beginning of September, and finishes from the middle to the end of the month. Cutting is now sometimes done with the reaping-machine, although that implement is not held in such high estimation for oats as for barley. It is said that the Aberdeen labourers are such good hands with the scythe, that the machine possesses but little advantage over them. With a good bottom, they can cut from 2 to $2\frac{1}{2}$ acres per day of 11 hours; and, as they leave a shorter stubble than the machine, they get more straw, which is an important consideration to the cattle-feeder. Piecework is not much in vogue, but sometimes the field operations of harvesting have been done by contract, at from 7*s.* to 9*s.* per acre. The most general system is to get hands at the hiring fairs, which are held in anticipation of the harvest throughout the county. These are men engaged at a

stipulated sum (from 3*l.* to 4*l.*, with food and beer), for the whole period of harvest, however long it may last. This period varies in length from five to eight weeks, according to the weather ; and it was once known to last as long as eleven weeks. Women are employed for sheafing and other of the lighter operations, and get from 55*s.* to 60*s.*, with food, for the whole harvest. Stacking and thatching are done by the harvestmen and the ordinary farm servants, who work at their usual rate of payment.

2. *Turnips.*—Immediately after harvest the oat-stubble is ploughed as deeply as possible, the deeper the better, from 7 to 13 inches, according to the depth of soil. It is then left until after oat-sowing is finished, generally until about the middle of April, when it is grubbed as deeply as possible, sometimes, if the land is not very clean, getting a cross-ploughing before the grubber is used. Ridging is delayed until immediately before seed-time, which commences with swedes about May 12th. When this work is commenced, no time is lost in completing it. Farmyard-manure, to the weight of from 10 to 20 tons, is put in the drills, and upon it not less than 10 or 12 bushels of bone-dust, and probably from 2 to 3 cwts. of guano; but the quantities of manures used vary with the quality and condition of the land. After the ridges have been split, from 2 to 4 lbs. of seed are immediately drilled, the sorts most used being Skirving's Purple-top swede, Shepherd's swede, and Aberdeen yellow turnips. No white turnips are grown, as they are not considered to possess sufficient feeding properties, being regarded as fit only for cows and young stock ; but the yellow Aberdeens constitute about one-half of the root-course. The plants are horse-hoed two or three times as may be required, and are finally hand-hoed, and singled by the hoe. The quality of the land determines the distance apart to which they are set out, and which varies from 9 to 13 or 14 inches. About the middle or end of October is the time when it is usual to commence topping and tailing, care being taken not to bleed the bulbs, which are "pitted and secured every night to keep them free from frost and rain." *

In his book, just quoted, Mr. M'Combie states, "I have adopted my friend Mr. Porter of Monymusk's plan (in a late climate, and where swedish turnips in some years never come to full maturity) of pitting them upon the land where they grow, from one to two loads together ; and, although not quite ripe, I have never seen a turnip go wrong when stored in this manner. The land also escapes being poached, as the turnips are carted in frost, and at a time when the other operations of the farm are not pressing.

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* 'Cattle and Cattle-breeders,' p. 26.

A foot of earth will keep them safe, and they are easily covered by taking a couple of furrows with a pair of horses on each side of the line of pits."

Twenty-seven or twenty-eight tons of yellow turnips, topped and tailed, are considered a fair average crop, and from 32 to 35 tons a good crop of swedes.

For tares the land is prepared as for turnips, and the seed is mixed with oats. If the land is heavy, white peas and beans are also mixed to hold up the crop. Tares are sown at different times, the earliest being in spring with the first portion of the oat-crop.

3. *Barley.*—The turnip-land is not touched until after all other spring cultivation has been completed, which is about the middle of April, when it is ploughed from 6 to 8 inches deep, and, without further preparation, sown with 4 bushels per acre of barley on the light land, or bere on the heavier soils.

4. *Seeds.*—The preparation for seeds consists of harrowing until a sufficiently fine tilth is obtained, when the roller is passed over the land previous to sowing, and the harrow and roller are again used after the seed is in. The mixture of seeds generally used is 1 bushel of Pacey's ryegrass, 5 or 6 lbs. of red clover, and 4 or 5 lbs of white Dutch, if the land requires it; but some portion of Mr. M'Combie's occupation grows white clover naturally. Upon the poorer soils an addition is made, consisting of 4 or 5 lbs. of alsike, but this is omitted on the better land, as cattle are not fond of it. Occasionally a few acres of Italian ryegrass are sown for early cutting; but red clover is the "seed" which is considered the great stronghold of the cattle-feeder. The quantity of hay made is only just enough for the horses, and never exceeds 30 acres. So great is Mr. M'Combie's dislike to cutting his own seeds, that he frequently prefers to buy hay, especially as he considers pasturing by cattle equal to a year's rest.

## Stock.

1. *Herd.*—The breeding stock consists of about 80 head of the black-polled Angus breed, including 1 old bull, 2 yearling bulls, and 30 cows, the remainder being one and two-year-old heifers. The bull calves are generally sold privately, and there is also a sale of breeding stock every second or third year. Cows are put to at any season; but it is preferred that the calves should drop early in spring, when they are allowed to suck their dams until October. The treatment of cows during winter, previous to calving, is based on the principle of keeping them as low as possible. They run over the grass that has been left by the feeding beasts, and are never taken under cover until the

end of October, when they go in at night; but they get no food except that afforded by the fields until after Martinmas, or even the end of November. About this time, or the beginning of December, the most forward of the feeding beasts go off, and the breeding cows take their places in the stalls; but their food is still kept down, consisting merely of straw, and once a day a barrowful of turnips divided between three or four of them; and, except in very bad weather, they still go out two or three hours every day. The only difficulty is to keep the breeding stock from becoming too fat.

After calving, the feeding regulations are very much relaxed in favour of turnips, so that the cows may give enough milk for their calves, which remain with their mothers for several months. The older calves are weaned about the end of October, no matter how early they drop; and the late calves remain with their dams throughout the winter. The latter lie behind their mothers at night; during the day, they get the run of the steading, and sometimes are given a turn in the yard; they also get from 1 to 2 lbs of oil-cake daily, with a little meal, the trough being placed in the stall behind the dam. By this method, Mr. M'Combie has made some of his best beasts from late calves; it enables them always to retain a good coat and to withstand the cold and ungenial climate in spring.

When the older calves are weaned, they are put into a straw-yard, and given as much as they can eat of straw and sliced turnips, with from $1\frac{1}{2}$ to 2 lbs. of oil-cake each per day. After the first winter, and when the young breeding stock are rising two and three years old, they are kept upon turnips and straw, without any allowance of cake. The calves are all carefully setoned, a good hold of the dewlap being considered necessary, as well as the renewal of any seton that may slip. These measures have been so effectual that not more than one case of black-leg has occurred amongst the high-bred stock at Tillyfour. Weaning-time, however, is not quite so simple a matter for the cows, as some will not allow themselves to be milked. In these cases, the practice is to let their calves suckle once a day at first, then once in two or three days, and thus, in the course of a fortnight, the cow gradually becomes dry; but unless these precautions are taken, the cow may lose two or three of her teats, and be ever afterwards useless as a milker. The younger calves are treated in precisely the same manner.

The calves are kept regularly growing on until the earliest grass is ready for them, after which time it is considered that there is little or no further risk from quarter-ill or other diseases incidental to young stock.

The after treatment of heifer calves is a matter which requires sound judgment; and if the allurements of shows are avoided, Mr. M'Combie finds it comparatively easy to produce breeding animals that will pay, and will exhibit very fine quality. The system he has adopted, except in cases of show pets, is to give them good grass during the summer, and during the ensuing winter to keep them on unlimited oat-straw and a fair supply of turnips. It is essential to keep them in good growing condition without a check, but, at the same time, to guard against their laying on too much flesh. Open straw-yards, in the winter, are thought best both for young breeding cattle and for store beasts to be grassed the next summer; and a covered yard is therefore regarded as an abomination. The principle of treatment of store or breeding animals is to avoid making the high-bred heifers valuable to the butcher; and, as it is well known that they have a great tendency to lay on fat if well fed, it behoves the farmer to work accordingly, for servants in charge of high-bred stock seem to take a pride in over-feeding them. Heifers are not put to the bull until fully two years old, as the polled Angus females become stunted in growth and otherwise deteriorated if used before they arrive at that age. In-and-in breeding is also found to produce a diminution in size and delicacy of constitution, although it undoubtedly produces finer quality, as Mr. M'Combie has shown in his work already quoted.*

2. *Feeding Beasts.*—Between 300 and 400 head of cattle are fed off between October and March, the number varying with the weight of the turnip crop and the luxuriance of the grass and seeds. About fifty of these beasts are bred and wintered on the farms, and the remainder are bought in Morayshire in March and April, arriving at all times up to the beginning of May. After arrival, they are kept on the remnant of the swede crop, or, in default of that, on hay and cake, in sufficient quantity to prevent their losing condition, until the grass is ready. This is not until from the 10th to the 15th of the month, although a certain breadth of first-year's seeds on each farm is top-dressed with from 2 to 3 cwt. per acre of sulphate of ammonia, dissolved bones, or guano, for the purpose of providing an early bite for these beasts. From about the 15th until the 20th of May, the cattle begin to go on ordinary first-year's seeds, where they remain for two or three weeks, when they are removed for a change of bite to a piece of two-year-old seeds, or an old pasture. It is considered an essential part of good grazing to give beasts a clean pasture and fresh grass at frequent intervals, say once a fortnight at farthest. In July, seeds begin to fail, and without the assistance of old

* 'Cattle and Cattle-breeders,' p. 104.

and late grass it would be almost impossible to carry on the stock in a thriving condition. No cattle are sold off grass, as Mr. M'Combie's experience shows that beasts do not pay unless they get at least two months' turnip feeding. The interval between the failure of the seeds and the maturing of the early turnips is therefore a critical period; and there can be little doubt that Mr. M'Combie's success as a grazier is, to a great extent, due to the manner in which he has kept his cattle supplied with nutritious food at this time of the year.

Part of the cattle are sent to the old pastures in the middle or end of July, and by the middle of August some of the best are put in the straw-yards, and receive clover, tares, &c.; thus reducing the number on the pastures, and giving more chance to those that remain, by reserving the second bite of the early-fed first-year's seeds until that time. As the seeds contain plenty of red clover, they form a most valuable food, and enable cattle to be kept on in thriving condition until the turnips are ready.

The forward bullocks are tied up very early; and, at the time of my first visit to Tillyfour (August 30th), no less than 125 beasts were under cover. Sixty of these were three-year-old bullocks, in straw-yards, getting food consisting of tares (three-fourths ripe), and clover, mixed with oats, white peas and beans, and 3 lbs. of linseed cake each per diem. In about a week's time they would be entirely on turnips and cake with straw. They were in good condition when bought from the Morayshire straw-yards, where they had got some of the finest swedes grown in Scotland, and they had been kept during the summer on capital grass in Aberdeenshire, so that they were in high condition when turned in. By giving them as many turnips as they could eat, it was expected to turn most of them off quite "ripe," without any addition to their allowance of cake, by the first or second week in October.

The remaining sixty-five—the largest and best of Mr. M'Combie's feeding stock—were intended for the Islington Christmas market, Liverpool, and Edinburgh. At the end of August they were feeding on yellow turnips, remarkably well matured for so early a period in the season—and such a season!—with a proportion of partially ripened tares, but without cake or corn. Cake is never given to "commercial beasts" until within six weeks of the date when they are destined to go to market, when they get from 3 to 4 lbs. per day to give them the "last dip" when necessary. A great many of the beasts sent to London by Mr. M'Combie never taste cake or corn, but only those pushed early to market, and the sluggish feeders amongst the lots that come afterwards. Indeed some of those sent to the Christmas market are not unfrequently considered too fat by certain butchers.

Many of the best of these beasts had been bred by Mr. M'Combie himself, and, in April, were worth, he considered, from 28*l.* to 30*l.* each. The remainder had been bought the previous winter and in the spring, and had cost from 25*l.* all the way up to 32*l.* per head.

All these cattle had been selected as better adapted for the earlier than the later markets; but we now come to the description of those which take the places of the 125 whose treatment has just been sketched. These were still in the fields; they had cost from 20*l.* to 24*l.* each in the spring, and would be all tied up immediately after the first sixty had been disposed of, getting turnips and straw as the others. They would go off gradually during the months of January, February, and March. The stalls vacated by the Christmas beasts are filled up by half-fed beasts, bought in the neighbourhood, and either finished for the London market the same spring or kept on for the grass and sold the following autumn or winter. For the latter purpose a bullock that has not been too well kept, especially if from the high grounds, well-bred, and not stunted in growth, will pay for its keep far better than one than one that has been kept on the higher priced lands in the valleys.*

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* The following extracts from Mr. M'Combie's work, entitled 'Cattle and Cattle Breeders' (pp. 21-29), contain some additional information on certain features of his system:—

"The earlier you can put cattle upon grass, so much the better. Cattle never forget an early bite of new grass. A week's new grass in Aberdeenshire at the first of the season is worth at least two and a half upon old grass; and it is wonderful what improvement a good strawyard bullock will make in four or five weeks at the first of the season. If kept on straw and turnips alone in winter, he may add a third, or at least a fourth, to his live weight. But much depends on the weather. I have never known cattle make much improvement in April, or even up to the 12th of May, because the weather is so unsteady, and the cold nights when they are exposed in the fields take off the condition the grass puts on. The grazier will find it of great advantage to house his cattle at night during this season. In Aberdeenshire, the 10th of May is about the earliest period cattle should be put to grass. Where there is new grass, first year, it is a most difficult matter to get the full advantage of it. There is no other grass to be compared with it for putting on beef in Aberdeenshire. You must be careful at the first of the season, if much rain falls, not to allow the cattle to remain on the young grass. They must be shifted immediately; and no one can get the proper advantage of such grass who is deprived of the power of shifting the cattle into a park of older grass till the land again becomes firm for the cattle. I have seen a small field of new grass utterly ruined in one night (in the month of May or the beginning of June) when heavily stocked with cattle. When wet and cold, the cattle wander about the whole night, and in the morning the fields are little better than ploughed land. In fact, the field so injured will never recover until broken up again. In regard to my own farms, I cut scarcely any hay. I pasture almost all my new grass; and the moment the cattle's feet being to injure the grass, they are removed. If cattle are changed to an old grass field, so much the better; but they will be safe on second or third year's grass, provided the land is naturally dry. By the 1st of July, the new grass land gets consolidated, and you are safe. New grass fields are bad to manage in another

3. *Sheep.*—From 400 to 800 three-shear black-faced wedders from Deeside are bought at Braemar or on the hills, about the begin-

respect. The grass comes very rapidly about the 10th June, and if you are not a very good judge of what you are about, it will get away in a few days, become too rank, and will lose its feeding qualities during the remainder of the season. By the middle of July, it will be nothing but withered herbage. Young grass ought to be well eaten down, and then relieved for two or three weeks; then return the cattle, and the grass will be as sweet as before. It requires practice to know the number of cattle, and the proper time to put on these cattle, to secure the full benefits of new grass. Three days' miscalculation may cause a heavy loss. I have been bit so often, and found the difficulty so great, that I fear to extend my observations on this part of the subject, when I am addressing gentlemen, many of whom make their young grass into hay, or sell the grass to the cowfeeders. The pasturing of new grass, in which the farmers of Aberdeenshire and the north of Scotland have a deep interest, may not apply to many other parts of Scotland. I come now to the way cattle should be treated after being taken from their pastures and put on turnips. The earlier you put them up, the sooner will they be ready for the butcher. The practice of tying the cattle early up in Aberdeenshire is now almost universal; the success of the feeder depends upon it, for a few weeks may make a difference of several pounds.

"I sow annually from twelve to sixteen acres of tares, and about the middle of June save a portion of the new grass full of red clover, and from the 1st to the 20th of August both tares and clover are fit for the cattle. I have for many years fed from 300 to 400 cattle; and if I was not to take them up in time, I could pay no rent at all. A week's house-feeding in August, September, and October, is as good as three weeks in the dead of winter. I begin to put the cattle into the yards from the 1st to the middle of August, drafting first the largest cattle intended for the great Christmas market. This drafting gives a great relief to the grass parks, and leaves abundance to the cattle in the fields. During the months of August, September, and October, cattle do best in the yards, the byres being too hot; but when the cold weather sets in there is no way, where many cattle are kept, in which they will do so well as at the stall. You cannot get loose boxes for 80 or 100 cattle on one farm. I generally buy my store cattle in Morayshire. They have all been kept in the straw-yard, never being tied. When the cattle are tied up on my farms, a rope is thrown over the neck of the bullock, the other end of the rope is taken round the stake; two men are put upon it, and overhaul the bullock to his place. When tightened up to the stall the chain is attached to the neck, and the beast is fast. We can tie up 50 beasts in five hours in this way. When tied, you must keep a man with a switch to keep up the bullocks. If you did not do this, you would soon have every one of them loose again. They require to be carefully watched the first night, and in three days they get quite accustomed to their confinement, except in the case of some very wild beast. I never lost a bullock by this means of tying up. This system is like other systems, it requires trained hands to practise it. I never give feeding cattle unripe tares; they must be three-parts ripe before being cut. I mix the tares when they are sown with a third of white peas and a third of oats. When three-parts ripe, especially the white peas, they are very good feeding. Fresh clover given along with tares, peas, &c., forms a capital mixture. I sow a proportion of yellow Aberdeen turnips early to succeed the tares and clover. I find the soft varieties are more apt to run to seed when sown early than yellow turnips.

"In a week or ten days after the first lot of cattle is taken up from grass a second lot is taken up. This is a further relief to the pastures, and the cattle left in the fields thrive better. This taking up continues every week or ten days to the end of September. At this period all feeding cattle ought to be under cover that are intended to be fattened during the succeeding winter. The stronger cattle are drafted first, and the lesser ones left until the last *cull* is put under cover.

"I change the feeding cattle from tares and clover on to Aberdeen yellow ning of September, and put on the grass left by the feeding cattle until Martinmas. They then get turnips for a couple of months, and go to the Edinburgh and Glasgow markets. Occasionally they get a little corn or cake, but they seldom require it, as they thrive very fast on the lowland pasture after coming off the hills. An average sheep will weigh about 17 lbs. per quarter, but some are much heavier. It does not answer to buy lambs, as they get braxey and die very fast; but aged sheep stand the change very well. The profit on one lot of 400 sheep paid Mr. M'Combie's election expenses; but it does not appear whether the profits were very large or the expenses very small.

4. *Horses.*—A somewhat light but active breed of carthorse is preferred; and as so large a proportion of the arable land is in seed, it is not found necessary to keep more than ten pairs in addition to four pairs of working oxen. The horses are turned entirely into the fields after turnip sowing is finished, and until the commencement of leading at harvest time. When taken in, they are given as much hay as they can eat, and are allowed 2 bushels of oats each per week. Every night they get a mash divided into two portions, one being given before the dry food and the other in the course of an hour or two; it consists of light oats or bere, mixed with cut swedes, and boiled together. About a bucketful is given to each horse every night, and in the spring a good feed of swedes is also given in the forenoon.

## Labour.

Married servants are engaged by the year, at Whitsuntide, for from 20*l.* to 22*l.* per annum with house and allowances; and unmarried men are engaged for six months at Whitsuntide and Martinmas, getting from 10*l.* to 11*l.* 10*s.* for the term, with the usual allowances. The "allowances" are 2 pecks of oatmeal per week, as many potatoes as they can eat, and either milk or 21*d.* per week in lieu of it. The unmarried men get their food cooked for them in the "bothy," as already described. The bailiff, or "grieve," as he is termed, is allowed to keep a cow, and sometimes a pony. Unmarried women are not employed, as a rule; but for hoeing turnips, and at harvest time they are in great request.

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turnips, and afterwards to swedes, if possible, by the middle of October. I do not like soft turnips for feeding cattle. The cattle that I intend for the great Christmas market have at first from 2 lb. to 4 lb. of cake a day by the 1st of November. In a week or two I increase the cake to at least 4 lb. a day, and give a feed of bruised oats or barley, which I continue up to the 12th or 14th of December, when they leave for the Christmas market. The cake is apportioned to the condition of the different animals, and some of the leanest cattle get the double of others which are riper. The cattle being tied to the stall places this quite in your power, while in the strawyard it could not be done."

## IV.—Highland Cattle and Sheep Farming.

The breeding of Highland Cattle was one of the subjects to which my attention was directed by the Council; but it is now very difficult to find what was in former days known as a "Black Cattle farm," except perhaps on the islands off the west coast. The displacement of cattle by sheep in the Highlands of Scotland has often been the text of political economists, most frequently in connection with the extensive depopulation of that part of the United Kingdom. There can be no doubt of the fact that of late years the tendency in Scotland has been towards the extinction of "crofts" and other denominations of small farms by a process of absorption; and the result has been the formation of larger hill-farms and the replacement of cattle by sheep. Several causes have combined to produce this result, but they may all be resolved into one, namely, that sheep-farming is more remunerative. Therefore comparatively few large breeding herds exist in the Highlands at the present day, a considerable proportion of the Highland cattle being bred by the small farmers and crofters who still remain; and whereas twenty or thirty years ago it was not uncommon to see a fold of twenty or thirty cows, such a thing can rarely be met with now. Hill-farms have of late years been sought for by lowland farmers, who prefer to breed sheep, and thus to work a farm in the Highlands in connection with one in the arable districts, where they finish off the wedders of their own breeding.

As an example, however, of Highland cattle-breeding, I venture to give the following short account of the system pursued by Mr. McKechnie, near Ford, on the hills bordering Loch Awe, in Argyllshire.

This gentleman's sheep stock is something over 4000 in number; so his occupation cannot be regarded as exclusively a Highland cattle-farm. Nevertheless, as he keeps a herd of about 20 cows, his system will no doubt be a fair index of the usual practice. Two bulls are kept on account of the extent of the farm; they are turned out on the hill with the cows about the beginning of May, and remain with them all the summer. Heifers are not sent until three years old, as otherwise their growth would be stopped; and calves drop from the beginning of the year until June. Previous to calving, the cows get nothing but hay or perhaps a little straw, but afterwards, especially in bad weather, they may get a few boiled oats, and for two or three weeks are kept entirely in the house. Calves are not let out until the beginning of June; so that, until that date, they do not run with their dams; and, even when first born, it is found necessary to keep them in a separate house, letting them in to their mothers twice a day. After the beginning of June, the cows and calves remain together on the hill, until the latter are weaned, which is generally about the end of November or beginning of December, when the cows are brought into the house at night, and hay-feeding is commenced. The calves, now known as "stirks," are also housed at night, and are fed in exactly the same manner as the cows.

With this small breeding-herd and the winter-keep of from 20 to 30 stot stirks bought as yearlings in May, Mr. McKechnie finds it necessary to cut at least 120 imperial acres of hay every year, either meadow or seeds. He has not more than 25 acres under the plough, two-thirds being in oats and the remainder in roots, otherwise he might be tempted to keep a few more cows, although he has hitherto found that the expenses are too great to leave a sufficient margin for profit. Servants' wages are now so high, and seasons are so precarious, that he has found it more profitable to buy store cattle and breed sheep. As a rule, he buys, as already stated, from 20 to 30 yearling stot stirks in May, and puts them on the hills or the low ground with the sheep, never herding them separately. During the next winter they are fed on hay in sheltered fields, this treatment commencing about the beginning of the year and lasting until the middle of April in good seasons, or until the beginning of May in severe weather. The following summer they are kept on grass, and they are sold the next October either on the farm or at the tryst. After they go away they are kept in a similar manner for another year by farmers who have more winter keep, and are sold by them the ensuing autumn to be wintered on turnips and made up for the butcher.

The question of winter keep is, indeed, a most important element in the problem of Sheep *versus* Cattle in the Highlands of Scotland. In face of the expense of feeding and housing cattle in winter, coupled with the scarcity, and consequent dearness, of labour, there can be little doubt that when wool fetches a good price sheep are decidedly more profitable. But of late, wool having been comparatively cheap and Highland cattle comparatively dear, it is probable that the one description of stock might be found as profitable as the other, although it is doubtful whether the return would be as certain from cattle as from sheep. The price of Highland cattle has risen enormously of late years, partly owing to the decrease in the breeding stocks already noticed, and partly to the increased demand for feeding beasts on lowland farms; and, with regard to West Highlanders, more particularly on account of the large demand for picturesque cattle to graze in parks.

It is possible that, by careful herding, more cattle might be kept on sheep-farms than hitherto, by confining them to the rougher hill grass that sheep will not touch. The practical difficulty is that the herd objects to having cattle and sheep on the same hirsell; but in a great many instances this objection arises chiefly from his not liking the trouble of herding them apart. It is tolerably clear, however, that there are fewer deaths from braxey amongst sheep when they are kept clear of cattle than when both kinds of stock run together.

On the question of winter keep, again, depends the system adopted by different farmers for disposing of the produce of their breeding herds. Two systems prevail in Argyllshire, one being to sell yearling stot stirks in the spring, and the other to sell six-quarter stot stirks in the autumn. With sufficient winter keep, it is doubtless more profitable to pursue the former plan, and keep a larger number of cows; but if there is not much natural hay at command, it is better to keep fewer cows, and hold on the stirks to help in the consumption of the grass in the summer. Heifers are kept on until they are three years old, when the best of them go into the herd to replace the cast cows. A good cow will be kept on for about five seasons, or occasionally six, before she is sold with the culled heifers at the October trysts.

Such being the salient points in Highland cattle-farming, I shall now endeavour to illustrate the more important subject of Hill Sheep-farming by the following description of a large hill-farm on the side of Loch Lomond.

## Ben Lomond.

It is needless to describe the geographical position of this farm, because both the Ben and the Loch are "familiar in our mouths as household words;" its extent, however, needs a word of explanation. Ben Lomond alone would seem big enough for a farm, and a few acres to spare; but it does not maintain more than one-tenth of the whole stock kept on the one about to be described, which extends for about 8 miles along the loch side, commencing behind Ross Point, and stretching northwards past Rob Roy's Prison, towards Inversnaid. Its breadth in an inland direction varies up to a maximum of 5 or 6 miles, including Craig Rostan along the loch side, Ben Lomond, Ben Uird, Cruinn-a-Bheinn (Crunevine), and other heights, of which Ben Lomond is the chief, with an elevation of 3192 feet. The picturesque farm-house, known as "Blairvockie," is situated nearly at the southern extremity of the farm, perched a little above the high road leading from Rowardennan to Balmaha, and looking over the plantation on Ross Point across the loch to Luss. A valuable adjunct to this large extent of "hill" is a "field" of about

1000 acres of low-lying moorland at Buchanan, near the seat of the Duke of Montrose, behind Balmaha. This field is used chiefly for wintering hoggs; but it is not by any means extensive enough for the requirements of the farm, which have to be met by renting additional "hogging land" of farmers in the neighbourhood. The occupation finally includes about 80 acres of arable land and 40 acres of meadow, and an island on Loch Lomond, which is principally reserved for the rams in close time and during the winter; and the whole is held by Mr. Duncan Mitchell, under the Duke of Montrose, at an annual rental of 1030*l.* per annum.

## Arable and Meadow Land.

The small quantity of tillage land held by Mr. Mitchell is farmed with a view of supplying the winter requirements of the 5000 sheep, 40 or 50 beasts, and half-dozen horses kept on the whole occupation. The meadow land is partly tile-drained, and it occasionally receives a dressing of compost, consisting of farm-yard-manure and old turf-fences, with anything else that can be scraped together. On an average, it will yield about one ton of dry hay per imperial acre. Its chief use is to provide winter food for the sheep on the north side of Ben Lomond, in hard winters, when their natural provender is scarce, or inaccessible on account of snow. Under such circumstances they are fed with meadow hay, in the lower grounds, for two or even three months; and in the event of their not requiring the whole or any part of this reserve food, it is kept for Highland cattle the ensuing season. The number of cattle annually bought depends entirely upon the quantity of unconsumed meadow hay of the previous season. The first desire is to secure as much as possible of that valuable food, in case it should be required for sheep in hard winters, its consumption by cattle the ensuing season being a comparatively subordinate consideration. During the past winter (1870-71), in consequence of a very heavy fall of snow, the sheep on two "hirsels," were kept for a considerable time on hay; and on almost the whole of the remainder of the farm during that time they lived principally on heath, which is an extremely useful herbage for them during snow. A clause in Mr. Mitchell's lease enacts "one-sixth of the heathy surface to be burned annually, and the whole to be burned over in six years;" but it has not been insisted on, as it is known that heath is valuable at a much more advanced age.

About two-thirds of the arable land is kept in seeds, so that not more than 25 acres are under the plough, two-thirds of that breadth being in oats, and the remainder either in turnips or potatoes. This is managed by taking oats on an old ley, and following with roots, which are again succeeded by oats and seeds. The seeds generally remain three years, sometimes only two; and occasionally a field has been laid down without a crop, or with rape, remaining for perhaps twenty years, if it continued to pasture well.

The climate does not suit clovers, therefore nothing but perennial rye-grass is sown; but, owing to the large rainfall, natural grasses make their appearance after the first year, and sometimes even earlier. Seeds are never mown, but are pastured by sheep the first year, and afterwards by cattle. The sheep put on this grass are frequently inferior wedders, which it is desired to bring up to the average standard; but the seeds are also grazed by the tup-lambs and tup-hoggs. After roots it is usual to give the land a good dressing of lime, about 3½ tons per acre, previous to sowing the oats and seeds; but the care to obtain good pasture is not confined to liming, for the turnip crop receives 3 cwts. of dissolved bones and 2 cwts. of Peruvian guano in addition to farmyard-manure, if any is left after dressing two acres of land for potatoes with 25 tons per acre.

Oat-sowing generally commences about the end of March, no less than 4½ bushels of seed being used. "Early Hangers" is the sort preferred for the best land, "Sandy" oats for medium soils, and common white oats for the poorer fields. In 1869 oats sown on March 28th were reaped on August 16th; and in 1870 those sown on March 26th were cut on August 10th, but both of these were very early years.

About 8 acres of turnips are grown annually, including some on the island. Aberdeen Yellows are generally sown, at the rate of 4 lbs. per acre; they are always drawn, heaped on the ground in small quantities, and covered with turf or earth.

### Sheep.

There are six "hirsells"* in Mr. Mitchell's occupation, and in 1869 they supported an aggregate of about 5000 sheep, as follows:—

| | | |
|---|---|---|
| 1. *Blairvockie,* | 750: | one-half ewes, one-fourth hoggs, and one-fourth wedders. |
| 2. *Ben Lomond,* | 530: | ewes, hoggs, and wedders in about equal proportions. |
| 3. *Craig,* | 1450: | 700 ewes, 400 hoggs, and 350 wedders. |
| Carried forward | 2730 | |

* A "hirsell" may be regarded as a hill-farm of itself, bounded generally by crests of hills, and not too large to be managed by one shepherd.

| | | |
|---|---|---|
| Brought up | 2730 | |
| 4. *Comer,* | 818 : | 316 ewes, 174 hoggs, and 328 wedders. |
| 5. *Crunevine,* | 599 : | 266 ewes, 178 hoggs, and 155 wedders. |
| 6. *Sluckvinch,* | 724 : | 383 ewes, 187 hoggs, and 154 wedders. |
| | 4871 | |
| | 100 | aged tups, |
| | 25 | tup-hoggs, |
| | 80 | bought hoggs at Comer, |
| | 60 | bought hoggs at Craig. |
| Total, | 5136 | |

The relative numbers of ewes, hoggs, and wedders vary from several causes; some hirsells are more subject to mortality in one or other class than others, but wedders are more particularly liable to disease, and are, therefore, always in the minority unless the deficiency is supplied by purchases. This is done to the extent of 15 per cent. of the number bred on the farm.

Ewes begin to drop their lambs about the 20th of April, and lambing-time continues for about a month, during which period it is essential that the shepherds should be on the "hill" every hour of daylight. Just previous to lambing the ewes voluntarily leave the lower ground, and ascend to the hill-tops; and they similarly descend again of their own accord when the lambs are about a fortnight old. In 1869, the crop of lambs from 2215 ewes, counted at the first collection, numbered no less than 2114; but it was the best crop that had been known for twenty years, exceeding the return of 1870 by 100 lambs, and the average of years by no less than 15 per cent. As a rule, it is found that about 15 per cent. of the ewes are barren, and a large number of lambs die as soon as they are born or very shortly after. Gaps left by deaths are refilled as far as possible by dividing the couples; but it does not often happen that the supply of couples is equal to the demand for them. Couples are comparatively rare after a hard winter, and proportionately abundant after a mild season. The total number of lambs is ascertained on or about the first of June, when the sheep are collected for the first time, and the lambs are marked. About twelve ram lambs are then selected for use in future years, and the remainder are cut at the same time. The next collection is in the middle of August, when the ewe lambs for the flock are selected, and about one-third of the lambs are drafted for sale, not being good enough to keep on. Of late years there has been a good demand for the smaller lambs, which are bought in large numbers by Irishmen, who never purchase the better class, but seem to prefer the cheaper. The whole of the lambs are branded on the nose at this time, and each shepherd marks those belonging to his hirsell with his distinctive paint. Advantage is also taken of this collection to wean the lambs, by keeping them on the low ground for eight or nine days, after which they return to their native hirsells. From this time the hoggs remain on the hills until October 20th, when they are again collected to be dipped or smeared, and are afterwards sent away to the low countries to be wintered, remaining on this land until the beginning of April. Buchanan Moor Park (the "field" already mentioned) in Mr. Mitchell's own occupation, will winter about 1000 hoggs; the remainder are sent to farms in the neighbourhood at a cost of about 5*s.* per head from the first of November until the first of April. Thirty years ago, the charge for wintering hoggs was not more than 2*s.* each.

The mortality of lambs is very considerable, and is a most fertile source of loss to the sheep-farmer. Taking an average of years, it is calculated that no less than $12\frac{1}{2}$ per cent. (that is $2\frac{1}{2}$ per score) of hoggs die on the low ground in the winter; in other words, between smearing and clipping (October 20th until the middle of June) the total mortality of hoggs is not less than $3\frac{1}{2}$ per score.

Clipping the hoggs commences about the middle of June, but the milk-ewes are not shorn until about the 10th of July. Shepherds from all the surrounding farms meet at the different hirsells on days agreed to, and do the shearing on the co-operative principle. They receive no payment, but get their food and an occasional glass of whisky. A good shearer will clip about 100 sheep in a day; but of course neither close nor even shearing is attempted. Women are employed to roll the wool, and receive payment in kind at the rate of one fleece per day. Four wedder fleeces, five and a half hogg, and six ewe fleeces, are reckoned to be the average to a stone of 24 lbs.

Four crops of lambs are generally got from the ewes, which are sent to market after the October collection following the fourth lambing, if they have been well wintered. At the same time, also, the three-shear wethers are sent to market, being often in good enough condition for the London butchers. In such cases they are killed in Glasgow, and go to London in baskets. These sheep will weigh about 55 lbs. per carcase dead weight. At the same time about 20 aged tups are annually disposed of, as well as a few "eyld ewes," viz., those that have lost their lambs.

The draft ewes are frequently bought by farmers in the low grounds, who keep them on grass during the winter, and take a crop of lambs from them the following summer, after which both ewes and lambs go to the butcher. These ewes cannot be kept another year because the grass in the low grounds generally produces disease in the liver.

Smearing or dipping, as the case may be, is commenced about October 20th, and should be finished in the course of a month, or sooner if possible, as the rams are sent with the ewes on the 25th November, and smearing should be finished at least a week beforehand. Smearing is done with a mixture of tar and grease-butter; about 10 pints of tar, and 28 to 30 lbs. of butter being sufficient on an average to do about 26 sheep. Dips of various kinds are used, but smearing is considered safer in a wet climate, being the best preventive of scab, and a perfect antidote against vermin, to which lean sheep are very subject on high ground. Dipping costs from 4*d.* to 7½*d.* per sheep, according to the quantity of grease or oil applied, and smearing with tar and butter from 9*d.* to 10*d.* per head, including labour and cost of materials. A good hand will smear 24 or 25 sheep from 6 A.M. till 7 P.M., being paid 2*s.* 6*d.* per day, and food.

On hill-farms generally the tups are sent with the ewes about November 25th; but in favourable localities very much earlier. They remain together until the latter end of December, the shepherds being in constant attendance to keep the ewes as much as possible on the lower portions of the hirsell. Thirty ewes to each tup is the ordinary allowance, and not less than 90 rams are kept on the farm.

After the tups are brought in from the moors at the end of December, they are kept on the low ground till about May-day, and fed on hay and oats, or cake, or perhaps some of both. Occasionally Indian corn is substituted, but whatever the food consists of it should be highly nourishing. Tups are bought as shearlings, and sold at four or five years old; about 30 are bought every year at a cost of from 3*l.* to 10*l.* per head, partly to obtain a change of blood, and partly to make up for losses. There is a great proportion of deaths amongst the rams, especially amongst those bought. About 2½ to 3 per cent. of the aged sheep die annually, thus making an average of 10 per cent. of deaths, taking the whole of the flock, male and female, of all ages.

A large number of deaths on the high ground are never accounted for, as the carcases are carried away by floods and streams, over rocks, and into gullies and other sequestered or inaccessible places. During snowstorms it is essential that the shepherd's attention should be directed to keeping the sheep well together; and in very severe weather he should take them down to the low ground to prevent their being blown into glens.

They are so frequently carried away by high winds in snow-storms, that it is desirable at such times to keep the flock on ground which is as flat as possible, and away from glens, streams, and rocks. Snow-storms, however, are not so frequent in the central and western districts of Scotland as they were some years ago, and the flockmaster's losses are therefore not so severe.

Some of the habits and instincts of mountain sheep are worthy of note. During the day they pasture on the sides of the mountain and in the lower grounds; and towards night they ascend to the hill-top. This practice seems to show, not only that the higher ground is preferred as a nocturnal resting-place, but also that it is inherent in sheep, in a natural condition of existence, to seek a fresh bite every morning and evening; and it may not be out of place to mention here that this practice is imitated by some of the best flock-masters in the south of England.* Sheep that have been wintered out as hoggs seem to remember the fact on the return of the season next year, when they are apt to seek the low ground, and to endeavour to reach their old winter-quarters; but they generally manage to get back to the spot where they were bred by the beginning of May. The attachment to the native hill is so strong that there are numerous anecdotes current in reference to it, some of which savour a little of the marvellous. Mr. Mitchell himself remembers an instance of a sheep swimming Loch Lomond, on its way back to its birthplace, and being picked up not more than 100 yards from the shore opposite to that from which it started.

Sheep and lambs are always sold by the "clad score" of 21; the custom of giving the extra one (one for luck, as it is generally termed in England) arose, it is thought, as a method of compensation for tolls; but, if so, what is the origin of the "long hundred" and the "baker's dozen"? Tolls vary from 6*d.* to 10*d.* per score at different bars; but they are very unequally distributed about the country. For instance, between Rowardennan and Glasgow, a distance of 27 miles, there are no tolls for the first third of the journey, and no less than five in the remaining distance. In a hilly country, where sheep and cattle are driven along the high road, there being no mode of conveying them long distances, it has been found necessary to provide resting fields for them at night. These halting-places are termed "drove stances," and are generally from 10 to 12 miles apart, a medium size being about 200 acres. They are set apart by the land-owners for this purpose, and a fee of 1*s.* per score is charged for sheep, and from 2*s.* 6*d.* to 3*s.* per score for cattle. They are not always enclosed, and it is in all cases necessary for a man to sit

* See the Report on Mr. Rawlence's farm, 'Journal of the Royal Agricultural Society,' 2nd series, vol. v., p. 505.

up with his lot, as there may be half-a-dozen or more lots in a stance at one time. It is commonly thought that sheep, as well as cattle, sent to market by road, are presented to the buyer in better condition than if they had travelled by rail.

In the southern and midland districts of Scotland, hill-farms are generally stocked with breeding ewes, and the wedder lambs are sold either to the butcher or for hogging, the superior quality of the land rendering this the more profitable system; but in the northern and higher districts a mixed or wedder stock is found most remunerative.

## Cattle.

With the exception of calves from a few milch cows, no cattle are bred by Mr. Mitchell. He generally buys about 40 three-year-old Highland bullocks in May, and grazes them on rough land during the summer. They are wintered on the meadow-hay of the previous season that has not been consumed by the Ben Lomond sheep, and about one-third of them are housed on turnips and a little cake. Highland cattle are not fond of the byre, and none would be tied up at Blairvockie but for the sake of the manure; in fact, those left out and wintered on meadow-hay alone are fit for the butcher before those which are kept in byres and given a moderate quantity of turnips and cake. The next season they are all turned on to the feeding pastures about the 1st of May, and by summer-grazing they are rendered fit for the Glasgow butchers by the beginning of September.

In former years it was Mr. Mitchell's custom to graze annually about 100 West Highland heifers; but they do not pay at the enhanced prices which they have since commanded as store stock, owing to the more restricted supply, in consequence of a much smaller number being now bred. Until 20 years ago, Mr. Mitchell was himself a breeder of West Highland cattle, and he then sent grazing cattle on the hills amongst his stock sheep; but since he has discontinued this system he has found that fewer sheep have died from braxey, although he cannot assert that there is any connexion between that disease and the companionship of cattle and sheep. The reasons which induced him to abandon his herd were chiefly the losses consequent on the liability to abortion in Highland cows, and the difficulty of providing winter keep for a breeding herd. As a matter of experience he has found that, notwithstanding the enhanced prices commanded by the picturesque West Highlanders, feeding pays better than breeding, chiefly because aged cattle do not require so much winter keep as breeding cows and young stock. As a contribution to the artistic literature of agriculture, I may mention that the West Highlanders, painted by Mdlle. Rosa Bonheur, in her well-known picture of 'The Cattle-fair,' were selected from a lot which Mr. Mitchell took to Falkirk tryst about the year 1854. The particular beasts were selected by the lady-painter herself on artistic grounds, and regardless of the prosaic protests of the breeder, who considered them anything but favourable representatives of his Highland herd.

## Labour.

Only one man and a youth are regularly employed as farm-labourers on the cultivated land. The former is paid 25*l.* per annum and his food, and the latter 15*l.* per annum and food. Occasionally men are employed at daily wages, viz., 12*s.* per week and food during the winter, and 15*s.* per week and food during the summer: they pay for their own washing, and sleep in a bothy. Married shepherds get 17*l.* per annum, 6½ bolls of oatmeal, keep for two cows, with permission to have a calf with each until it is 12 months old, and a croft comprising ground enough for planting potatoes sufficient for the family. Unmarried shepherds of the district get 25*l.* per annum and board in the bothy, but Mr. Mitchell does not employ them. Occasionally, however, a young man boards with a shepherd, who receives for his keep 6½ bolls of meal, a cow, and potato-ground. Women are employed during haymaking and harvest, for hoeing turnips and on other lighter occupations. They get 1*s.* 6*d.* per diem and have their meals in the house-kitchen, as also do the farm labourers. Breakfast, at 7 o'clock in the morning, consists of oatmeal porridge and sweet milk, and oatcake and sweet milk afterwards. Dinner is ready at 12, and consists of broth or soup, butcher's meat, potatoes, bread, and sweet milk. Supper time is 7 o'clock, and the meal consists of oatmeal porridge and sweet milk. For six months in the year the labourers are allowed fresh mutton for dinner, and during winter they get salt meat instead. The hours of labour are from 6 till 6, an hour being allowed for breakfast and dinner.

The wages of farm-servants have doubled since Mr. Mitchell commenced farming, in 1827, when his first ploughman received 11*l.* per annum.

Piecework is not much in vogue; but sometimes oats are harvested at 14*s.* per acre, including cutting, sheafing, and stooking. Formerly the price was not more than 10*s.* per acre, but the scarcity of labour in the Highlands has raised the price of all agricultural fieldwork. Turnips are generally thinned by hand, before being hoed, at a cost of 2*d.* per 100 lineal yards; but hoeing and other such work is done by women and by the yearly labourers kept on the farm.

## VIII.—*On the Agricultural Capabilities of the New Forest.* By W. C. Spooner, of Eling, Southampton.

Contents.



### I. Introduction.

The New Forest is an extensive tract of land, consisting of some 63,000 to 66,000 acres, forming the south-west of Hampshire, and facing the south. The Solent separates it from the north-west coast of the Isle of Wight, which, no doubt, it originally joined, whilst its south-western half faces the English Channel. Its aspect, therefore, is extremely favourable, and, if its soil were equally good, the most sanguine expectations as to its future productiveness would undoubtedly be realised. In support of the goodness of the climate, I may adduce the well-known fact that on its south-western borders the modern town of Bourne has been built, a place which owes its prosperity to its having been selected as the winter abode of invalids suffering from chest complaints. This town was also, from its salubrity, selected as the site of the Sanatorium built in connexion with the Salisbury Infirmary, and in honour of the late Sidney Herbert.

The geological system to which the Forest belongs is the Tertiary, and it is placed in the Upper and Middle Eocene divisions. Thus, whilst its subsoil ranges from a retentive clay to the most arid sand, its surface-soil—never very deep—varies from a few inches of the poorest of the poor to 6 or 8 inches of hazel loam. One striking peculiarity appertaining to this tract of land is, that throughout its longest extent, from Lyndhurst Road Station to Christchurch, it contains no river, properly so called, but lies between two of some length and importance: the Test on its eastern, and the Avon on its western, border. The former rises in North Hampshire and brings with it washings from the chalk hills, and the other, of still greater extent, rises in the neighbourhood of Bath, and annually enriches the alluvial plains which it originally formed. The New Forest, lying between these rivers, neither participates in their advantages nor derives assistance from their aid; whilst its own small streams rise in the locality itself and issue, in many cases, direct from the Forest to the sea. This fact explains how it is that there is so little alluvial soil within the range of the Forest, although, in most instances, the best pasturage and the most productive arable soil are in the immediate vicinity of some of these streams, as, for example, that which is termed the Lymington River, which, tracing it from its mouth, is seen to have passed by the village of Brockenhurst and the productive and highly cultivated land of New Park. Not only, therefore, is the locality under our notice unenriched by assistance from without, but for ages past it has been called upon, out of its poverty, to aid the wealth of the various surrounding and intermingling spots. Many of these, although probably once belonging to the Forest itself, have for many years, through favour or by services, by right or by might, become private property; and they have consequently been endowed with the right of robbing their poorer neighbour, depriving it of its soil as well as of its productions, and making no return whatever for this ancient and time-honoured system of legalized plunder.

The New Forest was formerly much more extensive than it is at present, and consisted, it is said, of no less than 147,200 acres. It reached from the Southampton Water to the River Avon, and from Aubridge on the north to the sea on the south. Such was its extent as described in Domesday Book, written soon after the Conquest. In the reign of Charles II. it was greatly reduced; and at the time of the perambulation in 1801 its gross extent—or rather the area within its *boundaries*—was 92,365 acres, which is its area at the present time; so that a great proportion of the land possessing Forest rights formerly belonged to the Forest itself. We should be wrong if we regarded the above figures as correctly representing the actual Forest: for there are to be deducted 27,140 acres, being freehold estates belonging to private persons; 125 acres copyhold, or land belonging to the Crown Manor at Lyndhurst; 600 acres leasehold under the Crown, granted for a certain number of years; 500 as enclosures, held with lodges; 1000 acres, freeholds of the Crown, planted; making altogether 29,365, and leaving about 63,000 as the woods and wastes of the Forest. Of these there are some 16,000 acres enclosed and planted, or intended to be so planted, 10,000 acres of which were granted for this purpose in consideration of the right of pasturing deer being given up by the Crown. From these plantations the public, or rather the commoners, are debarred turning their cattle for the space of forty years; but even after this it is found that the young oak trees are often injured by the cattle so turned out; and provided that it were still desirable to grow oak for the navy, it would by no means be advantageous that common-rights should be exercised at the same time. An additional argument may be found in the fact that the enclosures, when thrown open, are of very little service to the commoners, inasmuch as the deep open drains are allowed to continue unfilled, and, being partially grown over with brambles, are extremely dangerous for cattle. It would have been a far better arrangement if only one-half of the land had been so allotted and planted, but without any provision for throwing it open to the commoners afterwards. It is a matter of great complaint on the part of the commoners that the Crown Commissioners have, in selecting land for planting, laid their clutches on the fairest and most fertile parts: a power, certainly, which, thus exercised, savours more of might than of right, and which has latterly been protested against with some success, and thus some favourite and picturesque spots have been, fortunately, rescued from the lovers of straight lines and formal avenues. Some gentlemen, who are strong advocates for the retention of, or full compensation for, forest-rights, contend, with much force, that it is a matter of great regret that, when the Deer Removal Act was passed, the Forest was not dealt with as a whole, instead of so large a portion of the best land being absorbed by enclosures. Whilst acknowledging the force of this argument, it must not be forgotten that, if large portions of these enclosures were offered for sale at the present time, the price realised would undoubtedly show that, as regards the question of value, the planting has not been done in vain, and that the outlay has not been all lost. It is contended by some that the district in question ceased to be a forest when the deer were destroyed. Be that as it may, it must be confessed that the Crown secured ample consideration in the right of enclosing and planting 10,000 acres of land, in addition to the 6000 allowed to be enclosed before; and the more so, as the best land in the Forest was secured for this purpose, instead of taking in equal quantities the good and the bad. There was, however, some excuse for this practice in the earlier years of exercising the right, inasmuch as the plea was that the object of enclosing was to supply oak timber in future years for the use of the Navy, and it would be useless to reserve land unsuitable for this purpose. The plea was a good one at the time; as it has been found that if cattle have access to young timber it is rendered perfectly useless for Navy, and of very little value for other purposes. A mighty change, however, has come over these affairs; for it is now an accepted fact that oak timber will no longer be required, and that the wooden walls of Old England have succumbed to the superior defensive claims of her iron ramparts. Two grounds for the retention of the Forest—the fuel and the oak—are thus removed; and we cannot be surprised if, with an increasing population and a circumscribed area, the remaining arguments should at length yield to the influence of public opinion. It is, however, of great importance that public opinion should be guided correctly, and that the Utopian ideas on the subject advocated by some enthusiastic partisans should be combated.

## II. Forest Rights.

The most destructive of the Forest rights, although perhaps at the present day one of the least valuable, is that of turbary, or cutting turf for the sake of fuel. It is customary to cut one turf, as it is termed, and leave two; so that in some instances the surface may be denuded every third year, for with the turf a considerable quantity of the soil is removed with the roots of the broom. Thus not only is there no chance of any restoration taking place under this system, but the soil is actually impoverished and diminished, whilst the ashes are used to enrich in some measure the surrounding land. Now, this right of cutting turf was no doubt of value before the bowels of the earth had been made to yield up much richer fuel, and when the supply of manures was so limited that the ashes of turf were highly estimated. At present it is a fair question, unless the carriage is very slight indeed, whether the value of turf is worth the expense of procuring it. There can, at any rate, be no great difficulty in ascertaining the value of these claims, which will doubtless be influenced and regulated by those which have actually been exercised during an average number of years. The buying up and extinction of these rights, or making allotment of lands in lieu thereof, will no doubt form the first grand step towards the amelioration of the soil of the Forest, although it may take many years to recompense it for the bad treatment of ages. The surface, whether wholly or partly covered with broom, would of course be burnt, and this would supply at once a very large amount of manuring matter and food for the earlier crops.

The most valuable of the privileges enjoyed by the Commoners is undoubtedly the right of turning out cattle; and where the pasturage is tolerably good, and is in the neighbourhood of villages where milch cows can be turned out during the larger half of the year, the right, although greatly abused, is no doubt one of value; and it is here that the hardship of enclosing the Forest will be mostly felt. It is to be hoped that this right will not be entirely abolished, or, if so, that it will be partially restored by re-purchase; for, as the idea of reserving so much common land for healthy and recreative purposes and appropriating the same to each town or village in the neighbourhood, is one very favourably entertained by the public, such a reservation can be very conveniently connected with the continuation of the right of pasturage—or rather, its restoration for a proper consideration.

It is somewhat difficult to estimate the value of these claims individually as well as collectively; for, whilst the right of turning out a yearling heifer, a Scotch or Welsh, or a pony, may not be worth so much as a pound a year, yet, in a locality where milch cows can be turned out and yet housed and milked, the value of the same may be from 2*l.* to 3*l.* With regard to the number to be commuted, no doubt the claims will be considerably in excess of the numbers that are pastured out; but the average number for some years past may perhaps rule the amount of claims to be compensated. At present the understood rule is that, on a farm possessing rights of feed, as many animals may be turned out during the summer as can be fed on the farm during the winter. We imagine, if this rule were fully exercised, there would be an insufficiency of feed for the animals turned out. If the average value of the feed of each animal were 25*s.*, and during the last five years an average of 3000 animals have been turned out, the aggregate value of the same would be under 4,000*l.*; but if one-half or one-third of these animals could get sustenance on the belt or circle of land proposed to be awarded to each town or village for sanitary purposes, the inconvenience would be much diminished. There are thus three strong arguments in favour of retaining a portion as pasture or improved forest:—

(1) The advantage for sanitary and recreative purposes: a principle generally conceded.

(2) The advantage in a picturesque point of view, as forest scenery might be retained, with many of its finest and most ornamental trees.

(3) The opportunity it would offer of retaining or restoring in part the most valuable of the Forest rights, that of pasturage or its equivalent; and, besides this, it may hereafter afford convenient means of utilizing the sewage of the respective towns or villages to which the land may be appropriated.

The practice of cutting fern for litter does not appear to be done in virtue of any right, but we presume it is paid for. It is much less destructive to the land than cutting turf, inasmuch as it does not remove the soil itself, with the exception of the earths which enter into the composition of the plant. The soil which furnishes it is also of a moister nature and deeper character and likely to make a more generous return. No mention is made of the right of cutting fern in the account of Forest rights which is signed by the three Commissioners, who sat in 1854 to decide on the Forest claims, and which precedes the list of claimants who have succeeded in establishing their rights for

65,000 acres and 1200 houses. This Commission expended a considerable amount of time and trouble in their task; and it is rather to be regretted that their labours were not followed by some plan of dealing with the Forest, or by some proposition for valuing as well as ascertaining the claims. It will be convenient, however, in this place to give the latter part of the Report defining these rights, and signed by the Commissioners in question.

In the year 1854, an Act of Parliament was passed for the settlement of Forest Claims, the nature of which is set forth in the Register:—"Now we, the said Charles James Gale, James Barstow, and John Duke Coleridge, to avoid unnecessary repetitions in each case, do hereby declare that each allowance of any right is made subject to, and that the same is to be exercised and enjoyed according to, the Laws and Assize of the said Forest, and that in all cases wherein a right is allowed subject to a payment, such payment is to be made to our Lady the Queen. And that every right of common of pasture may be exercised and enjoyed at all times of the year, except during the fence month, that is to say, the twentieth day of June to the twentieth day of July yearly, and the time of the winter hayning, that is to say, the twenty-second day of November to the fourth day of May yearly, during which times we declare there is no right in all the unenclosed waste lands of our Lady the Queen within the said Forest for all their commonable cattle, levant and couchant, in and upon the said lands in respect of which the allowance is made.

"And we do hereby declare that common of pasture for sheep is allowed only in cases where it it is expressly mentioned.

"And we do hereby also declare that every right of common of mast is to be exercised only in times of pannage, that is to say, on and from the twenty-fifth of September up to and on the twenty-second day of November yearly, in all the open and unenclosed woods and woody lands of our Lady the Queen in the said Forest for all their hogs and pigs, ringed, levant, and couchant, in and upon the lands in respect of which the allowance is made, upon payments, unless otherwise expressed, yearly, to and for the use of our Lady the Queen, for every hog or pig exceeding the age of one year, four-pence, and for every hog or pig under that age, two-pence.

"And we do hereby also declare that every allowance of turbary is of the liberty of having, digging, cutting, and taking turf in and upon the open wastes of our Lady the Queen within the said Forest by the view and allowance of the Foresters of the said Forest, and of carrying away the same turf from the said places to and into the messuages mentioned and described in this our Register for the necessary fuel of the said messuages, to be therein burnt and expended. And that every allowance of fuel and fuel-wood is an allowance of the quantity described of good fuel-wood yearly from the open and unenclosed parks of the said Forest by the view and allowance of the Foresters of the said Forest as reasonable and necessary estovers for the necessary fire-wood of the messuages mentioned and described in this our Register, to be burnt and expended therein.

"And we do hereby also declare that every allowance of a claim of marl is of a right to have, dig, take, and carry away from the open and accustomed marl-pits in the said Forest, a Schedule whereof is set forth at the end of this Register, by the view and allowance of the Foresters of the said Forest, sufficient marl for the necessary marling of the lands in respect whereof the said marl is allotted and adjudged to be exclusively used thereon. And we do hereby also declare that, save as aforesaid, no payment or render is to be made to Her Majesty or Her Successors in respect of any of the said rights, or in respect of the allowance thereof, except such as herein mentioned.

(Signed) "CHARLES JAMES GALE.
"JAMES BARSTOW.
"JOHN DUKE COLERIDGE."

It appears at first sight very singular that in this document the power of clearing the Forest of the cattle during a month of the summer, for the purpose of fawning the deer, is retained when there were no deer left to be fawned, and the more so when for many years previously the right had become obsolete by non-usage. The effect of enforcing the right would have been to have almost destroyed the value of the right of pasturage, and it must have been retained by the Commissioners as a sort of rod to be held over the commoners to ensure their good behaviour, and perhaps hereafter to lessen the pecuniary value of their claims.

In the Register referred to, mention is made of twenty-four accustomed marl pits; they are mostly situated south of the rail, but the most northern is found at Boldrewood. The high royalty of 6*d*. per ton is charged for the privilege of digging this marl.

In a return made to the House of Commons, moved for by Mr. Bonham Carter, and ordered to be printed in 1867, some interesting particulars are supplied, as well as the map from which our own is reduced. The first is a return of all enclosures made under the Acts of William III. and George III., with the dates of enclosure and disenclosure. The enclosure under these Acts commenced in 1700 and terminated in 1815, and are thirty-nine in number, containing altogether 7727 acres, of which 955 acres have been disenclosed and enclosed again, and the remaining 6772 acres still remain disenclosed.

This is followed by another return, showing the number of enclosures made under the Act 14 & 15 Vict., from which it appears that these are seven in number, comprising 3089 acres; and that the expense of the same amounted to 17,800*l.*, or 3*l.* 13*s.* 6*d.* per acre, including fencing, draining, planting, and sundries. There are nearly 900 fir-plants per acre, and 666 of oak; and as only 60 of the latter are ultimately allowed to remain till they are 100 years old, when they are supposed to be worth 10*l.* each, there seems to have been ample provision made for a supply of oak.

To whom does the Forest belong? One would suppose that there could be only one answer to this question, and on such a simple case there could be no difference of opinion; but such is not the case. It is held, however, that the right of the Crown is paramount; that it has the first claim, and can demand compensation before that of the commoners is satisfied. Many who assent to this will yet argue that this first claim being satisfied the remainder reverts to the commoners. The forest originally was vested in the Crown; and grants of land were made for services rendered, which grants were accompanied by certain privileges, or rights, over the land still continued as forest. As the value of the Forest will not only be sufficient to satisfy the claims of the Crown, but the rights of the commoners also, it is quite immaterial which are first and which are second. The largest portion will, we imagine, be that which remains, and which undoubtedly belongs to the Crown, or rather to the Department of Woods and Forests, or in other words, by the arrangement of the Civil List, to the country itself. The claims of the commoners, &c., being satisfied, the remainder, then, belongs to the country, in common with all the woods and enclosures, which will therefore, we presume, be dealt with together.

The rights of the commoners consist very largely of pasturage. It is supposed that about 3000 ponies, heifers, and cows are turned out during the summer months, and there used to be many more. As they seldom or never get fat, we may consider that, with the above number, the Forest is sufficiently stocked. The annual value of the pasturage, therefore, cannot greatly exceed 4000*l.*; and we cannot suppose a better arrangement than by first ascertaining the money-value of the rights of pasturage per animal, multiplying this by the number of animals turned out on the average of the last five or ten years, adding a liberal percentage, and dividing the sum total amongst those who have such rights, in the most equitable manner. The amount and value of the land sufficient to compensate these rights can, of course, be ascertained by public auction ; and so can the value of the right of pasturage over that portion of the forest to be retained as public land for recreation. There are, of course, acres, I may say miles, of forest which afford little or no sustenance to either horses or cattle ; but they are so interspersed with patches which afford either a scanty or abundant feed, that no line can be drawn between them. If, however, we take the whole acreage not enclosed, and divide the same by the number of animals, we shall find about 12 acres per animal as the product of the calculation, or about an average renting value of 1*s.* 6*d.* per acre. It may be worth mentioning, that in Exmoor Forest, where the celebrated Exmoor ponies are raised, it is, or used to be, customary to let the feed at so much per head, according to the age of the animal ; thus three-year-old cattle were charged 1*l.*, and horses of any age 1*l.* 5*s.*, and sheep 2*s.* 3*d.* for the twelvemonth.

The pannage, considering the short time in which it can be exercised, viz., from September 25 to November 22, is of more comparative value than the pasturage ; and as it yields a certain amount of revenue to the Crown, viz., 1*s.* for pigs under one year, and 2*s.* above, the number of swine can be more accurately ascertained than in the case of other animals. I am indebted to the courtesy of the Deputy-Surveyor for the information afforded by the following Table :—

*Number of Pigs turned into the New Forest during* 5 *Years, from* 1865 *to* 1869.

| | |
|---|---|
| 1865 | 1,575 |
| 1866 | 5,893 |
| 1867 | 3,475 |
| 1868 | 5,139 |
| 1869 | 3,721 |
| | 19,803 |
| Average per annum | 3,960 |

It will probably be the best plan to ascertain the money value of this right of feeding the acorns and mast to satisfy the claim in the same manner as the other rights are disposed of, and then to relet hereafter the pannage for a fixed number of swine ; as, of course, so long as the planted portion is retained, the pannage will be of some value.

It has already been stated that the Forest was once considerably more than double its present size. Not that the Crown had the same kind of right over the whole, for a considerable portion was held by the right of prerogative; that is, the power of making a forest of any land belonging to private owners, and keeping deer thereon. In return for the injury thus done, the owners of the adjoining property were allowed the privilege of turning out cattle and pigs, and cutting turf over the land belonging to the Crown as its private demesne. Such appears to have been the origin of very many of the Forest claims. Well, in process of time, the Forest was greatly reduced; that is, for certain considerations—probably money payments—the Crown relinquished its right of prerogative over the adjoining land, and allowed the owner to enclose and cultivate it. It then ceased to belong to the Forest, although exposed to injury from the deer, which were often less disposed than the Crown to recognise their circumscribed bounds. It is ever to be regretted that, in yielding its prerogative rights, the Crown did not at the same time insist on the extinction or diminution of turbary, the exercise of which barbarous privilege has acted like the upas-tree, and blasted the means and almost the hopes of improvement. For the sake of supplying a little scanty fuel in times past, Nature's efforts at restoration were continually frustrated, and succeeding generations deprived of food. Its one redeeming quality is that it has supplied the present generation with an unanswerable argument in favour of the enclosure and cultivation of the Forest.

It is contended by some that ceasing to keep deer in the Forest, and by the acceptation of ten thousand acres in lieu thereof, for the purpose of planting, the Crown gave up its rights as lords of the soil; but it appears that whilst it ceased to be a Forest as regards the deer, the Forest laws are, as far as they can be, still retained—*e.g.*, the very same document which establishes the claims of the commoners also recognises the fence month.

It may be urged by the commoners, with some reason, that, if the Forest is to be broken up, they have a right to participate in the increased value which the land assumes from the very fact of its being about to be so treated; and that, although as compared with the owners of the soil they are the weaker party, and will not have the power of putting in a veto against an improvement which the public good demands, they should be treated as if they had such power, and on the same principle that owners of property taken by the Crown by Act of Parliament are allowed an extra price for a forced sale, in addition to the value of the property settled by agreement or by a jury. In the case of two owners equally interested in a property which can be sold to great advantage, it would be necessary to have the assent of both, and both would participate in the advantages of the sale. But if the interest of the one is paramount, the other having simply a lien on it, it would be sufficient for the former to satisfy the lien, and, the obligation being satisfied, to possess the property. The Forest can hardly be treated like other commons, where there are often three parties—viz., the lord of the manor, the copyholder, and the tenant. The commoner in the Forest cannot be like the copyholder. He has paid no fine, and he is not the owner of the soil subject to the right of the lord of the manor; but he possesses rights which, as long as they are exercised, forbid the more beneficial occupation of the soil; and, consequently, for removing these obstructions he ought to be, as Mr. Bone says, very liberally dealt with; the more so, as these rights are not only extremely ancient, but, it is asserted, were attached to the land which gives the claim in many instances before the Forest was extended over private lands by the King's prerogative. The fact of rights having been claimed, and recognised, for lands beyond the utmost bounds of the Forest, even to the west of the Avon, will prove this; and these claims are sufficient to show that all rights were not merely given in exchange for the injury inflicted on private lands by the exercise of the King's prerogative. All these matters will, no doubt, be fully debated and deliberately settled. Our object is simply to ventilate the subject, and to throw on it sufficient light to show the many difficulties with which it is enveloped.

## III. Legal Position of the Forest.

The legal position of the Forest is very curious, and, we may also add, is involved in considerable intricacy and obscurity. Lawyers will, doubtless, be able to show on behalf of the Crown and the commoners likewise how much can be said, and well said, on either side; and if the contending points were to be decided by the strict letter of the law, we should despair of any solution being arrived at. However, it is to be hoped that common sense will be called in to decide the matters on which the law breaks down, and, with such assistance, we do not despair of the result. The history of the Forest is exceedingly remote, and the origin of the claims of the commoners is equally ancient, and extends far back into Saxon history. It is fortunate, however, that within recent years a Commission has been appointed to determine who have rights and who have not, and the Record of the Commissioners is now accepted as a sort of Forest Charter.

That the commoners do not lack either numbers or intelligence the following communication from a gentleman residing within the ancient boundaries of the Forest will sufficiently testify:—

"Dear Sir, "January 23rd, 1871.

"You ask me to send you a sketch of the present state of the New Forest, from a legal point of view. Although I have not the right to speak with authority as a lawyer, I have paid some little attention to this subject during my residence in the Forest, and am happy to give you my ideas for what they are worth. I shall not go into any detail as to the acreage or geographical position of the Forest, because as I understand that you are engaged on a paper that treats of its agricultural capabilities, you will yourself have entered upon these points; but I will endeavour to give you a simple outline of the somewhat peculiar situation it occupies when the legal ownership of the soil and the beneficial enjoyment of its produce are considered. The New Forest, alone of English forests, has a record of its first formation made contemporaneously with its afforestation. Shortly before the date of Domesday Book the area of the Forest was subject only to the ordinary land laws of the kingdom. If not the whole, the greater part of the land within its limits was probably uncultivated, very extensively wooded, and in the hands of the Sovereign as part of that royal demesne from which, in theory, all the private property in the realm originally had been carved out. Around and within its boundaries lay various manors, the results of grants from the Crown, as well as demesne lands of the Sovereign, which have since passed into the hands of subjects; and without doubt the same method of cultivation and the same privileges of the tenants of the Crown, or of the Lords of Manors, were here in force as were usual elsewhere. Those who held the cultivated soil, whether ploughlands or meadow, used it in connection with the right of pasturing their cattle on the uncultivated waste, a right then probably necessary to the rude farming of the period, and with which neither the Crown nor a Lord of the Manor, as the proprietor of the soil itself, had any power to interfere, further than to prevent the illegal encroachments of strangers, or the assumption of unlimited pasturage by their tenants. A power, however, existed in the Sovereign, traceable back to very remote times, possessed by no subject, and which, when exercised, was capable of working very great hardship, and of effecting a great change in the holding of all lands over which it extended. This was the prerogative of afforestation; and it is the peculiar nature of this excrescence, as it were, of the land laws, which renders at this very day the management and the disposal of the New Forest so difficult to arrange, so as at once to promote the advantage of the public, and at the same time zealously to respect the interests of private persons. This power of afforestation was put in force by William the Conqueror upon an area of land which, in its limits, may be taken to be identical with the New Forest as it exists at present. The great bulk of the acreage was probably the King's own demesne, but a portion of it certainly was in the possession of subjects. From that moment the common law was overridden by forest law, the preservation of deer and provision for their food became of an importance far superior to the production of meal and corn, and the prosperity of men; consequently these laws are almost universally opposed to the cultivation of the soil and the increase of the people. It is impossible in a short space to enter minutely into these laws. Suffice it to say, that men within a forest might be forbidden to build houses, to cut their timber, to plough their lands, to grub their coppices, or to pasture the open lands with freedom, either as to time or as to the animals they chose to keep. With the laws for the punishment of crimes committed directly against the deer we are not now concerned, but it is necessary for our purpose to allude to such constitutional infringements of public liberty as I have mentioned above, not so much because I would point to instances of legal wrong founded upon such laws in old times, but because in these very days, long after such obnoxious powers had ceased to be exercised by any Sovereign, a Government Department has raked them from the dust, and threatened to enforce them for purposes entirely foreign to those to which alone they owe their origin. Amongst these powers of the Crown over the property of a subject within a forest, I will take one as an example to which I must presently refer in my endeavour to trace the legal history of the Forest up to its present time. This is 'fence-month.' Shortly, this means that the Sovereign had power, if he pleased, to prevent all men (possibly all cattle also) being in the forest during the four weeks in June and July, at which time the deer were fawning. It may be taken as regards the New Forest, that it came to be considered that the Crown had the power of clearing the Forest of all cattle in that month; but, at the same time, there is no instance on record of its being put in force within the New Forest for a very long number of years, if ever. The case, then, of the New Forest, immediately on afforestation, was this. The relative rights of the Crown and of subjects over its soil were materially altered, greatly to the detriment of the latter; but it is to be by no means inferred that this last stroke was permanent, or that the original position was utterly destroyed. On the contrary, the Sovereign could disafforest, as well as afforest; and upon this taking place, that first condition of things revived which had only been put in abeyance by the imposition of forest laws. Of this there are plenty of examples when, as liberty began to dawn, Sovereigns were compelled to narrow the limits of the forests which they had wantonly constituted over various parts of the kingdom. I have said that lords of the soil over which common rights extended, had no power to interfere with the pasturage of their tenants, certainly, therefore, no power to enclose the open lands; but what they could not get by common law it was open for them to obtain, if they could, by statute. Thus, in the reign of William III., an act was passed to enable the Crown by degrees to enclose, for growing timber, 6000 acres of this forest. It seems to have been a wise and just measure. Originally, doubtless, the forest had been rich in timber, oak and beech, and from it the Crown had been accustomed to draw the requisite supply for the Royal Dockyards; but in the lawless times which just preceded the date of this statute the forests of England had become the easy prey of land-pirates, who had cleared the old woods of almost all that was valuable in them. The Crown was thus robbed of its property; and the Commoners, if they gained a somewhat more open space for grazing their cattle, lost what was then to them a particularly valuable right —the pannage of their swine on the acorns and the beech-mast of these ancient woodlands. This statute, therefore, especially provided that plantations should be made for the sole purpose of restoring this devastation and supplying timber to the Royal Navy, and made it a condition that the lands should be taken in such places as would least inconvenience or damage the Commoners of the forest. It gave, too, a further power of making plantations with the like purpose and condition to the extent of 6000 acres more, when the plantations first made should again be flung open to the cattle. The property of the Commoners in the Forest was thus carefully asserted and confirmed, and in a separate section the time of 'fence-month' was mentioned as a forestal exception to the ordinary exercise of their rights of pasturage. Who these Commoners were, and what lands had rights attached to them, was not then mere matter of conjecture, for within thirty years a very ample register of claims had been made under a Commission from Charles II., which register has been lately translated from the Latin, and printed and published by the Office of Woods. If the Commoners had no reason to complain of the tendency of this Act of William III., they had still less cause for complaint with regard to the execution of its provisions. Up to 1808, little over 3000 acres had been taken from the open lands and planted, but a Royal Commission having been appointed at the end of the eighteenth century to report generally on the Royal Forests, public attention was drawn to the fact of their gross mismanagement. Any one desiring to know what the result of Crown management was in 1739, cannot do better than peruse this masterly report, which not only pointed out the abuses, but laid down principles of reformation. I may sum up the recommendations of the Commission into three points:—

1. To remove the deer.
2. To ascertain the common rights.
3. To do away with the forest laws.

A faint attempt was made in 1792 to follow out two of these suggestions, but the Bill introduced for the purpose failed to pass. It did not embody the whole plan recommended by the Commission. It proposed, indeed, to park the deer; but, with that proposal, it fixed so exorbitant a compensation for their removal, that the commoners petitioned against the Bill, and it was lost. It was impossible that it could have had a better fate; for not only did the Government fix their own compensation, without any scheme for arbitration between the Crown and the commoners, which the Commissioners had very carefully insisted upon, but the Bill was totally without machinery for settling the rights of common, which had lapsed into great abuse, to the prejudice of those whose rights were legally indisputable, and to the encouragement of a lawless population. From 1808 to 1851 ample amends were made for the previous laxity in taking in land for plantations. An Act was passed to get rid of the principle of gradual planting; and, in the latter year, not only had 8000 acres been planted and been again flung open, but more than 6000 other acres had been enclosed, or were officially marked out for enclosure. Thus, not only were the provisions of the Act carried out to the full, but the limits laid down were very materially exceeded. At this last date, then, more than 14,000 acres of the best land in the Forest had passed into plantations, whilst the ancient woods were estimated still to cover 9000 acres. The old principle of providing timber for the Royal Navy, which alone was the object of the enclosing Act of William III., had come to an end, for the era of iron ships had dawned; but in its place the scheme of growing timber for a purely commercial end was adopted. So far from the land being taken "where it could be best spared from the Commoners," the best pasturage was carefully selected and brought within the new fences, and within a year or two the Forest officials were able openly to declare a policy that the power of planting should henceforth be used, not only with reference to a money return from the profits of the timber produced, but for the more remote but certain result of converting all available land into woodland, and thus destroying common rights, which had so inconveniently asserted their legal existence.

"In 1848 and 1849, a Select Committee was appointed by the House of Commons once more to investigate the affairs of the Royal Forests. Again the result of a searching inquiry was the exposure of gross mismanagement and fruitless expenditure. In consequence of their Report, a Bill was introduced into Parliament in 1851, now known as 'The Deer Removal Act.' As in the Bill of 1792 full attention was not given to the recommendations of the Commissioners, so now the result of the evidence given at great length before the Committee, and the suggestions made in their first Report, were all but set aside by the Government promoters of this Bill. The Draft Report presented to the House, after recommending the removal of the deer, proceeds thus:— 'Cotemporaneously with the removal of the deer, your Committee contemplate the determination of the Forest Laws, of the Forest Courts, and of all exclusively forestal offices, authorities, and jurisdictions. They are of opinion that henceforward the Royal Forests should assume the character of ordinary property.' This Bill, nevertheless, consisted simply of nine or ten clauses, providing only for the removal of the deer, and fixing an arbitrary compensation for the loss to the Crown of that expensive privilege to the extent of 14,000 acres, in addition to the power to enclose 6000 already existing. Again the Commoners resisted, not the removal of the deer, which was nothing to them, but the amount fixed for compensation. Again they complained that they had no adequate legal means for excluding strangers from their pasturage, or for defining and limiting the rights of each other over the forest. The Bill seemed at one time to have been in their power, but the temper of the times then was for the enclosure of all commons, the excessive practice of which has, I fear, inflicted loss and inconvenience on the poorer classes, and upon the Chief Commissioner threatening to apply the powers of general enclosure to the New Forest—which, if carried out, would have been ruinous to the smaller freeholders—a few leading men of the Commoners, very imprudently, as I think, yielded their ground, and were contented to withdraw their opposition to this most unjustifiable measure in consideration of a reduction of 4000 acres of the proposed compensation, and of the introduction into the Bill of a machinery for completing a legal register of claims which should be the title-deed of the Commoners over the remainder of the forest. These claims have now been adjudicated, the Crown in every instance more or less objecting to each claim. In the result, the tactics, if not the fairness, of the Government Department in introducing a Bill which did not provide for the registration of the rights of Commoners was fully exemplified; for, notwithstanding their opposition before the arbitrators, no less than 65,000 acres of land and 1200 houses established their various ancient rights over the New Forest. It had, previous to this decision, been urged against the view which I have given of the inception of these common rights, that they were simply a permissive indulgence from the Crown as some recompense for the infliction of the forest laws upon private lands; but a strong argument arises against this theory from the fact, that of these 65,000 acres to which the rights were adjudged to attach only 2600 are within the circle of the forest boundaries.

"The deer being removed, it would seem naturally to follow that the laws for their preservation would have passed away also, and the official evidence given before the Select Committee of the House, as well as the suggestions in the Report of the Committee which has been quoted, directly led the Commoners to that conclusion, the solicitor in charge of the Bill, when under examination, repeatedly and distinctly stating that it would leave the Crown as Lord of the Manor, with the sole claim to soil and timber. But the Bill as it became law did not bear out his interpretation. An ingenious wording of the Deer Removal Act itself, and the non-repeal of the section of the Act of William III. by which "fence-month" passed from the region of the forest law and became recognised by the statute law, had left it open to the Crown first to remove the deer, and then to claim power to enforce all forest laws as if they were present. The oldest inhabitant had up to this time never heard of the word "fence-month," nor had his cattle ever been disturbed in their grazing grounds for the protection of the fawns; but now the Chief Commissioner of Woods issued a placard announcing his intention of clearing the forest of cattle for the purpose of protecting non-existent deer during the production of an imaginary progeny. He might, with equal discretion and good faith, have added a formal prohibition to all owners of property within the forest not to build any more houses, nor plough any fields, nor cut their timber. Such commands would have been equally respected, and would have been enforced with equal safety. I need hardly say that, though the placard ornamented the forest trees, no cattle were driven off the forest. The attack, however, could not be forgotten; but, lest it should be, it was kept alive by a suggestion made by a local official to the headquarters at Whitehall, which afterwards was made public, advocating the future enclosure of plantations in such a way as most to depreciate the value of the common rights, and so to prepare for the time when the Crown might see the favourable moment for demanding a division. It wanted one more bold stroke to complete the strategy, and this was delivered about two years ago, when the Chief Commissioner presented a report to H.M. Treasury on the New Forest, in which he claimed all forestal rights, notwithstanding the removal of the deer, not only over the wastes of the forests, but over all the private lands within its ambit—a pretension which had been publicly disclaimed by one of his immediate predecessors in office. Thus, therefore, it now stands. Enormous plantations, in blocks of thousands of acres, have been created, through which the Crown claims the power of preventing the passage of the public, even along the ancient highways, and this vast extent of land, which was valuable in its original state, has become, after an expenditure of some 10*l.* per acre, worth far less than it was before the outlay, and all possible improvement barred for generations. There may at this moment be about 30,000 acres of heath-land still open, but of this area the Government surveyor speaks as "unfit for cultivation," whilst only a very limited space of land, which is pronounced by the same authority as "profitable," remains unenclosed for the use of the Commoners. The safety, too, of the remnants of the ancient woods, whose beauty and picturesque value it is beyond my power to describe, is threatened, and so the enjoyment of the public in the glory of the unequalled landscape is in the utmost risk of extinction.

"You will not wonder, then, when you consider the singular laws which bear upon the Forest, and the still more remarkable way of using and administering those laws of late years, that the owners of land, whether to a great or small extent, view with some anxiety the position of their affairs; or that the public, to judge from letters which now so frequently appear in the newspapers, and from the speeches made during the last few months, look upon the present state of the New Forest as that of a perpetual chaos. Still, the remedy is neither intricate nor difficult. It requires only to follow out that course which has been so often recommended by those who have carefully weighed the subject. Let there be a strictly neutral and impartial tribunal constituted, and let such a tribunal, after due inquiry, make a division between the Crown and the Commoners, totally excluding each from any rights or power over the share of the other. The appointment of such a tribunal would silence the complaints of the Commoners, or if not, would deprive them of that public sympathy and support which they now receive. The effect of the severance of these joint-proprietorships would follow in the natural course of events. The nation would become possessed of a valuable property, freed from all the restrictive incumbrances which now exist, and the House of Commons would take care that it was properly administered; whilst, on the other hand, the Commoners would be sure, for the sake of their own financial interests, to carry out such improvements upon their exclusive share as might be capable of proving remunerative.

"I have written at far greater length than I intended, but I found it impossible to give any fair view of the peculiar laws which affect the New Forest without adverting to the administration of those laws, and, in some little degree, to the consequences. But what I have written, still, is but an incomplete sketch, the value and interest of which consist only in the accuracy of the lines which I have endeavoured to trace." *

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* As these sheets are passing through the press, an important meeting of the commoners has been held at Lyndhurst, which may be regarded as the Forest metropolis. The meeting was well attended, and presided over by one of the members of the county, and appeared to be pretty unanimous in favour of retaining as much of the Forest as possible for pasturage. It appears, from what was stated, that two Bills were intended to be brought into Parliament during the present session, one by the Crown and the other by the commoners, which were somewhat antagonistic to each other, although both embraced the idea of a division of interests between the Crown and the commoners. The Crown, it was intimated, wished to exchange timber for land, but the commoners wanted pasturage, not timber; yet, surely, if a portion of the open forest is given up to the commoners,

## IV.—The Animals of the Forest.

One strong plea that might be urged for continuing the Forest as it is, would be afforded if there were any prized and particular breed that it was desirable to rescue from extinction. In times gone by, we heard a good deal about the value of the Forest ponies; but in the absence of every endeavour to improve the breed, and the more than indifference with which every attempt from others to attain this object has been received by the Foresters, or owners of ponies, no plea can be urged on this score. So long as inferior large-headed stallions are turned out promiscuously, it is in vain for any one to think of improvement by selecting improved male animals; although when this has occasionally been done by private means, the good qualities of the Forest breed has shown itself in the produce. Mr. Bone, of Avon, has had for some years an old Arab stallion, and it is astonishing what capital stock he has raised from Forest mares. They have been sold for good prices on many occasions, and one at the Bath and West of England show at Southampton, in 1869, (not, however, as a Forester, but as a Galloway), gained a first prize. At this show every effort was made by the local committee, by the offer of numerous prizes, to bring out the Forest people with their mares and stallions. But there was no response whatever; and it was felt by many that a breed that appears to have no friends must submit to the fate that belongs to the destitute.

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due provision must be made for the preservation of the ornamental timber. Where this timber is found, there is also the best pasturage; and such spots also present the most suitable sites for building, and consequently the most valuable and saleable land. Some compromise will, therefore, be necessary, not only between the Crown and the commoners, but amongst the commoners themselves; for, whilst the meeting in question may be considered to represent the owners of property and commoners residing within the Forest, yet there are large numbers of the latter on the outside whose claims are equally good, but who, either from the distance at which they reside, or from the improved system of husbandry they adopt and the improved animals they breed, have in great measure ceased to exercise their Forest rights, and would, therefore, no doubt, prefer to receive compensation in some other form, such as land or money. One great advantage in retaining the most picturesque portion of the Forest would be that it would settle the question of the recreation ground for the neighbouring towns and villages, by granting the boon required in the most effectual manner. In return for a concession of ornamental timber the rights of turbary might well be given up; although we were sorry to observe in a report of the meeting, though we scarcely can believe it, that such right—or rather, barbarism of the dark ages—would be supported both by the Crown and the commoners. It was elicited at the meeting that the cost to the Crown of a three-year-old buck used to be computed to amount to 112*l.*; so that, if this be correct, we cannot be surprised at the Deer Removal Act having been introduced. Supposing that the wishes of the resident commoners are gratified by the retention of the greater part of the open Forest, on which there is grass really growing, for the exercise of pasturage, there will still be a large area left on which now there is no grass, but which may advantageously be devoted to agricultural purposes.—W. C. S.

The quondam Derby favourite, *Autocrat*, has for many years held his head-quarters at Lymington, on the borders of the Forest, and occasionally his services have been rendered to this neighbourhood, and his blood has in the second generation been introduced here and there with very good effect, so that some of the best ponies in the Forest have been the grandsons of old Autocrat. No better proof can be afforded as to how well, how kindly, and how successfully one-fourth blood will intermingle and improve native stock. The produce have been of a larger size than usual—Galloways in fact—and much more valuable. If the system had been followed of not allowing stallions to be turned out, but keeping the mares at home till they had seen the horse, great improvement might have been effected, and a valuable race of animals might have been raised. For the Foresters, although so neglected, are not without their virtues; they are hardy, and have good fine limbs, and good action. Many of these Foresters of a larger size are used by the small farmers as farm horses, and for carting timber and other Forest productions; and it is no uncommon thing to see one of these flat-sided little beasts pull away more than a ton of pitwood, or of sand, they are so extremely staunch. If the mares of this race had been put to small compact cart stallions, they would have produced some of the most profitable farm horses any one could possess. This has been done in several instances, and with good effect.

With regard to the cattle, they are useful and hardy, though small; and as they have never had the opportunity of putting on fat or flesh, there has been nothing to distract their attention from the production of milk. They have no doubt been extensively crossed with the Guernsey and Jersey breeds—the Norman, as they are commonly termed; but they are much more hardy than their pure-bred ancestors, although they do not give such rich milk. It is very common to find these animals in the Forest in the depth of winter as well as during the summer months, on the principle, we suppose, that although they have no right to be there at this period, there is no great wrong committed. There are, in the hands of various private proprietors in the Forest, herds of pure-bred Jersey and Guernsey cattle, which have proved their excellence at various cattle shows.

## V. The Manors of the Forest.

It has been already stated that in ancient times the Forest was more than double its present extent. It comprehended, indeed, those large tracts of outlying land known as the manors, which for some centuries have been private property, having probably been granted originally by the Crown for services rendered by the ancestors or predecessors of the present proprietors. The larger portion of the Forest rights belong to the owners and occupiers of the property interspersed or immediately bordering the Forest. The largest manor is that of Beaulieu, at present belonging to Lord Henry Scott, M.P. for the county. It is situated on the south of the Forest, and on the side of the Beaulieu river, and comprehends some useful farms and large woods. It extends from north to south some 5 miles, and from east to west between 2 and 3. Like that of other manors, the land is above the average of the Forest in quality.

On its eastern side, we have the manors of Fawley and Exbury, the former containing the noble mansion of E. A. Drummond, Esq. It consists of various farms of fair average land favourable for roots and for barley, the quality of the latter being well adapted for malting. It is bordered by the Southampton Water on the east, and the Forest on the west. Exbury, a smaller manor, borders the Solent on the south, and the few farms belonging to it are various in quality.

Hobury manor, belonging to W. H. Stanley, Esq., immediately adjoins, and contains some useful farms. Second or third in size, but first with regard to the numerous rights it enjoys over the Forest, is Brockenhurst, the seat of J. Morant, Esq. It extends from beyond the village on the north nearly to Lymington. The park occupies a considerable portion of the manor, and abounds, as well as the adjoining farms, with oak timber.

The manor of Minstead, the property of H. Compton, Esq., is a compact estate in the north-eastern central part of the Forest, being some 3 miles by 2 miles in extent. It embraces a fine park, and in the adjoining grounds are to be found some of the finest rhododendrons in the kingdom, a result partly due to the moisture of the soil, and partly to the mild and favourable character of the climate. On this estate the land has been treated liberally for some years, and, so treated, it is very favourable for roots.

Burley manor is the seat of W. C. D. Esdaile, Esq., who, residing in the midst of the Forest, has taken a great interest in all matters connected with it, and whose views on various points are worthy of much attention. Mr. Esdaile has very much improved his land by means of marling and otherwise.

There are many other estates, of various degrees of importance, bordering the Forest, the rights on which have been fully established.

## VI.—The Enclosures.

There appear to have been 13,727 acres enclosed under the Acts William III. and George III., of which 6772 acres have since been disenclosed and thrown open, and 955 acres have been enclosed again. By the Deer Removal Act, 10,000 acres were further allowed to be enclosed, of which 3090 acres were actually enclosed in 1867, and since then a further 1552 acres up to the present time, making together 4642 acres; and leaving 5358 acres over which the Crown has not yet exercised its rights. In addition to this, there are between 5000 and 6000 acres of ancient Forest which do not appear ever to have been enclosed. There are thus 12,772 acres that may be considered open Forest, 11,597 acres in the form of enclosures, and 5358 acres intended to be enclosed under the powers of the Deer Removal Act, making altogether a sum total amounting to within a few thousands of half the Forest. It is to be hoped that if the Forest is to be dealt with as a whole for the general interest, the Crown will not exercise its rights over the parts not yet enclosed; so that any additional planting may be put in practice on the poor sands, and confined to fir, with a view of obtaining a soil by the time the plantations are fit to cut.

The planting of the recent enclosures of the Forest has been very effectually done, and according to the Returns moved for in 1867, with great attention to economy, the total expense being under 6*l.* per acre, of which two-thirds is for labour. As this amount comprehends the expense of open drains, 25*s.* per acre, the expense of planting fir alone would not amount to more than 4*l.* per acre, unless the land were trenched or broken up.

The geographical divisions of the Forest consist of 15 walks, each being under the supervision of a particular officer, whose duty formerly consisted chiefly in looking after the deer. Thus we have, as our map will show, the following walks:—Ashley, Ashurst, Bramblehill, Broomy, Boldrewood, Burley, Castle-Malwood, Denny, Eyeworth, Holmsley, Irons Hill, Lady Cross, Rhinefield, Whitby Ridge, and Wilverley.

The officers of the Forest are the Deputy Surveyor, first, second, and third Assistants; Clerk, eight Foresters, and twelve Woodmen, including Constables. The annual expense for the past year was 2489*l.* for salaries and allowances.

The expenditure for planting for the same year was 4466*l.* 8*s.* 5*d.*, which, however, includes 1468*l.* 1*s.* 6*d.* as the value of trees and plants supplied to the Forest by its own nurseries.

The receipts for the sale of produce amount to 8310*l.* 13*s.* 8*d.*, but the labour in preparing this for sale was 2192*l.* 14*s.* 10*d.*, and 2236*l.* for labour and materials, under the head of maintenance. Altogether the expenditure exceeded the receipts by 223*l.* 17*s.* 3*d*; but then the large sum above stated was expended in planting. It is proper to state that no less than 640*l.* was received for fees for licenses to sport over the Forest;

and for Forest dues and pannage 178*l.* 18*s.* 7*d.*; whilst Mr. Dickenson pays 490*l.* as rent for his farms, and 326*l.* 1*s.* 6*d.* as additional rent for drainage and other works.

## VII. Geology.*

The New Forest is occupied by five formations belonging to the Middle and Upper Eocene groups, viz., the Lower Bagshot, Bracklesham, Barton, Upper Bagshot, and the Fluviomarine or Headon Beds. The lowest in the geological scale, the Lower Bagshot Sand, is found within the Forest limits only at the extreme northern corner, where it underlies the gravel of the highest ground between Godshill Enclosure and Woolmer Post, and comes to the surface in the "bottoms" which run up from the Avon Valley towards Bramshaw Telegraph.

The Bracklesham beds likewise underlie the gravel covering of the highest part of the Forest between Woolmer Post and Black Bush Plain, from which they extend by Eyeworth, Amberwood, Sloden, and Woodford Bottom, in a south-westerly direction, in a band about 2½ miles broad.

The Barton Clay also forms the substratum of the gravel on the highest ground at Black Bush Plain. The division between it and the Bracklesham beds is roughly defined by a line drawn in a south-westerly direction from the Forest boundary, where it is crossed by the road from Bramshaw to Salisbury, by Eyeworth Lodge and Broomy Lodge, towards Ringwood. Its breadth at the western boundary of the Forest is about two miles from the line just defined to near Picked Post; it underlies the gravel on Picked Plain, and occupies an irregularly shaped area to the south of Boldrewood, comprising the Burley and Oakley enclosures. From Boldrewood Lodge the southern boundary runs in an irregular line between Minstead and Lyndhurst, by Irons Hill Lodge and Ashurst Lodge to the Forest boundary near Langley Wood. The breadth of this formation, measured in a north-westerly direction from this point to Bramshaw enclosure, is nearly ten miles.

The Upper Bagshot Sands extend south from Picked Plain by Burley and Rhinefield to Boldrewood Lodge, lapping round the Barton Clay, the southern edge of which they follow in a belt of varying breadth by Lyndhurst, Pondhead, and Culverley, to Dibden Bottom. The Fluviomarine or Headon Beds occupy a considerable part of the south of the Forest. The division between

* This section of the paper has been kindly re-written, in explanation of the accompanying map, by my friend Mr. T. Codrington, F.G.S., who has fully described the superficial deposits of the south of Hampshire in the 'Quarterly Journal of the Geological Society,' for November, 1870 (vol. xxv., p. 528.)—Edit.

these beds and the Upper Bagshot Sands runs from a little south of Burley Beacon (which is capped by an outlier) to Holmsley Station, round Wilverley enclosure to Rhinefield Lodge, New Park, and to a point 1½ mile east of Lyndhurst, from which it bends eastward, and takes a tolerably straight course by Denny Lodge to Penerley, and thence in a north-easterly direction round Beaulieu Heath. To the south of this line all the country to the coast is occupied by the Headon Beds.

Speaking roughly, the area of the Forest may be said to be divided among these formations in the following proportions:—Fluviomarine, or Headon Beds, one-third; Upper Bagshot, one-fourth; Barton, one-fourth; Bracklesham and Lower Bagshot together, one-tenth.

Lying alike upon parts of all the above formations is a sheet of flint-gravel, which varies from 2 feet to 6 or 8 feet in thickness, and extends uniformly over the open plains and heaths of the Forest. It covers a plateau of very irregular shape, which extends from the northern extremity of the Forest to Burley, and is spread over a succession of open heaths, stretching from Burley Beacon eastwards to the borders of Southampton Water. The gravel gives to the surface the same character, whatever the underlying stratum may be. The Headon Beds, consisting of clays and marls, afford some of the best land in the Forest; but over one-third of their area they are covered by gravel, on which barren heaths prevail, as about Beaulieu.

About one-third of the Forest is covered with this gravel, and its extent has been shown on the accompanying map. There are, however, other superficial deposits scattered over the lower ground which are not shown. They consist of gravel mixed with clay, marl, and loam, in different proportions and varying from a mere wash to several feet in thickness. Though they are but of partial occurrence, they often exercise an important influence on the character of the soil. The Upper Bagshot Sands generally afford a poor soil; but where they are covered by these alluvial deposits, and watered by the numerous tributary streams of the Beaulieu River, some good land is found.

With reference to the agricultural capabilities of the Forest, Mr. Spooner states, "I do not think that we should err very much in stating that one-third is incapable, at the present time, of profitable tillage, although a part, or the whole, might be planted with larch and fir to some advantage. One-third may admit of cultivation by the aid of burning, draining (where required), and marling or chalking. The other third consists, for the most part, of land occupied by new or old plantations, or open forest, adapted for timber, and would supply the most profitable spots to be offered for sale, and might realise from 20*l.* to 30*l.* per acre."

## VIII. Streams.

Probably there is no better mode of describing the surface of a country than by giving an account of its rivers and their contributaries; for although a geological description will, to a certain extent, serve to convey an idea of its general character, yet, with the exception of pointing out its alluvial deposits, it often fails in common with other means of procuring the same information, in indicating the good spots from the bad, because it deals with the subsoil rather than the surface, and we thus often find as belonging to the same formation the most barren spots, and land highly productive. On the other hand, the presence of running water is an unfailing indication of the existence of the proximity of the best land which its geological formation will furnish. It will also serve to show the levels and the prevailing aspect of the surface. I have already observed that the Forest has no rivers, properly so called, but some of its streams convey no small contribution to the two rivers between which it is situated—the Avon and the Test. The former has the giant's share, receiving the surplus rainfall of the north-western part, extending to the westward as far as Fritham, embracing a district equal to some ten or twelve square miles, and joining the river at various points between and including Fordingbridge and Ringwood. A small portion of the north-eastern part of the Forest, commencing about Fritham, drains into the River Test.

The Lyndhurst Race-course is a moderately-elevated piece of land, lying on the right as one enters Lyndhurst from the east. It is poor and heathy on the hill, and boggy at the base. The water on the south of this hill crosses the turnpike-road and joins the brook, passing at the foot of Ashurst Lodge into the Ipley stream. On the north side of the race-ground the water takes a different direction, coming from Minstead, and beyond it it runs through the Forest and inclosures parallel with the Southampton Road, and is here called Dogben Gutter. It forms a large pond, called Costicles Pond, at the north of Lyndhurst Road Station, where it leaves the Forest and pursues its circuitous course through private property for the space of two or three miles, and, after receiving another brook coming from the Forest, enters the sea at the tidal mill at Eling.

The old turnpike-road from Romsey and Southampton to Ringwood, by way of Stony Cross, does not enter the Forest until it reaches Cadnam, some nine miles from Southampton. It here crosses the old mail road from Romsey to Lyndhurst, and ascends by a long steep hill to the high ground of the Forest, by Stony Cross, 347 feet above the level of the sea. The road pursues a distance of about 12 miles through the Forest in this direction till it approaches Ringwood. About three-fourths of the land to the north of this road drains into the Avon, as before mentioned, by various streams, whilst the water from about one-fourth, by means of small brooks, takes an easterly circuitous course and joins the river Test a mile or two only before it enters the sea at Redbridge. It is a peculiarity in North Hampshire that most of the strongest land is found on the high ground and the tops of the hills. This is not the case in the Forest, for the worst land, the thinnest and most arid, is more frequently on the highest ground. The road we have just been speaking of passes over some of the high land of the Forest, and we may adduce the tract of land on each side of Picked Post, and thence to Burley Beacon, as presenting its most unfavourable aspect. The geological subdivision to which it belongs, the Upper Bagshot sands, does not convey a more favourable impression as to its capabilities. Standing on the high land near Fritham, nearly 400 feet above the level of the sea, we find the land around us slopes to the right and to the left as we look to the south, the larger part being to the right. When, however, we get to the south of the Southampton and Ringwood road, we find the Forest streams, which are very numerous, although taking the most circuitous course, draining a considerable quantity of land. The Beaulieu river, which is navigable for small vessels for some miles in a north-westerly direction from the Solent, is lined on each side by cultivated land belonging to the Beaulieu manor; and its various farms, the park at the Palace, and the ruins of the old monastery, all point out that in ancient times, as well as at the present, it was regarded as an *oasis* in the desert. A rather considerable amount of water is found at Beaulieu, which is fed by contributories extending both east and west in a north-westerly direction to the land round Burley Beacon, and also by an eastern branch, called the Ipley stream, which drains the greater portion of the land lying west of the Lyndhurst and Lymington road, and on both sides of the railway.

The South-Western Railway, which enters the Forest at the Lyndhurst Road station, where it crosses the Southampton and Lymington road, gives its passengers a favourable impression of the locality during the summer, for not only do they behold the flourishing enclosures extending towards Lyndhurst, but also the beautiful woodland scenery in the neighbourhood of Ashurst Lodge. The land, too, in this locality, belonging to the Barton clay, is of a character very favourable to cultivation, as shown by two analyses, which we subjoin.* Its value, so enhanced by

* *Analyses of Forest Soils.*—The following analysis was made from a sample of soil taken from the neighbourhood of Ashurst Lodge—a part favourable for the growth of timber. It is situated on the Barton clay. There is a fair depth

the beauty of the woodland scenery and the flourishing state of its trees, will, it is hoped, rescue it from the plough, and preserve it as an ornament to some neighbouring town, and thus convey to future generations a most favourable impression and reminiscence of the ancient Forest.

The railway pursues a very devious course from its entrance, just spoken of, to its exit on approaching Ringwood, justifying its sobriquet of the Corkscrew line. Leaving Lyndhurst some miles on the right, it proceeds at first in a southerly and then in a westerly direction towards the coast, leaning towards Beaulieu in its course, and touches the sea by means of its branch from Brockenhurst to Lymington. The main line takes a westerly course by Holmsley station, after which it turns towards the north, in order to reach Ringwood. During this circuitous journey it passes many spots well deserving of cultivation, and

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of soil, and the subsoil is clay, but not of a very retentive character. The sample analysed was about two inches from the surface. Altogether, from its external aspect, we should consider it as a favourable specimen of forest-land. It will be seen that it has a fair amount of phosphoric acid :—

| | |
|---|---|
| Moisture | 1·10 |
| Organic matter, &c. | 5·42 |
| Oxide of iron and alumina | 1·41 |
| Lime | .. |
| Magnesia | ·33 |
| Sulphuric acid | .. |
| Phosphoric acid | ·31 |
| Carbonic acid | .. |
| Insoluble siliceous matters (sand clay) | 90·50 |
| Alkaline salts | ·93 |
| | 100·00 |

ALBERT SPOONER, *Dec.* 9, 1870.

The next analysis is from the Upper Bagshot sands. The sample was taken with the heath growing on it attached, the roots of which could not be altogether separated, which accounts for more organic matter being found than might be expected. The soil was very thin, and the subsoil was sand ; indeed, it was very near a large sand-pit, from which thousands of tons of sand had been shipped for the manufacture of coarse glass. The bottom of the old pit had been planted with firs, which were growing admirably.

A particular feature in this and the preceding analysis is the absence of lime. We are rather disposed to draw a favourable augury from this than otherwise, as the remedy is readily obtainable in the form of marl and chalk.

| | |
|---|---|
| Moisture | 1·80 |
| Organic matter | 11·92 |
| Oxide of iron and alumina | 4·15 |
| Lime | .. |
| Magnesia | ·28 |
| Sulphuric acid | .. |
| Phosphoric acid | trace |
| Carbonic acid | .. |
| Insoluble siliceous matter | 80·86 |
| Alkaline salts | ·99 |
| | 100·00 |

ALBERT SPOONER, *Jan.* 13, 1871.

this is the more important, inasmuch as one of the chief deficiencies in the Forest land being lime, its carriage, in the form of chalk, can be economically provided by the railway. Indeed, with the exception of some poor sandy land near the old station at Beaulieu Road, most of the land on each side of the railway, not occupied by enclosures, is very suitable for cultivation. Some portion, indeed, is already covered by fine gorse, and the undulated surface of the greater part is extremely favourable for the plough. In this journey of 20 miles and upward the larger portion is through the Forest proper, only about 4 miles being lined by enclosures, some other 3 miles through old enclosures, now thrown open, and about the same extent through private property, leaving 10 miles through the Forest itself, at any point of which chalk can be conveniently brought and laid down.

Passing on to the remaining streams of the Forest, we find on the southern coast, some four miles west of the mouth of the Beaulieu river, a small brook, which discharges itself into the sea; it reaches a few miles to the north and passes near Pylewell House, where there is some cultivated land. Some two or three miles further to the west we come to the inlet of the sea at Lymington, which receives a small river. This may be considered the most important river in the Forest, for it extends some twelve miles to the north-west, and by its numerous tributaries drains no small extent of land. Its longest affluent first appears near Ocknell enclosure, which since 1815 has been thrown open. It drains this wood, then crosses the turnpike-road between Stony Cross and Picked Post, traverses in a southerly direction the large enclosures in Boldrewood walk, receiving accessions from tributary brooks on each side, and after being joined by a branch on the eastern side, almost of equal importance to itself, issues from the enclosures and proceeds by Allum Green to Queen Meadow. It is here joined by a branch rising near Boldrewood Lodge, and with this accession passes through New Park at its south-westerly border, being here joined by two very important branches, one rising nearly as far to the north as the main branch, but more to the west, and passing first south and then east by Burley Lodge. The other branch proceeds through Burley Manor and Rhinefield in a due easterly direction, draining the land at the north of the railway between Holmsley and Brockenhurst. These branches, joining the trunk at New Park, no doubt assist, in conjunction with other natural advantages, to render this spot, by means of a spirited outlay in manures, the most productive part of the Forest. With these accessions the stream crosses the railway above Brockenhurst, and proceeds by the manor and through Boldre to Lymington, thus draining in its course a very considerable portion of the Forest—a space not only ten miles in length, but from four to six miles also in breadth, amounting on the whole to one-third or nearly one-half of the Forest.

We have yet another stream to notice, but it is of much less importance than the last. It first appears west and south of Holmsley station, takes a zigzag and easterly course some four miles in the Forest by Wootton enclosures, then turns towards the south and enters the sea to the west of Lymington.

## IX. Agricultural Features.

The contour of the Forest exhibits gentle elevations and moderate sized plains; neither lofty hills nor deep valleys, and very few dead flats. The streams, which for the most part rise in the northern part, take a southerly course towards the sea; but in their course there are no rapids nor falls, so that the declination of the land from the north to the south is gradual. The aspect is exceedingly good, being for the most part southerly and westerly; and the agricultural question to solve is, how far will this favourable aspect and mild climate atone for the natural and enforced poverty of the soil. Opinions differ extremely as to the value of the Forest land. Hudibras laid down the axiom long ago, that

> "The greatest value of a thing
> Is just as much as it will bring."

And probably it would be the wiser plan to leave this question to be decided with several others by the test of public competition. There are some who are sanguine enough to anticipate that 20,000 acres would, thus submitted, realise 50*l.* per acre. But although a small portion may reach this sum, we are certainly not justified in thus estimating so large an amount as 20,000 acres. A very useful criterion, and perhaps the best within our reach, is afforded by the public sale of the land appropriated to defray the cost of the Deer Removal Bill, when 356 acres, 2 roods, 20 poles, realized 8694*l.* 10*s.*, or somewhat over 24*l.* per acre. It may be urged that land is more valuable now than it was some sixteen years ago, when this occurred, and that people were not then alive to its value; but, in opposition to this, it may be urged that the land selected for sale was divided into lots and bordered land owned by private proprietors, by whom in most instances it was purchased. We therefore think we should be nearer the truth if the 20,000 acres were estimated at 25*l.* per acre, valuing perhaps the timber on it separately. On this estimation we have a sum of half a million; and if a certain portion of the poor land could be attached to each lot, the property, at the sum we have put it at, would certainly be well sold.

With regard to the other land for agricultural purposes, public auction would still be the best mode of ascertaining its value, special care being taken that by the conditions of the sale the adoption of the wisest measures for bringing it into cultivation should be secured, and each purchaser be debarred from injuring his neighbour or occasioning any public nuisance. If an average of 10*l.* or 12*l.* per acre could be obtained, it would probably be the wisest system for bringing it into cultivation.

The marl pits might be turned to much greater pecuniary advantage than is the case at present, but the royalty should be reduced from 6*d.* to 3*d.*; and as the supply is comparatively boundless, a considerable quantity existing alongside the rail might be transported beyond the Forest to improve the poor Bagshot sands on the west of the Avon and on each side of the railway, a district that the traveller looks at with surprise, particularly when he finds that the land belongs to private proprietors.

These poor sands are sterile because they will not retain moisture sufficiently, and because they are deficient in certain important constituents, such as the oxides of iron and alumina, as well as carbonate of lime. It has been found elsewhere that under sewage such soils become extremely fertile; and if that cannot be expected in the Forest, the other constituents above mentioned may be all supplied by the marl—the oxide of iron and alumina to the extent of 10 per cent., and carbonate of lime to that of 25. Nothing, therefore, can be more desirable than that these natural privileges should be freely applied to the poor sands within a reasonable distance. It is fortunately the case that there are some thousands of acres within an easy distance of the marl pits. In some instances and on other soils, where it may be surmised that the application of too much marl may render the land too adhesive, and yet lime is very much required, a remedy is easily found in the use of chalk, instead of, or in company with marl; or otherwise experiments may be made in burning the marl, and thus destroying the cohesive properties of its clay and rendering its lime of still more value. This latter plan is thrown out as a hint, for although theoretically correct, it may not succeed unless the mechanical state of the burnt marl is favourable and corresponds to the burnt clay, which in many heavy clay districts has been used with much success. Numerous instances are recorded in the 'Journal' where the system of burning clay on strong soils has been attended with great success.

When marl is used it should be applied as much as possible during the summer months, for not only is it then of lighter carriage, but it crumbles more readily, and mixes with the soil, whereas in winter it is apt to run together and injure the grass if placed thereon. There is no doubt a considerable difference in the various marls found in the Forest, as regards the quantity of lime which they contain; and we are inclined to think that those nearest the coast abound most with this important constituent, and that it diminishes as we get inland. A gentleman farming on the coast sent, some little time since, several samples of marl from different pits in his neighbourhood to Dr. Voelcker for analysis, with the following result:—

| | Beck. 1 Sample. Pit A. | Beaulieu Rails. 3 Samples. Pit B. |
|---|---|---|
| Moisture and water of combination | 7·06 | 4·61 |
| Oxides of iron and alumina | 10·66 | 10·49 |
| Carbonate of lime | 26·08 | 25·67 |
| Sulphate of lime | ·32 | ·20 |
| Phosphoric acid | traces | traces |
| Carbonate of magnesia | 2·08 | 2·16 |
| Alkalies | 1·04 | 1·34 |
| Insoluble silicates (clay) | 52·76 | 55·53 |
| | 100·00 | 100·00 |

The samples, it will be seen, were in rather a dry state, which of course rather enhanced the percentage of other constituents than water; they were found to contain upwards of 25 per cent. of carbonate, but, unlike chalk, no phosphate of lime. The following analysis by Mr. Albert Spooner is of a sample taken from a pit at Holmsley, near the railway, and shows but a small amount of lime. Mr. Esdaile, of Burley Manor, has applied marl found on his estate, a few miles north of this, to his sandy soils with decided benefit, although only at the rate of 15 cart-loads per acre. On having this marl analysed, phosphate of lime was found to be absent, and carbonate of lime rather deficient. It is, of course, very important that an analysis should be made of marl before it is applied. Two samples of supposed marl were recently sent me, and were found to contain no lime. When lime is deficient, but not absent, it may be desirable to use chalk in conjunction with it.

*Sample of Marl from Holmsley.*

| | |
|---|---|
| Moisture, Water of combination | 7·48 |
| Carbonate of lime | 8·8 |
| Clay, &c. | 83·72 |
| | 100·00 |

It has elsewhere been observed that the highest portion of the Forest is to be found on its northern, or rather its north-eastern, border. Thus we find that at Fritham, near the Royal Oak, the level is 396 feet above the sea. Thence passing south in the direction of Lyndhurst, we find the bench marks give respectively 377, 373, and 166 feet. Taking the road from Cadnam to Ringwood, we find at Stony Cross 347 feet, and further on 373, 230, 338, 208, 339, 333, and 311 feet at Picked Post, from which place it descends to 137 feet midway between that and Ringwood. There is also some high land in the neighbourhood of Burley, where 306 and 279 feet are marked; but very near the latter only 156 feet at the foot of a hill.

At the point where one of the main branches of the stream which terminates at Lymington crosses the road we have lately mentioned, we find the bench mark 230 feet. After pursuing a course for a mile, we find it at 183 feet, a fall of nearly 50 feet in that distance. Two miles further on we note it at 107 feet. Another branch of the same stream has a fall of 70 feet in the space of two miles. The average fall of the streams is, however, about 24 feet per mile, from their origin to the sea. Although there are some plains and much boggy land in the Forest, the larger portion of its surface consists of undulated land and low hills, the major part of which slopes to the south and the west, although some portion has a northerly and easterly aspect. The direction of the streams simply shows the slope of the valley through which they run, for that of the land drained may lie at right or obtuse angles with these valleys.

As the highest part of the Forest is less than 400 feet, and the highest part of Hampshire upwards of 800 feet, the contrast is most favourable, and its moderate elevation goes far to counteract the poverty of the soil.

## X. Rainfall.

The rainfall of a district is important as affecting its profitable cultivation, and in determining whether it is more desirable in certain cases to grow corn or grass. It is a well known fact that the Eastern counties of Britain are particularly suited to the growth of corn, and the Western to grass, and this corresponds pretty closely to the difference in the rainfall, which is considerably greater in the West than in the East. There is a large breadth of country lying in the centre of England which is well adapted for either, where the rainfall is not in excess, but where the land, on the New Red sandstone, is very favourable for retaining its fertilising moisture. Notwithstanding its small rainfall, the Eastern counties are celebrated for the growth of roots, for which a certain amount of summer moisture is a *sine qua non.* This success is due partly to the fine state of division to which the surface of the land is naturally and artificially reduced, and partly to the fact that the difference in point of rain between the East and the West is not so remarkable or so different in the summer as the winter months. The average rainfall of the kingdom is considered to be about 26 inches, and if this is the case, we may consider that the district of the Forest exceeds the average by about two inches; for on comparing a register kept by myself at Eling, I find the rainfall for the last eleven years amounts to 29·57 inches; whilst another kept by Mr. A. Hogg, land steward to E. A. Drummond, Esq., records during the same course of years an average of 31·84. Cadlands lies about ten miles south of Eling, and therefore so much nearer the Channel. In the absence of other records, we must assume the mean of the two, 30·7, to represent the average of the district, and this will be seen to exceed the general average of the kingdom by about 4 inches.

This fall of upwards of 30 inches represents a weight of 3000 tons annually per acre, or about 2,000,000 of tons per square mile; and assuming that the Forest contains 100 square miles, we have a gross fall of 200,000,000 of tons per annum, of which we may consider 57·6 per cent. is evaporated, but leaving 84,000,000 tons to be filtrated and pass annually to the sea. It is reasonable to expect that this large amount of water, conveyed as it is by some ten or twelve different streams, seven or eight of which discharge directly into the sea, can be dealt with so as to insure some benefit from irrigation, and an abundant supply for ponds wherever they may be required. The following is the annual rainfall at Eling and at Cadland for the last 11 years, as noticed above:—

| | Eling. | Cadlands. |
|---|---|---|
| 1860 | 34·43 | 38·30 |
| 1861 | 26·13 | 23·29 |
| 1862 | 27·99 | 30·88 |
| 1863 | 30·46 | 27·38 |
| 1864 | 22·88 | 23·32 |
| 1865 | 34·79 | 38·62 |
| 1866 | 33·92 | 41·96 |
| 1867 | 29·57 | 30·18 |
| 1868 | 35·63 | 38·05 |
| 1869 | 27·91 | 32·82 |
| 1870 | 21·60 | 25·50 |
| Average | 29·57 | 31·84 |

There are few mills and little mill-power within the ranges of the Forest, the fall of the streams being for the most part gentle; there is, however, no reason why the water in many situations could not be rendered available for irrigating the contiguous land.

In some elaborate experiments carried on by Mr. Dickinson, of King's Langley, some years ago, and communicated by Mr. Parkes in his excellent paper in the fifth volume of this Journal, we find that of an average rainfall of eight years, amounting to nearly 27 inches, 42·4 per cent. filtrated through the soil, and

57·6 per cent. evaporated. The evaporation was, of course, greatest during the six summer months, when it amounted to nearly 93 per cent. of the fall, while, in the six winter months—October to March inclusive—little more than one-fourth evaporated. In six of these years out of eight there was no filtration during four of the summer months.

At present no doubt a large portion of the rainfall of the winter months remains in the bogs and low places of the Forest to be evaporated during the summer. This would be dealt with under a different system, and discharged into the watercourses, and the climate thereby greatly improved.

## XI. The Cultivation of the Forest.

We now approach the most important, and at the same time the most difficult, branch of our subject, *i.e.*, the agricultural value of the land in the New Forest, and the means for its improvement. Were we to rely on the expressed opinions of many gentlemen living within and around the district in question, and whose opportunities for gaining information are by no means to be despised, we should have to record the most discordant and contradictory opinions; and it would be difficult indeed for a stranger to find his way to the truth through such a chaos of ideas. Some will insist that the soil throughout only requires capital and labour (both of which it is contended would be remunerative) in order to convert it, if not into a garden, at any rate into fertile land, not inferior to the best of the surrounding properties. Others boldly maintain quite the opposite opinion, and contend that, with the exception of some of the land now covered with timber, the remainder is a waste, incapable of redemption, that it would never repay the expense of breaking up, and that it is not worth more than 1*s.* 6*d.* per acre. Such opinions as the last have been expressed by those who possess forest rights, who exercise the right of pasturage, and who do not wish to relinquish these rights, but express a great idea of their value. Such opposite views, however, appear to negative one another; for surely if the land is of little or no value, the rights thereon can scarcely be worth retention. It must surely be the interest of the commoners, if they wish to secure good compensation for their claims, to enhance, rather than to depreciate, the quality of the land and the goodness of the pasturage. Probably there never was a case in which the truth of the motto was better illustrated—

"In medio tutissimus ibis."

It may, I think, be taken as a fact, that all the land occupied by furze would pay to break up and cultivate, and that much of the land occupied by fern, particularly where it grows luxuriantly, would also so respond. That any land that has produced good timber would also pay for cultivation after the timber has been removed, and the bogs would, for the most part, after being drained. That where the heath grows freely and to some length, although it would be most prudent to wait two or three years after the right of turbary has been extinguished, so that the surface should be quite covered, and a large amount of ashes insured from the burning of the turfs, would yet, after the expiration of such time, pay for breaking up. However, after all this land has been thus secured for cultivation, there will yet be a very large margin so poor and unpromising, that it would be vain to expect that it could be broken up for tillage with any prospect of remuneration. The proportion of land at present occupied by timber, and including the new enclosures and the old ones disenclosed, are supposed to be about 27,000, so that this would leave about 36,000 covered with heath, fern, and gorse; and there are some who entertain a strong opinion that 30,000 of this is totally unfit for cultivation, and would not pay three per cent. for the capital expended in breaking it up; and that if it were devoted to planting fir, for which alone it may be fit, it would greatly injure the residential value of the neighbourhood to have this 30,000 so planted, in addition to the 27,000 previously enclosed or under timber. There is much force in this argument, more particularly as, putting aside the claims of those now resident in the neighbourhood, it must be remembered that the greatest source of revenue to be derived from the Forest would undoubtedly arise from the sale of spots for residence, of sufficient size to be attractive and desirable. It would therefore be extreme folly to do anything calculated to lessen the value of such spots, and this fact offers to the present residents the best possible security that nothing will be done likely to injure the residential value of the neighbourhood.

I cannot, however, agree with the opinion that 30,000 acres are totally unfit for tillage, which, if correct, would leave only 6000 suitable for that purpose. And although the question can only be settled by actual experiments, these might be instituted in different localities so as to decide the question without any great loss. Yet I must hazard the conjecture that not less than 20,000 acres would be found to repay the expense of tillage, thus leaving 16,000, one-half of which might be planted with larch and fir, and the other might remain open, or be sold with the woody portion it adjoins. The residents could hardly complain of this, more particularly if the timber in the old forests now thrown open were realised when of most value, and the land thus cleared devoted to tillage, reserving the new enclosures for timber purposes for some years to come. As this plan would secure the drainage of all the bogs in the Forest, its climate would be improved, and the residents would therefore have nothing to complain of on the score either of health or beauty. In devoting a fair amount of the Forest for residential purposes the wooded parts would, of course, be selected, and the most attractive sites, whether these were to be found amongst the old woods or the present enclosures. The argument that has been used in opposition to the scheme for submitting to public competition some of the best sites for residential purposes, viz., that that plan would not employ so much labour, nor produce so much food, as if cut up into small plots for tillage, will scarcely bear the test of argument; for it surely must be apparent that, by importing some of the capital realised in London or other large cities, we import and apply the means of employing a considerable amount of labour in building and laying out the grounds; in addition to which a considerable income, derived from other sources, would be permanently expended in the neighbourhood; whilst in the scheme of small allotments it will be the income only produced by the soil itself that can be so expended, and, if from adverse seasons, it should not be remunerative, the occupants will become dependent on charity. Some have gone so far as to advocate a scheme closely bordering on communism, viz., that Government should supply the capital required, not only to bring the land into cultivation, but also to keep it going afterwards. This, of course, must cover a twelvemonth's support to the man himself, as, from being without capital, he would require to be kept a twelvemonth before his produce could be realized. With equal reason it might be argued that the Government should supply capital for our shoemakers and tailors, and all small tradesmen deficient in capital. I may dismiss this scheme with the observation that it would be contrary to our system, unsupported by our laws, and would, I feel sure, prove in the end calamitous in its results. There will be abundance of opportunities of testing the advantages of small allotments, should many of the small commoners receive their compensation in land, which they will either cultivate themselves, or dispose of to others. Besides which, sufficient allotments would be attached to the labourers' cottages that would require to be erected to meet the demand for labour which other improvements would require. If this is not sufficient, the philanthropical friends of the poor could step in and purchase land, and let it out in suitable allotments and at moderate rents.

The means required for bringing much of the Forest land into cultivation are grubbing and burning, chalking, marling, and draining. The expense of these operations will materially depend on the precise locality, and the distance to be overcome. The cost of grubbing may be estimated at from 4*l.* to 8*l.* per acre, including the burning necessary, the latter extreme price being incurred where the roots of underwood are thick, and where there are a quantity of stool moors to remove. The timber in many instances will partly compensate for this expense. It is very common for labourers to receive the old stools for fuel for the expense of removing. Where furze alone has existed the expense will not be so heavy, but must be taken at the minimum, whilst the cutting and burning of turf or heath will range between the two.

It is difficult to estimate what proportion of land will require the operation of draining; but one fact may be accepted, viz., that, although the expense may be more, the returns are likely to be most favourable where a clay subsoil points out the necessity of draining, except in certain instances where the surface soil is extremely shallow or has been almost entirely denuded. The expense, where tiles or pipes are used, may be taken at about 6*l.* per acre, the larger half being required for the cost and carriage of the pipes. I have observed that the expense of draining new enclosures is almost entirely incurred for labour, and there is no filling in, as the drains are left open. The expense per acre is only 1*l.* 5*s.* 3*d.*, according to the returns which were made in 1867.

It is impossible to estimate the expense of draining the bogs, as their depths vary and are extremely uncertain, sometimes being only knee-deep, at others double and treble this depth. It is by no means uncommon for hunters, and particularly if they are strangers, to be so mired as to be unable to extricate themselves or their horses without assistance; and sometimes the aid of horses has been required to extricate the unfortunate animal. In most cases, however, one large channel will drain a large quantity of land; and a fall will generally be found in the great majority of instances, as the land has a declivity of nearly 400 feet from the high ground on the northern part of the Forest to the sea on the south. If a fall cannot be secured from the bottom of the bog to the nearest stream, artificial ponds might absorb the surplus water.

In no part of the Forest do we find any of the strata belonging to the Secondary series, and thus we cannot be surprised that throughout its extent there is a great deficiency, if not an absolute want, of calcareous matter. It is true that a very few miles only separate the northern borders from the chalk soil, and that this chalk basin underlies the whole of the Forest, to crop out on the surface on the high hills on the western part of the Isle of Wight; but the depth at which the chalk lies underneath the London and Plastic Clays is, of course, an insuperable obstacle, on the ground of expense in raising it to the surface. This difficulty is, however, to a great extent, obviated by the existence of numerous marl-pits in various parts of the Forest, but mostly to the south of the Railway. These marl-pits have, in times gone by, been largely availed of for the improvement of the surrounding land, and considerable benefit has been derived therefrom in many instances, and particularly on light sandy land; but in other cases, where the land is naturally retentive, the application has so much increased the tenacity of the soil as to neutralise the good effects of the limited percentage of calcareous matter thus imported, and to occasion the preference to be given to the application of chalk, procured at a greater cost per ton, but at a less expense for a given amount of calcareous matter per acre. The number of public marl-pits is stated in the Book of Forest Claims to be twenty-four, and, as a charge of 6*d.* per ton is made for royalty, the quantity dug annually is known, and of late years it has been extremely trifling. The advantage of these pits will, however, be very largely availed of when the Forest is broken up and cultivated, and will be found of great advantage, particularly on light soils deficient not only in calcareous matter but in clay likewise. An inspection of the analyses which accompany this paper will show the amount of calcareous matter found in marl, and, by comparing it with chalk, a guide will be afforded as to the respective advantages of the application of the one or the other.

One advantageous feature belonging to the New Forest is the existence, in almost every direction, of good roads; due partly to the excellence of the material with which they are made and repaired, but still more to the absence of hedges and hedge-row timber, so that they are freely exposed to the drying effects of the wind. Such being the case, marl and other materials can be carted at a moderate expense, and may be reckoned, perhaps, including the filling, at 1*s.* per ton the first mile, and 6*d.* per ton afterwards; so that 20 tons of marl can be conveyed an average distance of two miles for 30*s.*, or three miles for 40*s.*, the cost of digging and filling being about 6*d.* per ton. The question of using chalk or marl will be determined partly by the respective cost of each, but still more by the necessities of the land to which they are intended to be applied. If clay is nearly absent from the land, then undoubtedly it will be highly advantageous to use marl; but if the land is tolerably stiff, and if there is a clay subsoil, then undoubtedly chalk will be most advantageous, from the much larger percentage of lime contained. The railway, which pursues an oblique and irregular course from north-east to south-west, offers the most favourable facilities for the application of chalk, as it can be brought either from North Hampshire or Dorsetshire at a very moderate expense. It may be laid down either at Lyndhurst Road, Beaulieu Road, or Holmsley, at a cost of from 3*s.* to 4*s.* per ton. If another 1*s.* per ton is allowed for carting on the land, 20 tons can be applied per acre at an expense of from 4*l.* to 5*l.*; and as this 20 tons would supply about 10 tons of lime, it may be considered amply sufficient.

In this country the fertility of land depends as much or more on its mechanical as on its chemical condition, more particularly as its deficiencies in the latter respect can be more easily supplied by artificial means. Therefore, highly as we may estimate the phosphate, the potash, and the ammonia found in various degrees in the most fertile land, yet the capability of working freely under tillage, and the power of absorbing and retaining moisture sufficiently, is of more importance still. Indeed, it is the absence of this faculty that makes it so extremely doubtful whether the thin white gravel which occupies the high land in the northern part of the Forest will pay for cultivation; and in support of this view it is worthy of note that such land is furthest removed from the marl-pits, which are mostly to be found in the south, and whose aid the land in question most requires. It should be observed, that at Holmsley the railway cuts through a marl, and thus an almost unlimited supply can be afforded to soils along the line, and also, for that matter, considerably beyond it.

From various analyses made of the marls of the Forest, we may roughly consider them as containing 50 per cent. of clay and 25 per cent. of carbonate of lime, with no phosphate of lime; whilst chalk contains about 90 per cent. of carbonate of lime and often appreciable percentages of phosphate of lime. It will require, therefore, 70 tons of marl to supply the same quantity of carbonate of lime that would be furnished by 20 tons of chalk; so that if the object of the application were to supply the carbonate of lime to the soil, and the cartage was three miles respectively either from the marl-pit or the railway-station, the chalk could be applied at a cost of 5*l.* 10*s.* per acre, whilst the expenses of the marl would not be less than 8*l.* It is only in cases where the soil is exceedingly thin, arid, and deficient in aluminous matter that the latter expenditure will be justified, or in instances at a much less distance from the marl-pit. We may take it as a rule established by precedent that the minimum quantity of chalk that should be applied to any soil requiring it would be 14 tons per acre. It would take some 40 tons of marl to supply the same quantity of lime. If the land is light, and will be improved by clay as well as chalk, nothing can be better than to apply some 40 tons of marl. Should it, however, be likely to become too adhesive from this quantity, the application may, with much advantage, be divided between marl and chalk, applying some 25 tons of the former and 7 or 8 of the latter. On the other hand, where there is a clay subsoil and the surface is somewhat stiff, it will be found, in most instances, that chalk alone will be the most beneficial application, and particularly in the vicinity of the railway.

The marl-pits, although 24 in number, are mostly situated in the southern part of the Forest, and there are but few on the north side of the railway. This is rather to be regretted, as there is a large portion of thin poor land belonging to the Bagshot sands in the neighbourhood of Picked Post that would no doubt derive much benefit from the application. There are two pits at Boldrewood that might be available, but their use would involve a cartage of several miles to a large portion of the land in question. This land, however, being so poor, is not likely to be broken up for tillage for many years, and therefore will not require the marl; but the belt of Bracklesham beds still further north is likely to be more responsive, and there chalk or marl would be very beneficial according to whether the sand or the loam predominates. When, however, the surface is sandy, and the subsoil also sandy, the prospect of successful tillage is altogether remote.

It may not be without use to quote some recorded experiments instituted to show the power of soils to abstract and retain moisture. It has been found that from 100 lbs. of the following soils, perfectly dry, water will begin to drop:—

| | | | | lbs. |
|---|---|---|---|---|
| Quartz sand, when it has absorbed | | | .. .. .. .. .. | 25 |
| Calcareous sand, | ,, | ,, | .. .. .. .. .. | 29 |
| Loamy soil, | ,, | ,, | .. .. .. .. .. | 40 |
| English chalk, | ,, | ,, | .. .. .. .. .. | 45 |
| Clay loam, | ,, | ,, | .. .. .. .. .. | 50 |
| Pure clay, | ,, | ,, | .. .. .. .. .. | 70 |

The latter soils, which absorb most, also retain it with the greatest pertinacity.

The high royalty of 6*d.* per ton charged on all marl dug in the Forest has no doubt assisted to bring its demand to a minimum, in common with the fact that the private lands around are pretty well saturated with this fertiliser. A considerable reduction would not only stimulate the extensive employment of it in the Forest itself when broken up, but might stimulate a considerable demand beyond the Forest.

## XII.—Opinions of Residents and Practical Men on the Value of the Forest.

As we have already stated, the most contradictory opinions are entertained respecting the value of the Forest lands. Replying to a few questions from the author, a resident thus writes:—

"Except in small portions which adjoin properties already in cultivation, I do not believe that any of the land now open (*i.e.* not timbered) would pay 3 per cent. for reclamation.

"I believe 30,000 acres are unfit for any cultivation (*i.e.* breaking up), except for fir, and that it would be destructive to residence in the district to have, in addition to the present moorlands, of say 30,000 acres, another 30,000 acres of fir."

Mr. William Warner, of Botley, who has had much experience both with timber and with breaking up waste lands, says:—

"I have had land myself which was producing only from 5*s.* to 7*s.* per acre as woodland, and by breaking it up, at an expense of 20*l.* per acre, I have made it worth from 40*s.* to 45*s.* per acre. Such lands as that would pay any owner for breaking up, but there are some descriptions on which it would be more profitable to grow underwood."

Mr. W. Warner also said his father had some timber valued in one year, and revalead twenty years afterwards:—

"It only paid 3 per cent. on the outlay when cut down; but had it been done earlier, I should have been considerably in pocket by it.

"Being pretty well acquainted with the New Forest, I should say that there was not an acre of land in it which would not profitably grow either corn or timber. In fact I have not seen any land in the Forest but would pay, if only the right plants were put in the soil. As to the people who have rights in the Forest, and would not like to see it enclosed without receiving compensation, that, I think, could be easily met."

To show the great depreciation in the price of oak, we have only to compare the value put on it by the three surveyors, Messrs. Menzies, Murton, and Mathews, who were requested to report on the value of the Forest property of the Crown in 1854, when they estimated that there were 30,000 acres of good plantations, which in 70 years' time would contain 60 oak-trees per acre worth 10*l.* each at 4*s.* per foot, amounting to 18,000,000*l.*, which sum would be realised by putting out at compound interest 1,800,000*l.* The same valuers at the present time would probably reduce their estimate nearly one-half to meet the present reduced price.

I have said that there are very contradictory opinions expressed as to whether the land of the Forest would pay for tillage. Mr. Thomas Hill, who has farmed for some years on the borders of the Forest, writes in reply to some questions:— "I do not think the Forest would pay to cultivate, except where the timber and the furze grow, as most of the soil has been taken away for turf, but much of the heath land might grow Scotch fir."

He adds: "the expense of grubbing the furze would be 4*l.* 10*s.*, the timber 6*l.* 10*s.*, or more, draining 4*l.*, chalking or marling about 6*l.*, tillage and manures 4*l.* 10*s.*, besides fencing, iron buildings, and cottages.

Mr. Dickinson, on the other hand, who has farmed at New Park and Burley Lodge since the land has been no longer required for the purpose of growing hay, &c., for the deer during the winter, entertains the most favourable opinions as to its agricultural capabilities. His opinions are derived from the results he has obtained at New Park and Burley Lodge, which he rents from the Crown. Mr. Dickinson, however, confesses that outside his own farms his observations of the New Forest have been mostly confined to the district around him. It is well known that he has grown, particularly at New Park, some extraordinary roots and other green crops, particularly Italian rye-grass, as well as grain; and it is equally well-known that the means he has put in force in raising them have been exercised with no lavish hand. The rent paid by Mr. Dickinson to the Crown amounts to 816*l.* per annum, which, however, includes the interest of money expended in a steam-engine, iron pipes for sewage, or rather manuring, irrigation, and the erection of some excellent farm buildings; and as the mansion formerly occupied by the chief officer in the Forest is included, it must be acknowledged that the rent is no doubt a just one. Moreover, it was open to public competition, and it was fairly taken. Mr. Dickinson is deserving of great credit for the spirited manner in which he has carried on the farm. Some 30 acres of the land at New Park are under the influence of sub-irrigation, the material for which is supplied by the drainage from the extensive cattle-sheds and stables, and is distributed through the iron pipes by means of the steam-engine, diluted by water from the stream which, coming from the centre of the Forest, passes through Burley Lodge and New Park on its passage to Brockenhurst and Lymington. It must not be forgotten that a good portion of the New Park Farm has been under cultivation for many years, but, for want of the same liberal expenditure, with nothing like the results that are now to be seen. It must also be borne in mind that the geological division to which New Park belongs is the most favourable for cultivation of any land in the Forest, viz., the Fluviomarine, whilst the smaller farm at Burley Lodge is situated on the Barton clay, the second best formation; and on these strata most of the Forest woodlands are found. With these facts before us, we are of opinion that whilst it would be absurd to adduce these farms as a sample of the whole of the Forest, or even as a specimen of the average land, yet the great success which has there attended cultivation speaks strongly in favour of the climate of the Forest, and the natural capabilities of a large portion of its soil; and, I may add, affords a strong argument in favour of its more extended cultivation. It is in vain to point at the liberal appliances which are at the command of a wealthy man, for no one presumes that any portion of the Forest would pay for cultivation unless it was supplemented by liberal manuring and spirited treatment. There is one strong suggestive feature connected with Mr. Dickinson's experience, that is, at the smaller farm at Burley Lodge, consisting of 160 acres, only 60 acres were cultivated when he took the farm, and the remaining 100 acres he has broken up himself, and with most favourable results. In the absence of other examples, with the exception of isolated spots and cottagers' gardens, I may be excused for directing special notice to this the largest example of Forest land being brought into cultivation during the present century. Subjoined is a communication from Mr. Dickinson received a short time since, in which he says:—

"The farm I hold here is 270 acres, and it is said that it has been cultivated many years, therefore ought to be productive. You have seen the produce of it on several occasions, and know as much about it as I can tell you. I have another farm, 160 acres (Burley Lodge), 4 miles off. About 100 acres of this was forest-land, growing furze, fern, and every other kind of rubbish. These 100 acres I cleared, and have grown as good crops of everything as I desire. The carrots this year got the second prize at Birmingham; they were certainly the finest I ever saw. I will answer your questions about the acres not planted. I do not think I can give you a very reliable opinion upon it. My journeys over the Forest have principally been from New Park to Burley Lodge and back. So far as I have observed, every portion of this is capable of being cultivated, and of producing good crops of all kinds of grain, roots, and grass. There is some land between Burley Lodge and Ringwood I have passed over a few times of indifferent quality—boggy; that would be rather more costly to cultivate, and not so productive; but I have an opinion that, if properly handled, it might be made to irrigate all that adjoining; and there is the finest description of marl underlying a good deal of the Forest that has the most wonderful effect in stimulating the growth of grain and grasses.

"The cattle do well upon the Forest from May until the 1st of August; but the value is entirely out of the question, because if your animals are of a kind to make flesh, they do not all find their way home. The number it is capable of keeping I cannot give you any intimation of. A few rides through the Forest would convince you of the quality of the land. Thistles grow not unusually 6 feet high; fern nearly as high; oaks as straight as a ladder-pole, any length you would like to have them. It makes no difference to me what is done with the Forest, but I think it a scandal that such a tract of land should be unproductive, and that men should be driven away, or be obliged to do what they ought not, to get a living during the winter."

I also subjoin with much pleasure the opinions of Mr. H. Bone, of Avon, a sound practical agriculturist, who, farming successfully on the borders of the Forest, has given the subject much thought and attention. He thus writes, in reply to a series of questions on which his opinions were solicited. The first of these questions relates to the dimensions of different portions, and has been replied to elsewhere.

"2. I do not consider the *poorest* land of the Forest adapted to the growth of larch, but I think it would grow Scotch fir, and pay well for so doing; and after the crop of fir was removed, it would become useful for other purposes. I have known land equally poor, and of similar character to the worst in the Forest, return 40*l.* per acre for Scotch fir of 40 years' growth. Larch would thrive well on the more staply lands of the Forest.

"3. All the best lands of the Forest are under plantation (enclosed), young growing timber unenclosed, or old matured timber; if this is excepted, a very small proportion of the residue would be of sufficient quality to *pay* for cultivation as corn-land. I should think not more than one-tenth part.

"4. I do not think any great good will accrue to the country through an enclosure of the New Forest unless the Crown sells the whole (that is all that remains to it after the rights of the commoners and others are satisfied). If the Crown retains those portions now growing timber, it will be impossible to dispose of the remainder to the best advantage, whether as building sites, or for agricultural or other purposes. Before the Forest generally can be made habitable, it must be drained. To do this effectually, outfalls and main channels for the discharge of such drainage must be provided; these main channels will be required through the length and breadth of the Forest. Roads will have to be formed for the accommodation of different properties and districts. In setting out the several lots of land, they should be so arranged as to embrace portions of the high poor lands with some of the good stapled lands, including also some young plantations and older timber, with a good building site. If this plan were adopted, properties of various extents would be the result, which I consider would be very desirable. Although I consider so small a portion of the Forest would pay for cultivation as corn-lands, I am not prepared to say what would be the condition of such lands, or what their powers would be, after large amounts of capital had been expended on them. They may be made fruitful, but possibly "the toll might be heavier than the grist." Hence it appears to me the owner should be a man who could afford to sink capital, having other objects than agriculture, such as making what is termed a desirable residential property. In carrying out this object he must improve the land, render it more or less productive, and the country at large would be benefited. I need not point out the beneficial change we, in the immediate neighbourhood of the Forest, would experience through having this large tract of land respectably inhabited; it would simply be the difference of living in a good neighbourhood instead of a bad one. The great help towards the staple improvement of forest-land is marl, of which unlimited quantities are to be obtained. Chalk is also quite within reach by the aid of railways, and at a cost within range. Quite as much timber, equally good, and much cheaper, would be produced if the Forest were in private properties instead of the property of the Crown. You have only to look at the timber growing on private properties within the Forest boundary to be assured of this.

"It may be right to apportion recreation-grounds in the neighbourhood of towns and villages, but as to pasturage for the same I apprehend the rights of the commoners would be considered, and compensation given either in land or money before enclosure could proceed. The commoners would be the greatest, and I think the only sufferers through an enclosure; therefore in considering their rights they should be dealt with liberally; and when compensation is made in land, it should be allotted as near as may be to the freehold, through which they obtain their common rights. By commoners I mean small freeholders. The strictly legal compensation to these people would not recoup them the benefits they now derive; but then it may truthfully be said they now get more than they have legal right to.

"5. A great deal of land, similar in appearance and quality, commences at Aldershot and continues from thence to Verwood and the neighbourhood of Wimborne. Having crossed the Stour valley you again meet with the same description of land, extending to the neighbourhood of Dorchester. All through this district considerable quantities of land have been brought into cultivation with variable success, although generally to the loss of the first beginner. Still, once broken up, the soils have been kept in cultivation; and, becoming gradually improved, they support a considerable population, and add materially to the wealth of the country.

"The cost of bringing such land into cultivation varies according to situation and circumstances.

"With the New Forest land you will have to consider—

Cost of drainage.
Cost of staple improvement.
Cost of breaking.
Cost of fencing.
Cost of necessary buildings.

These items will reach at least 15*l.* per acre. Add to this the amount per acre the land would fetch if sold, as I propose, and then estimate the value to rent; and, whether a lucrative investment will be the result or not, much good will be effected and the national wealth increased."

I do not require any excuse in calling particular attention to one or two strong points in Mr. Bone's remarks, in which I entirely coincide. (1.) The necessity, supposing the Forest is to be broken up, of dealing with the enclosures and wooded part, as well as the open wastes, and so arranging the sale lots that each may partake of both classes of soil. (2.) The certainty that the timber would not be depreciated by such sales, as it would be equally well protected in the hands of private owners as in that of the Commissioners.

Some little idea as to the prospect of recompence likely to arise from breaking up waste lands of an apparently unfavourable type may be afforded by examples of various commons in South Hampshire, and particularly in the neighbourhood of Botley, Bunsledon, and Titchfield. One of the most recent is the latter. The many occasions on which I have ridden and driven over these wastes enables me to testify as to their former most unfavourable appearance, and the emblems of barrenness afforded by their productions or by the appearance of their subsoil when it was brought to the surface occasionally. The success that has attended these efforts is sufficient to lead to the inference, that no matter what the main portion of the soil consists of—whether chalk or gravel, sand or clay—if we get rid of the surplus bottom water where it exists, and by deep cultivation and an admixture of soils render the land capable of retaining a proper amount of moisture, cultivation and manuring will supply all the rest. One of the most recent instances afforded is that of Titchfield

Common, over which many and many a time I have met the winter's blast and the summer's heat, in either case intensified by the arid and dreary character of the district, and I have the opportunity of testifying from many sources the very great satisfaction which has followed the successful exertions of the valuer, Mr. Richard Wooldridge, of Titchfield, in bringing it into cultivation, and from whom the following brief communication will be read with interest:—

" *Titchfield Common, county of Southampton.*—This common waste of the manors of Titchfield and Swanwick, extent 1200 acres, was awarded under the 'Enclosure Acts' in 1866. As valuer I was fortunately able to effect an agreement between the Lords of the Manors and the copyholders that the land should be allotted as of freehold tenure; it would otherwise have been copyhold, subject to arbitrary fines and other manorial rights, most discouraging to liberal outlay of the requisite capital to bring the land under proper cultivation as agricultural property—but this difficulty removed, a large proportion of the land has become productive and valuable arable. The soil consists of a small proportion of dry gravel surface and substratum, but more generally loam and clay, more or less mixed with gravel resting on retentive substrata, generally requiring drainage and in every part the application of marl or chalk. As a rule, the land requires subsoiling by hand-trenching or double-ploughing to break through a hard concreted band, locally called the pan, lying usually from nine to eighteen inches under the surface. These operations cost from 15*l.* to 25*l.* per acre, less the first and second crops, say turnips or potatoes, and oats. The effectual performance of these first acts of tillage is, in my opinion, the most economical as well as the best management. If the land is intended for pasturage, it requires cultivation some few years with vegetable crops previous to laying down, to ensure the growth and destruction of the seeds of indigenous plants. I have felt great interest in the work of reclaiming this waste, and you may infer that I attach much importance to the addition thus quietly made to our national wealth and civilization. It is particularly pleasing to see the space of the dreary old common dotted here and there with neat freehold cottages and well-managed gardens, each occupied by the owner, who, although perhaps not entirely free of borrowed means, is making his way surely to independence and comfort unknown to him before this local property had existence."

Mr. James Withers, the writer of the following short communication, in reply to some questions put to him, is a practical and experienced agriculturist, who, although he has farmed for some years on the other side of the Southampton Water, is well acquainted with the Forest, and for some years lived and farmed on its borders:—

"I consider that three-fourths of the Forest would pay for breaking up for tillage and pasture, and the poorest part will pay for planting, if properly treated. It should be trenched two feet deep, and if wet, made dry by open drains. I think every town and village should have in its immediate neighbourhood a portion of the land set apart for recreation and pasturage, and that the best sites in the Forest should be set apart for residential purposes and gradually brought into the market."

In reply to the question as to whether he is aware of land of similar quality being brought under cultivation successfully, he mentions Curdridge Common, Waltham Chase, Durley Common, besides twelve acres attached to the New Forest Union. He adds—

> "The grey sand and the white pebble are the poorest soils, but when properly treated, often prove the best for the growth of fir. I know land which has a poorer appearance than any in the New Forest cultivated for fir of various kinds, proves most successful — in the neighbourhood of Bagshot in particular. The cost will vary according to the nature of the work in grubbing. The wood land, if thickly planted with timber, would cost 6*l.* or 7*l.* per annum for grubbing, while the heath and furze could be done for less—about 4*l.* or 5*l.*, and a great portion could be broken up with a strong plough and four horses. I should judge that the average cost of first breaking would be about 5*l.* per acre, the after horse-labour about 2*l.* or 3*l.*—altogether about 8*l.* per acre to complete a seed-bed. A great portion of the surface should be burnt, which I know from experience is the best course to pursue."

In the XVIth volume of this Journal there is an excellent practical paper, by the Right Hon. J. E. Denison (Speaker of the House of Commons), on the subject of breaking up and cultivating woodlands in Nottinghamshire. The experience of the writer as well as that of his steward, Mr. Huskinson, shows a considerable profit on the practice, which, however, is enhanced by the high price of corn which prevailed about sixteen years ago, and also by the fact that in most of the instances detailed the land was of excellent quality and worth afterwards a good rental as corn land. The expenses are given at about 15*l.* or 17*l.* per acre, including draining with pipes and trenching 10 inches deep. The grubbing itself is put in one case at 6*l.* 13*s.*, and in an estimate by Mr. Huskinson at 8*l.* 5*s.*, including stubbing, digging, and trenching the land. Eight pounds per acre, or 1*s.* per rod, is about the expense of grubbing old woods in this neighbourhood: the value of the roots, or rather the ashes derived from their burning, goes some way towards compensating for this cost. In a paper read before the Botley Farmers' Club last year, by Mr. Joseph Blundell, details are given of the expenses of breaking up woodlands in various localities. In one case grubbing is put at 10*l.* per acre and chalking at 4*l.* This includes the removal of the roots of the timber as well as that of the underwood. In another case, where the timber was left, the cost of grubbing the underwood between it was 6*l.* per acre. In Mr. Denison's case some expense was saved by avoiding the felling of the timber in the ordinary way, but making the grubbing the roots accomplish both purposes. It is much to be hoped that steam will be brought to bear on the practice of grubbing, and so materially reduce its expense.

Mr. Joseph Blundell, partner in the firm of Blundell and Palmer, land-agents, Southampton, has taken a great interest in the subject of the New Forest, and entertains very sanguine opinions as to the economical results that would follow its being dealt with. He has in a communication to the author thus expressed his views:—

"I think the Government has made an error in planting the best land with worthless Scotch fir (no matter what the object), for in many instances spaces of unrivalled beauty and elevation, covered with beautifully picturesque beech and oak timber, have been cut and cleared away, the land being converted into a dense and gloomy plantation of Scotch fir, and whether planted as nursery for future growth of oak, or the value of the fir timber, it is alike unprofitable for the present generation.

"Irrespective of the 16,000 acres enclosed, there are probably about 5000 partially covered with timber, such as beech and oak, and sufficient to ornament the land with a view to its being sold as residential sites; there are also probably about 8000 acres growing only heath and furze, but capable of cultivation. There are probably about 6000 acres of sandy land, bearing fern, &c., also capable of being made fair stock and corn land, and about 3000 acres, probably consisting of bog land, which may be made fertile either for arable or pasture by draining, marling, chalking, &c. The tracts of land consisting of clay subsoil, and now bearing more or less herbage, and capable, when drained, of bearing corn, or being converted into pasture profitably, I should estimate at 10,000 acres. There are tracts of mixed clay and gravel soils extending in different directions, amounting to probably 7000 acres, which would pay to cultivate, particularly as 24 marl pits are to be found in the different localities. The remaining portion of the land, consisting of 8000 or 10,000 acres, composed of white and yellow sands and gravel, is too poor and arid for cultivation; but, in my opinion, there is not an acre of it that would not pay if planted with larch, fir, and underwood plants of sweet chesnuts, ash, &c., for ornament, after the soil had been properly broken by steam cultivation or otherwise to the depth of 18 inches, the climate of the Forest being especially favourable for such plantations. My observation and experience induce me to estimate that this land will pay a rental of 20*s.* to 25*s.* per acre, if planted as above stated. I therefore consider that the whole of the Forest is capable of being converted into profitable arable or pasture land, except the last-named 8000 or 10,000 acres.

"I beg to suggest the following course as a good one for the Government to pursue. To effect the main drainage and the completion of roads after a careful survey, together with an apportionment of land to parties having Forest rights, setting apart 3000 or 4000 acres as recreation ground, &c., to be appointed to the different towns and villages in the vicinity; then to offer for sale by auction such portions as are adapted for residential estates, in separate lots, together with any timber thereon; also to offer, in convenient lots, including a portion of the Government plantations, all the remaining land, for farming or other purposes, having regard in so doing to the situation of contiguous estates. In concluding my observations as to the value of the Forest, I wish especially to note the fact, that in almost every locality there are gardens, attached to the cottages, which represent all the soils to be found in the Forest, and that by continuous spade-culture even the poorest are made productive.

"In giving you the result of the enclosure of wastes under my own management, I beg to state that my property, being situated in four different parishes, I had allotments on the commons in each of them. In Durley parish my allotment on Wintershill Common was a strong piece of land: this was let to a tenant of my other land, at a nominal rent for twelve years, he breaking up, chalking, and draining, I finding tiles and paying for fences. This is now good land and letting at 40*s.* per acre. A piece of sandy loam land in Botley parish cost in draining, chalking, fencing, and breaking-up, about 10*l.* per acre: this is now under spade culture, and lets at the rate of 50*s.* per acre per annum. A piece of land in Bursledon parish, of similar soil, broken up at a cost of 7*l.* per acre, is now let at the annual rent of 5*l.* per acre. Another piece in Hound parish, broken up at a cost of 11*l.* per acre, is poor land, and although it is under cultivation at a rent of 20*s.* per acre, it should have been planted with larch and firs to yield the best rental: this, however, has not been done, as I am looking to its future value as a site for building, it being an elevated spot and giving one of the most splendid views to be found in this county. I can only say that these different pieces of land represent nearly all the soils to be found in the New Forest, except bog, the climate being also the same. Again, as agent to the late Richard Trench, Esq., two pieces of land, called Sanday Hill and Windmill Hill, I had brought into cultivation, both being part of Bursledon Common. The former was purchased at 25*l.* per acre, and although the surface was very irregular, caused by old sand and gravel pits, yet it was broken up, levelled, drained, and chalked, at a cost of about 12*l.* per acre. This land has been in cultivation ever since, and is now worth 35*s.* per acre rent per annum. The land on the Windmill Hill was allotted to Mr. Trench under the enclosure, and is now useful land, having cost about 8*l.* per acre to bring into cultivation, and is worth about 32*s.* per acre rent. Both these pieces of land are in parts, I consider, as poor as the worst parts of the New Forest."

## XIII.—Military Purposes.

An idea started some years ago has since been revived and received with favour, viz., the appropriateness of the New Forest for the extensive manœuvring and movements of troops; and it is certainly much to be regretted that before such large sums of money had been expended at Aldershot, preference had not been given to the Forest on account of its equality in other advantages, and its superiority in regard to extent and variety of surface. Should the idea be revived, it is not at all likely to supplant Aldershot after the enormous expense there incurred, but may be used as supplementary to it. For the purpose of a camp the highest and driest portion of the Forest will be found most suitable, and the district occupied by the Bagshot sands will afford abundant scope for the manœuvring of troops, for sham fights, and for a summer camp. There is no necessity whatever that the land should continue unutilized in order that it should be employed for the exercise of troops. Should it be desirable that a camp should be formed near the railway, the Old Beaulieu Road Station would afford a very convenient locality, there being a dry sandy soil on both sides of the railway; or, should a turnpike-road be preferred, the neighbourhood of Picked Post would be equally suitable. It is, however, by no means necessary that upwards of sixty thousand acres of land should remain unutilized, in order that a camp for our troops may be available.

## XIV.—Summary.

Having now described imperfectly, but as well as the circumstances will admit, the various points connected with the New Forest, I cannot do better than atone for discursiveness by gathering up the conclusions which appear to follow from the facts that have been stated.

(1) Without pretending to decide the extent of the claims which the commoners may have on the Forest, it is sufficient to know that their nature has been duly settled, and recorded by a commission, and no doubt by a similar tribunal their value and mode of compensation will be determined.

(2) The obscurity and difficulty with which the subject is surrounded offer no valid reason for further delay; but the very fact that some thousands of acres are still unenclosed, although set out for the purpose, is a strong argument why there should be no further postponement in dealing with the Forest.

(3) The very great diminution of the value of oak-timber, and the cessation of its demand for navy requirements; the improved system of agriculture by which old forest customs are fast becoming obsolete; the insular position of the country; the large extent of land required by railways and other public works, all offer the strongest arguments in favour of breaking up, utilizing, and cultivating our waste and forest lands.

(4) Although the soil of the New Forest is not, on the whole, of the most favourable character, yet the climate is good and the soils are various; facilities are great for ameliorating the land by means of marl and chalk, and the examples are numerous in the county of land which offered an equally unpromising aspect having been broken up with success within the last twenty years.

(5) Opinions of practical men agree as to the most profitable mode of dealing with a great portion of the Forest, viz., by cutting it up into small estates, each possessing a favourable site for building, and consisting, if possible, partly of wooded and partly of waste land, and that the properties so carved out should be submitted to public competition.

(6) The revenue derived from such sales would supply the means of effecting those general improvements, such as main drainage, which it would not be wise to leave to individual proprietors, and also of satisfying the claims of commoners whose property is not conveniently situated for receiving compensation in land.

(7) The expense of breaking up the land for tillage cannot be estimated on the average at less than 15*l.* per acre, but the large amount of ashes that would accrue from the process would render the after-expense of the first two crops extremely moderate.

(8) The plan suggested would furnish the means of employing a considerable amount of labour, and, it is hoped, a remunerative return for the investment of capital. It would improve the health of the neighbourhood, and benefit its trade, and, whilst contributing to individual advantage, would greatly conduce to the national wealth.

## IX.—*On the Comparative Agriculture of England and Wales.* By William Topley, F.G.S., Geological Survey of England and Wales.

That Agriculture is carried on under widely different circumstances in different parts of England is well enough known. Until quite recently, however, there have been no certain data on which to institute a comparison between one district and another; but the publication of the Agricultural Statistics prepared by the Board of Trade enables this now to be done with some degree of accuracy. On some points, however, information is totally wanting. There is no return for Woodland and Fruit: the former is important in every county, and the latter is especially so in some. With one other exception, the Returns are fairly complete for acreage, and that exception is, an estimate of unenclosed land, hill-pastures, &c.; all, in fact, which is commonly understood as "Waste Land."

These statistics give the actual acreage of each crop; but the numbers, though essential for obtaining an accurate knowledge of the producing power of a county, are useless, as they stand, for comparing one county with another. This can only be done by obtaining percentages, which may be calculated on different bases. For general purposes, the *total acreage* is decidedly the best, and is the only one which affords a sufficient test of the agricultural value of the various counties.

In order to obtain some accurate knowledge of the distribution of the different crops, with the view of comparing them with the physical structure of the country, I have calculated the *percentage* of acreage devoted to each. The numbers thus obtained are embodied in the following Table, so that the productiveness of any county may be seen at a glance. Some of the more obvious results will be noticed presently. It must be remembered that the numbers here given are *percentages only*, and afford no information upon the actual acreage of crops. This must be sought for in the original Returns. Thus, in comparing the counties of Huntingdon and Lincoln, the acreage under wheat in 1869 was more than six times greater in the latter county than in the former; yet there is a larger *percentage* of Huntingdon under wheat than of Lincoln. Again, Cambridge, which is the most productive county in the kingdom in proportion to its size, and which excels especially in corn, is yet itself exceeded in actual acreage under corn by eight counties, two of which, Devon and the West Riding,* are not even considered as corn districts.

* The three Ridings of Yorkshire rank as separate counties in the 'Returns.' In his Introduction to these Returns, Mr. A. W. Fonblanque gives a list of 'Corn'

The percentages mentioned in the following pages are calculated on the Returns for 1869. This year alone has been chosen, in preference to taking the mean of the four, 1866-69, as many of the Returns for the earlier years were erroneous in important particulars. Thus, waste land seems often to have been given as fallow in early Returns, and probably is so still in many cases. Again, "Down land," such as that of the Sussex Chalk hills, being unenclosed, was not returned. In the later Returns it is included in Permanent Pasture. The Returns for 1869 were more numerous than in former years. For these and other reasons, the year 1869 has been taken alone.

Whilst the variations in absolute acreage are often considerable in the same county in different years, the percentages differ but slightly. In the Returns, the only case in which percentages are calculated is in one column headed the "Percentages of Corn-crops to total Acreage under all kinds of Crops, Bare Fallow, and Grass." Here it is evident that the difference between 1868 and 1869 is small. In only ten counties does it amount to more than 1 per cent., whilst in only one (Suffolk) does the difference amount to 2 per cent.

The Returns for 1869 were required for "Holdings of and above one-quarter of an acre;" therefore the area unaccounted for includes all holdings smaller than this. Remembering that many families grow a large portion of their vegetables in their own small gardens, it will be seen that a considerable aggregate of potatoes, cabbages, peas, &c., is not accounted for. It is unlikely that such blanks have any material effect in modifying the *percentages* of entire counties, still less in altering the relations which the counties have to each other. This area also includes orchards, fruit-gardens, woods, towns, houses, gardens, railways, roads, and all hill-pastures and uncultivated land. Probably, also, for the most part, hedgerows are included, the area occupied by which is very considerable in all counties, and enormous in some.

In trying to classify the English counties according to their leading physical features, we find that the western part of the country contains the largest portion of high land, and that this higher western land is occupied by the older geological formations. A map of rainfall and temperature shows that the greatest fall is over the western high lands; and, speaking generally, over other districts the fall is in proportion to the height of the ground. Summer temperature is of great importance; this is highest

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and 'Grazing' counties, according to the percentage of *cultivated land* under corn or grass. The result nearly agrees with the classification proposed by Mr. Caird in 1851. I find that this division of England had already been roughly shown in a map appended to Becquerel's 'Physique et Météorologie,' 1847.

TABLE showing the Percentage of each CROP

| COUNTIES. | Wheat. | Barley. | Oats. | Rye. | Beans. | Peas. | TOTAL CORN CROPS. |
|---|---|---|---|---|---|---|---|
| SOUTH-EASTERN. | | | | | | | |
| Kent .. .. .. .. .. | 10·6 | 4·0 | 5·2 | 0·06 | 2·1 | 2·0 | 24·4 |
| Sussex .. .. .. .. | 11·2 | 2·5 | 7·0 | 0·05 | 1·0 | 1·4 | 23·2 |
| Surrey .. .. .. .. | 9·5 | 3·6 | 5·5 | 0·3 | 0·6 | 1·5 | 21·1 |
| Hants .. .. .. .. | 10·8 | 6·1 | 6·1 | 0·2 | 0·5 | 1·0 | 24·9 |
| Berks .. .. .. .. | 14·3 | 8.5 | 5·8 | 0·1 | 3·1 | 1·8 | 33·8 |
| SOUTH-MIDLAND. | | | | | | | |
| Middlesex .. .. .. .. | 5·1 | 1·1 | 3·1 | 0·3 | 0·7 | 0·9 | 11·3 |
| Herts .. .. .. .. .. | 15·9 | 11·7 | 7·0 | 0·07 | 3·0 | 2·5 | 40·0 |
| Bucks .. .. .. .. | 13·0 | 6·1 | 5·5 | 0·1 | 3·8 | 2·0 | 30·8 |
| Oxford .. .. .. .. | 13·3 | 10·9 | 5·0 | 0·05 | 3·8 | 2·4 | 35·6 |
| Cambridge .. .. .. | 24·9 | 10·5 | 7·1 | 0·15 | 5·9 | 2·1 | 50·6 |
| Bedford .. .. .. .. | 18·0 | 9·7 | 3·4 | 0·2 | 6·9 | 2·8 | 40·8 |
| Huntingdon .. .. .. | 21·2 | 8·8 | 5·0 | 0·2 | 6·5 | 3·1 | 45·7 |
| Northampton .. .. .. | 13·0 | 8·3 | 3·0 | 0·05 | 3·9 | 2·0 | 30·3 |
| EASTERN. | | | | | | | |
| Essex .. .. .. .. .. | 18·3 | 9·9 | 4·4 | 0·15 | 4·5 | 3·2 | 40·3 |
| Suffolk .. .. .. .. | 16·4 | 14·5 | 1·9 | 0·8 | 4·6 | 3·6 | 41·8 |
| Norfolk .. .. .. .. | 15·0 | 14·3 | 2·7 | 0·7 | 1·2 | 2·0 | 35·9 |
| NORTH-MIDLAND. | | | | | | | |
| Lincoln .. .. .. .. | 18·1 | 8·1 | 6·1 | 0·14 | 1·9 | 1·6 | 35·4 |
| Rutland .. .. .. .. | 11·0 | 10·7 | 3·9 | 0·2 | 1·8 | 1·6 | 29·0 |
| Notts .. .. .. .. .. | 14·1 | 8·9 | 4·0 | 0·5 | 2·3 | 2·2 | 32·1 |
| Leicester .. .. .. .. | 9·5 | 5·9 | 4·3 | 0·04 | 2·0 | 1·4 | 23·3 |
| Derby .. .. .. .. | 5·4 | 2·1 | 4·6 | 0·04 | 0·3 | 0·4 | 12·9 |
| YORKSHIRE. | | | | | | | |
| East Riding .. .. .. | 17·0 | 6·2 | 10·2 | 0·3 | 2·1 | 1·6 | 37·0 |
| West Riding .. .. .. | 6·7 | 3·9 | 3·5 | 0·1 | 0·9 | 0·6 | 15·7 |
| North Riding .. .. .. | 6·5 | 4·1 | 5·1 | 0·1 | 0·8 | 0·4 | 17·0 |
| NORTHERN. | | | | | | | |
| Durham .. .. .. .. | 7·7 | 1·9 | 6·4 | 0·04 | 0·7 | 0·2 | 17·4 |
| Northumberland .. .. | 3·7 | 2·4 | 5·3 | 0·03 | 0·5 | 0·3 | 12·2 |
| Cumberland .. .. .. | 2·8 | 1·0 | 7·1 | 0·09 | 0·02 | 0·02 | 11·1 |
| Westmoreland .. .. .. | 0·6 | 0·6 | 3·5 | 0·02 | .. | .. | 4·7 |

* The numbers given in this Table were originally calculated to enable me to construct a tabular chart, showing therefore the numbers were not calculated with great nicety. I mention this to anticipate any criticisms as to county to be compared with any other.

In the last column of the Table the numbers have, for the sake of brevity, been shortened by to the TOTAL ACREAGE of each COUNTY.*

| Potatoes. | Turnips and Swedes. | Mangold. | Carrots, Cabbage, Kohl Rabi, and Rape. | Vetches, Lucerne, and other Green Crops. | TOTAL GREEN CROPS. | Clover, Sainfoin, and Grasses under Rotation. | Bare Fallow. | TOTAL ARABLE LAND. | Permanent Pasture. | TOTAL CULTIVATED LAND. | Area unaccounted for, Waste, Woods, Towns, &c., &c. | Area of County in Statute Acres (,000 omitted). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1·3 | 3·0 | 0·8 | 0·4 | 1·8 | 7·5 | 3·8 | 1·1 | 40·7 | 28·7 | 69·4 | 30·6 | 1,039 |
| 0·4 | 3·9 | 0·9 | 1·0 | 1·8 | 7·7 | 5·6 | 3·0 | 40·6 | 27·3 | 67·9 | 32·1 | 936 |
| 0·8 | 4·1 | 1·5 | 0·6 | 1·6 | 8·6 | 4·6 | 2·7 | 37·4 | 21·7 | 59·1 | 40·9 | 478 |
| 0·4 | 8·7 | 0·8 | 0·7 | 2·1 | 12·8 | 9·6 | 2·0 | 49·6 | 14·4 | 64·0 | 36·0 | 1,070 |
| 0·2 | 8·9 | 0·9 | 0·7 | 2·3 | 13·1 | 7·3 | 1·7 | 56·2 | 25·4 | 81·6 | 18·4 | 451 |
| | | | | | | | | | | | | |
| 1·6 | 1·1 | 1·0 | 0·4 | 1·8 | 6·0 | 1·3 | 0·04 | 19·0 | 42·6 | 61·6 | 39·4 | 180 |
| 0·4 | 7·2 | 1·3 | 0·5 | 2·4 | 11·8 | 5·7 | 3·8 | 61·5 | 23·0 | 84·5 | 15·5 | 391 |
| 0·4 | 4·8 | 0·8 | 0·4 | 1·6 | 7·8 | 4·2 | 2·0 | 44·6 | 40·2 | 84·8 | 15·2 | 466 |
| 0·3 | 8·7 | 0·9 | 0·4 | 1·5 | 11·9 | 7·3 | 1·5 | 56·4 | 29·1 | 85·5 | 14·7 | 472 |
| 1·9 | 3·8 | 2·8 | 2·5 | 3·0 | 14·2 | 6·1 | 3·7 | 74·9 | 14·6 | 89·5 | 10·5 | 525 |
| 1·4 | 4·6 | 1·4 | 1·3 | 2·5 | 11·1 | 3·7 | 4·0 | 59·6 | 25·3 | 84·9 | 15·1 | 295 |
| 1·5 | 1·9 | 1·6 | 1·5 | 2·2 | 8·7 | 3·9 | 7·0 | 64·4 | 25·7 | 90·1 | 9·9 | 229 |
| 0·6 | 4·2 | 0·7 | 0·2 | 1·1 | 6·4 | 3·1 | 2·7 | 42·6 | 42·6 | 85·2 | 14·8 | 630 |
| | | | | | | | | | | | | |
| 0·9 | 2·8 | 2·7 | 0·4 | 2·9 | 9·9 | 4·9 | 4·1 | 59·4 | 16·0 | 75·4 | 24·6 | 1,060 |
| 0·2 | 6·6 | 3·9 | 0·4 | 2·2 | 13·4 | 6·1 | 2·2 | 63·6 | 15·6 | 79·2 | 20·8 | 947 |
| 0·5 | 10·5 | 2·8 | 0·4 | 0·8 | 15·1 | 9·7 | 0·5 | 61·2 | 16·5 | 77·7 | 22·3 | 1,354 |
| | | | | | | | | | | | | |
| 2·4 | 7·6 | 0·8 | 1·0 | 1·0 | 12·9 | 7·4 | 1·4 | 57·2 | 23·6 | 80·8 | 19·2 | 1,775 |
| 0·3 | 6·6 | 0·3 | 0·06 | 0·7 | 8·0 | 4·1 | 2·3 | 43·4 | 38·3 | 81·7 | 18·3 | 95 |
| 1·1 | 7·0 | 0·7 | 0·2 | 1·1 | 10·2 | 7·7 | 3·1 | 53·2 | 29·6 | 82·8 | 17·2 | 526 |
| 0·4 | 3·1 | 0·8 | 0·2 | 0·8 | 5·3 | 3·3 | 2·0 | 34·4 | 55·1 | 89·5 | 10·1 | 514 |
| 0·5 | 2·0 | 0·2 | 0·4 | 0·5 | 3·5 | 3·9 | 1·3 | 21·7 | 51·2 | 72·9 | 27·1 | 658 |
| | | | | | | | | | | | | |
| 1·6 | 9·9 | 0·4 | 1·3 | 1·1 | 14·1 | 10·0 | 3·1 | 65·1 | 21·6 | 86·7 | 13·3 | 771 |
| 1·7 | 3·6 | 0·1 | 0·1 | 0·5 | 6·1 | 3·4 | 1·1 | 26·6 | 40·1 | 66·7 | 33·3 | 1,709 |
| 0·9 | 4·3 | 0·07 | 0·3 | 0·3 | 5·8 | 4·2 | 2·5 | 30·0 | 29·1 | 59·1 | 40·9 | 1,350 |
| | | | | | | | | | | | | |
| 1·3 | 3·7 | 0·03 | 0·1 | 0·6 | 5·7 | 5·4 | 4·0 | 32·5 | 31·5 | 64·0 | 36·0 | 622 |
| 0·5 | 4·0 | .. | 0·1 | 0·3 | 5·0 | 6·1 | 1·6 | 25·1 | 28·2 | 53·3 | 46·7 | 1,249 |
| 1·2 | 3·5 | 0·06 | 0·2 | 0·05 | 5·1 | 8·8 | 0·7 | 26·1 | 25·5 | 51·6 | 48·4 | 1,001 |
| 0·4 | 1·8 | 0·02 | 0·06 | 0·02 | 2·3 | 3·3 | 0·2 | 10·7 | 35·2 | 45·9 | 54·1 | 485 |

at a glance the crops of each and every county. In this chart the smaller fractional numbers could not be drawn; incorrectness in these figures. They are not offered as absolutely correct; but are amply sufficient to enable any one

omitting the last three of each; thus for Kent, instead of 1,039, read 1,039,000 (really 1,039,419).

TABLE showing the Percentage of each CROP

| COUNTIES. | Wheat. | Barley. | Oats. | Rye. | Beans. | Peas. | TOTAL CORN CROPS. |
|---|---|---|---|---|---|---|---|
| **NORTH-WESTERN.** | | | | | | | |
| Lancashire .. .. .. .. | 3·4 | 0·6 | 4·3 | 0·1 | 0·3 | 0·03 | 8·8 |
| Cheshire .. .. .. .. | 5·9 | 0·6 | 6·5 | 0·2 | 0·6 | 0·1 | 13·9 |
| **WEST-MIDLAND.** | | | | | | | |
| Stafford .. .. .. .. .. | 8·2 | 4·2 | 4·2 | 0·2 | 0·6 | 0·7 | 18·3 |
| Warwick .. .. .. .. | 14·1 | 4·8 | 2·6 | 0·1 | 4·4 | 2·2 | 28·2 |
| Gloucester .. .. .. | 12·0 | 5·1 | 2·0 | 0·03 | 2·4 | 1·4 | 23·1 |
| Worcester .. .. .. .. | 15·2 | 3·9 | 1·5 | 0·1 | 4·6 | 2·1 | 27·6 |
| Salop .. .. .. .. .. | 10·9 | 6·2 | 3·1 | 0·2 | 0·8 | 0·9 | 22·2 |
| Hereford .. .. .. .. | 11·3 | 3·9 | 2·2 | 0·03 | 1·6 | 1·3 | 20·5 |
| **SOUTH-WESTERN.** | | | | | | | |
| Wilts .. .. .. .. .. | 11·9 | 7·5 | 3·8 | 0·2 | 1·6 | 1·0 | 26·0 |
| Dorset .. .. .. .. .. | 7·5 | 6·2 | 3·2 | 0·1 | 0·5 | 0·6 | 18·2 |
| Somerset .. .. .. .. | 7·5 | 3·4 | 2·2 | 0·01 | 1·6 | 0·3 | 15·0 |
| Devon .. .. .. .. .. | 7·8 | 5·0 | 5·3 | 0·01 | 0·07 | 0·1 | 18·2 |
| Cornwall .. .. .. .. | 6·3 | 5·9 | 5·0 | 0·01 | .. | .. | 17·0 |
| **SOUTH WALES AND MONMOUTH.** | | | | | | | |
| Monmouth .. .. .. | 6·0 | 3·3 | 2·0 | .. | 0·2 | 0·4 | 12·0 |
| Glamorgan .. .. .. | 3·0 | 2·2 | 2·6 | 0·03 | 0·03 | 0·03 | 7·7 |
| Brecon .. .. .. .. .. | 2·4 | 2.0 | 3·4 | .. | .. | 0·08 | 7·8 |
| Radnor .. .. .. .. .. | 3·0 | 2·0 | 4·4 | 0·05 | .. | 0·1 | 9·6 |
| Cardigan .. .. .. .. | 2·1 | 5·3 | 7·1 | 0·05 | .. | 0·07 | 14·7 |
| Carmarthen .. .. .. | 2·2 | 3·4 | 7·0 | 0·05 | 0·01 | 0·01 | 12·6 |
| Pembroke .. .. .. | 2·3 | 6·8 | 6·8 | 0·01 | .. | 0·02 | 16·1 |
| **NORTH WALES.** | | | | | | | |
| Montgomery .. .. .. | 4·8 | 2·5 | 4·6 | 0·03 | 0·1 | 0·2 | 12·3 |
| Merioneth .. .. .. | 0·6 | 1·3 | 3·0 | 0·03 | .. | .. | 4·9 |
| Denbigh .. .. .. .. | 5·3 | 5·1 | 7·2 | 0·2 | 0·2 | 0·1 | 18·1 |
| Flint .. .. .. .. .. | 9·5 | 3·8 | 6·2 | 0·1 | 1·2 | 0·2 | 21·1 |
| Carnarvon .. .. .. | 0·6 | 2·3 | 3·6 | 0·1 | 0·02 | 0·03 | 6·7 |
| Anglesea .. .. .. .. | 1·2 | 3·2 | 12·4 | 0·1 | 0·01 | 0·01 | 17·0 |
| Mean of England and Wales .. .. .. | 9·5 | 5·4 | 4·7 | 0·2 | 1·5 | 1·0 | 22·3 |

to the Total Acreage of each County—*continued.*

| Potatoes. | Turnips and Swedes. | Mangold. | Carrots, Cabbages, Kohl Rabi, and Rape. | Vetches, Lucerne, and other Green Crops. | Total Green Crops. | Clover, Sainfoin, and Grasses under Rotation. | Bare Fallow. | Total Arable Land. | Permanent Pasture. | Total Cultivated Land. | Area unaccounted for, Waste, Woods, Towns, &c., &c. | Area of County in Statute Acres (,000 omitted). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3·3 | 0·9 | 0·1 | 0·1 | 0·1 | 4·6 | 4·5 | 0·4 | 18·4 | 40·9 | 59·3 | 40·7 | 1,219 |
| 3·6 | 1·2 | 0·2 | 0·1 | 0·2 | 5·2 | 5·6 | 0·4 | 25·0 | 46·0 | 71·0 | 29·0 | 707 |
| | | | | | | | | | | | | |
| 1·3 | 3·8 | 0·4 | 0·2 | 0·6 | 6·3 | 5·1 | 1·4 | 31·1 | 47·8 | 78·9 | 21·1 | 728 |
| 0·5 | 3·5 | 0·7 | 0·1 | 1·0 | 5·7 | 4·8 | 2·5 | 41·3 | 42·5 | 83·8 | 16·2 | 563 |
| 0·8 | 5·3 | 0·4 | 0·1 | 1·3 | 8·0 | 8·9 | 1·2 | 41·3 | 37·3 | 78·6 | 21·4 | 805 |
| 1·2 | 3·4 | 0·7 | 0·1 | 1·6 | 7·1 | 4·9 | 2·3 | 42·5 | 38·7 | 81·2 | 18·8 | 472 |
| 0·8 | 6·4 | 0·4 | 0·06 | 0·3 | 8·0 | 7·3 | 1·4 | 38·9 | 42·2 | 81·1 | 18·9 | 826 |
| 0·5 | 5·0 | 0·2 | 0·05 | 0·9 | 6·8 | 6·0 | 1·4 | 35·9 | 42·1 | 78·0 | 22·0 | 534 |
| | | | | | | | | | | | | |
| 0·4 | 7·9 | 0·5 | 1·0 | 2·4 | 12·3 | 7·7 | 2·1 | 48·3 | 35·4 | 83·7 | 16·3 | 865 |
| 0·5 | 6·7 | 0·7 | 0·4 | 1·1 | 9·3 | 6·7 | 1·3 | 35·6 | 35·1 | 70·7 | 29·3 | 632 |
| 0·9 | 3·4 | 1·1 | 0·3 | 0·5 | 6·2 | 4·1 | 1·0 | 26·4 | 49·5 | 75·9 | 24·1 | 1,047 |
| 1·1 | 5·1 | 1·3 | 0·8 | 0·4 | 8·7 | 6·9 | 3·0 | 36·9 | 24·0 | 60·9 | 39·1 | 1,657 |
| 0·9 | 3·5 | 1·0 | 0·8 | 0·1 | 6·3 | 12·1 | 3·8 | 39·6 | 16·5 | 56·1 | 43·9 | 873 |
| | | | | | | | | | | | | |
| 0·6 | 2·7 | 0·2 | .. | 0·5 | 4·0 | 4·0 | 1·4 | 21·2 | 38·2 | 59·4 | 40·6 | 368 |
| 0·5 | 1·9 | 0·1 | 0·02 | 0·2 | 2·8 | 3·4 | 1·1 | 14·8 | 31·6 | 46·4 | 53·6 | 547 |
| 0·4 | 1·2 | 0·02 | 0·01 | 0·1 | 1·8 | 3·5 | 1·0 | 14·2 | 26·5 | 40·7 | 59·3 | 460 |
| 0·6 | 2·4 | 0·01 | 0·01 | 0·1 | 3·1 | 3·1 | 0·9 | 17·2 | 36·6 | 53·8 | 46·2 | 272 |
| 1·8 | 0·9 | 0·07 | 0·02 | 0·1 | 2·8 | 6·8 | 1·2 | 25·6 | 32·4 | 58·0 | 42·0 | 443 |
| 0·8 | 0·6 | 0·1 | .. | 0·04 | 1·5 | 5·6 | 1·7 | 18·0 | 29·7 | 47·7 | 52·3 | 606 |
| 1·1 | 1·6 | 0·3 | 0·05 | 0·05 | 3·0 | 6·7 | 1·5 | 27·4 | 40·8 | 68·2 | 31·8 | 401 |
| | | | | | | | | | | | | |
| 0·7 | 1·8 | 0·04 | 0·01 | 0·1 | 2·6 | 4·4 | 0·9 | 20·2 | 29·1 | 49·3 | 50·7 | 483 |
| 0·7 | 0·3 | 0·03 | .. | 0·01 | 1·0 | 2·6 | 0·6 | 8·9 | 20·7 | 29·6 | 70·4 | 385 |
| 1·4 | 2·1 | 0·1 | 0·04 | 0·3 | 3·9 | 7·8 | 1·4 | 31·4 | 30·3 | 61·7 | 38·3 | 386 |
| 2·0 | 2·5 | 0·2 | 0·07 | 0·4 | 5·2 | 7·0 | 1·5 | 34·8 | 29·6 | 64·4 | 35·6 | 184 |
| 1·5 | 0·6 | 0·1 | 0·02 | 0·1 | 2·3 | 7·1 | 1·9 | 18·0 | 29·7 | 47·7 | 52·3 | 370 |
| 2·7 | 2·7 | 0·1 | 0·03 | 0·04 | 5·6 | 12·7 | 1·2 | 36·5 | 34·0 | 70·5 | 29·5 | 193 |
| 1·1 | 4·5 | 0·8 | 0·4 | 0·9 | 7·7 | 6·1 | 1·9 | 38·3 | 31·1 | 69·4 | 30·6 | 37,324 (Total) |

over the eastern central district. Considered agriculturally, we find that the western counties are characterised by their large acreage of grazing land, whilst in the eastern there is a high percentage of corn land. There is thus a general coincidence between geological structure, contour, climate, and agricultural products. These four classes of facts are of importance in the order here given; each is controlled by the one that precedes it. Agriculture depends mainly on climate, climate mainly on contour, and contour mainly on geological structure.*

The central high land of England is formed of the Lower Carboniferous rocks, which, commencing on the flanks of the Cheviots, extend through the western parts of Northumberland, Durham, Yorkshire (North and West Ridings), the eastern parts of Lancashire, Cumberland and Westmoreland, and the greater part of Derbyshire. This hilly region (the Pennine Chain) attains its maximum elevation at Cross Fell, in Cumberland, 2892 feet, but a great part of its area exceeds 1500 feet. It is completely broken through by the broad valley which runs from Newcastle towards Carlisle. Generally, through this district, the limit of cultivation is reached at about 1000 feet; all above this level being, for the most part, moorland, hill pastures, and waste. In Northumberland the limit is somewhat lower.

In Derbyshire the hills are formed by Millstone-grit, overlying Carboniferous Limestone, which here consists mainly of massive beds of limestone. Proceeding northwards, the Limestone series is much split up by shales and sandstones, until, in Northumberland, limestone forms only a small proportion of the rock masses. The western part of Northumberland is wholly formed of the Limestone series, whilst in Durham the hills are capped by Millstone-grit. These lithological changes are important, for the hilly districts are valuable in proportion to the quantity of limestone soil they contain. The outcrop of a bed of limestone amongst shales and sandstones can often be traced by the eye at a long distance, simply by the character of the grass it bears. From Northumberland, through Durham, the West Riding, and Derbyshire, there is a decrease of waste land, and an increase of pasture going southward. This is probably due to the increasing quantity of limestone soil in the same direction. The North Riding includes the eastern moorlands of Yorkshire, and has thus a large quantity of waste land, otherwise it would probably be intermediate in this respect

* The Sections given, p. 276, will in part illustrate these remarks. They are not offered as accurate delineations of geological details, but are simply intended to show the general relations of geology, contour, and agriculture.

between Durham and the West Riding; and the series would then be complete.* The Lower Carboniferous rocks of the Pennine Chain sink below the newer formations with a gradual slope on their eastern side, more abruptly on the south-west, whilst along their north-western limit they end in a grand "escarpment," overlooking the valley of the Eden (*see* Section No. 1). The Pennine Chain joins the Cumbrian Mountains by the high land on the north-east of Kendal, much of which is over 1000 feet in height. It is quite broken through, however, by the narrow valley of the Lune.

The higher parts of the Pennine Range are generally bare, alike of trees and houses. The lead-mining district of Alston Moor is a curious exception to this rule. Here a considerable number of people live at a great elevation; quite above the limit of cultivated land. In an account of a school at Allenheads it is stated that of 40 or 50 children only 5 had seen wheat growing; and "the master mentioned that in all the time he had had charge of Allenheads School there was but one boy who had pulled a bird's nest."† We presume because nests are exceedingly scarce.

The Cumbrian Mountains, of Silurian slaty rocks, rise abruptly from the fertile valley of the Eden, and are almost wholly waste land. They form a large proportion of the area of Westmoreland. The valleys which run up into the mountain-range have strips of pasture along their lower slopes, and some of the deepest contain corn-land. Westmoreland, however, is by far the least productive county in England: its percentage-area of arable land only slightly exceeds that of Merioneth, the least productive of the Welsh counties; in corn it is even less productive, the percentages are :—

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Westmoreland, | Arable | 10·7 | .. | Corn | 4·7 | .. | Pasture | 35·2 |
| Merioneth | „ | 8·9 | .. | „ | 4·9 | .. | „ | 20·7 |

The Welsh Mountains form the third great unproductive area. They are composed mainly of Silurian and Cambrian rocks. A large proportion of the corn grown in this district is oats and barley. Anglesey and Flint have the smallest quantity of high land. The former, indeed, has no mountain land, its appearance

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* "Hill Pastures" are not included in the Agricultural Returns, and all such are here spoken of as Waste Land. The boundary line, however, between them and what is taken as "Permanent Pasture" is often very ill defined; and, in point of real value for stock, there are considerable areas of hill pasture which surpass much of the poorer pasture fields at lower levels. This must always be remembered when comparing the quantity of cattle and sheep kept in different counties. These numbers are given in the Returns, but will not be further considered in the present paper.

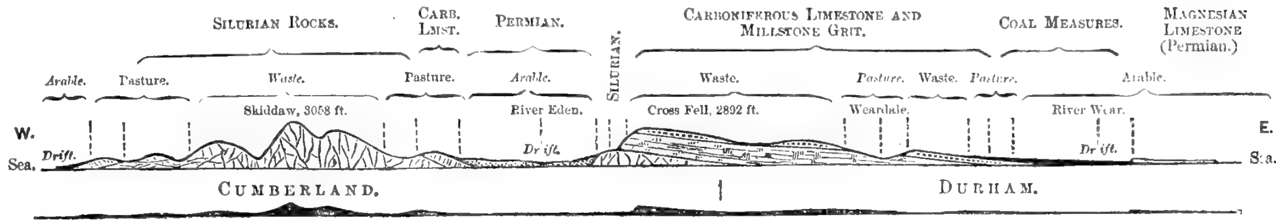
† Walter White, 'Northumberland and the Border,' p. 460.

## Comparative Sections, Showing the Relations of Geological Structure and Contour to Agriculture.

(The Heights are Magnified Six Times.)

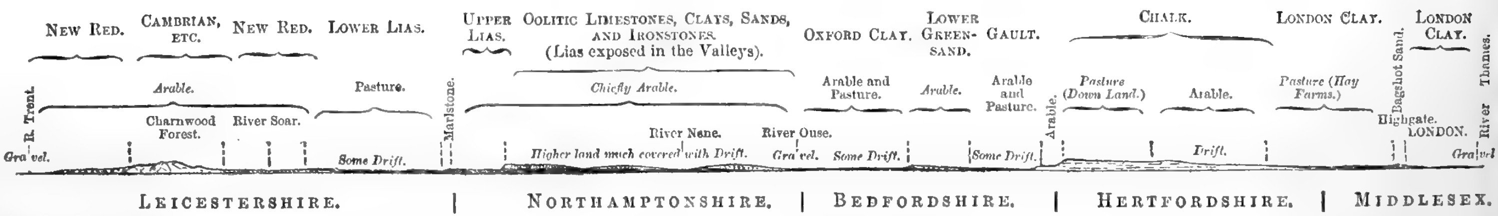
Scale of Miles 5 10 15 20

### No. 1.—Section through Cumberland and Durham, across the Cumbrian and Pennine Mountains.




Approximately True Outline of No. I. Section.

### No. 2.—From the Trent to the Thames at London.



when viewed from the elevated districts of the main land is that of an unbroken plain ; and its highest point only slightly exceeds 700 feet. Anglesea is in great part covered with drift clay and gravel, the older rocks protruding as isolated patches, which are frequently waste land. The most striking feature of the agriculture of Anglesea is its high percentage of oats and rotation grasses, in both of which it exceeds every other English or Welsh county. The westerly aspect of Anglesea will always prevent this county from ranking high in the list of corn-growing districts, but there is every reason why it should take a higher rank than it does now.

Along the coast of South Wales, especially of Cardigan and Pembroke, large quantities of barley are grown.* In each of these counties, and in Carnarvon, the percentage of barley is more than double that of wheat. Barley also ranks higher than wheat in Anglesea, Merioneth, and Carmarthen. This is not the case in any English county. In Westmoreland the proportions are equal (both 0·6 per cent.).

Cornwall and Devon contain a large proportion of high land ; but this area differs from all other mountainous regions of Great Britain, because the high land occurs in detached masses. In other districts a contour line, say of 1000 feet, can be traced continuously on the map for very long distances; being interrupted only by stream valleys, or by the lower points of the watershed. In the South-west of England it is not so ; the contour line of 1000 feet winds round the granitic areas of Dartmoor, St. Austell, &c., and the slaty rocks of North Devon and West Somerset. We have here, therefore, an excellent illustration of the dependence of contour upon geological structure. The same district also furnishes an illustration of the dependence of agriculture upon contour, perhaps the most striking to be found in England. The granitic (or "growan") soils, which are barren at high elevations, furnish some of the most prolific soils in Cornwall when they occur at lower levels.

Another district of high moorland is the eastern part of the North Riding of Yorkshire, where the Lower Oolitic rocks consist very largely of sandstone. A great part of these eastern moorlands is above the 1000 feet contour-line. Here, again, the relation between geology, contour, and agriculture, is well seen. In the South of England, where the Oolites consist largely of limestone, there is no moorland. Much of the Cotswolds consists of

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* In a wonderful district of Cardigan, barley (without other manure than sea-weed and sea-sand) has been grown for many years in succession. One field is mentioned as *having been cropped with barley for* 100 *years, without a single alteration.*—(C. S. Read, "Farming of South Wales,"—'Journal of the Royal Agricultural Society,' vol. x. p. 133.)

Down land, the grass of which greatly resembles that of the Chalk Downs, both having calcareous soils. The heights attained by the southern Oolite are much less than those of the North Riding; and even the high regions of the former are now invaded by the steam plough. Lincoln Heath holds an intermediate place between the northern and southern Oolites. It is for the most part sandy, and of moderate elevation. Few districts in England have undergone so remarkable a change in character. "Within living memory," writes Mr. Pusey in 1843, "Lincoln Heath was not only without culture, but without even a road." * It is now a continuous tract of good arable land.

The remaining areas of waste land are small in extent, although their aggregate acreage is considerable. The Malvern Hills, on the borders of Hereford and Worcester, rise to heights exceeding 1000 feet, but their total area is small. They consist of a ridge of Palæozoic rocks rising from beneath the newer formations. Charnwood Forest, in Leicestershire, is another mass of slaty rocks, formerly waste land, but now chiefly enclosed; the summit is only 850 feet above the sea.

Along the New Red Sandstone there is some waste land, chiefly on the conglomerate beds; but much of this is being enclosed. The neighbouring marls are of immense value for dressing this newly enclosed land. The Lower Greensand has a good deal of waste land, especially in Surrey. Here, again, there is a marl obtainable for improving the land, part of the neighbouring Gault Clay being sufficiently calcareous. The Tertiary beds afford a good deal of waste land, also in Surrey, overlying the Bagshot Sands. In Hampshire the New Forest lies on Tertiary sands; but here, too, marl is to be had. A large proportion of the waste lands of Dorset overlie the Tertiaries. The unreturned area of Surrey is very large. Much of this is included in the Metropolitan area, and land thus occupied is not at present separable from waste; but the main cause of the low position taken by Surrey amongst the English counties is the large area of sandy waste land it contains.

From this very superficial survey of the waste lands of England we see that the larger part is at a high level, and is not available for arable culture under our present climate. Should the climate of the high land of England become more suited to corn-growing, much of it will, in time, be reclaimed; but even now it might in large part be improved for pasturage, and not a little taken into arable culture. Of the smaller areas last noticed, there are none in which climate exerts a sufficiently unfavourable

* "On the Agricultural Improvements in Lincolnshire,"—'Journal of the Royal Agricultural Society,' vol. iv. p. 287.

influence to prevent arable culture. All the New Red Sandstone area is within the vertical range of wheat or barley. Of the Lower Greensand wastes in Surrey, and the much smaller areas of sandy wastes overlying the Wealden beds of Sussex, some may possibly be above the height at which wheat can now be grown with safety and profit, but even there crops of roots and barley will some day be raised. Speaking generally, then, we may say that the characteristic crops, on land yet to be reclaimed, will be turnips and barley, with, of course, a considerable acreage of oats. But the future increased production of wheat must be obtained mainly by improved cultivation of land already under the plough, or by breaking up inferior pasture on the heavier soils.

There is one important district of high land not noticed above, because little or none of it is, or ought to be, classed as waste land. The Chalk hills of England cover a large extent of country. Commencing on the Yorkshire coast at Flamborough Head, they range east and south through the East Riding, and south through Lincolnshire, forming the "Wolds" of those counties. In Norfolk they recommence, and occupy areas, more or less extensive, of the following counties: Suffolk, Essex, Cambridge, Herts, Bedford (a small tract only), Bucks, Oxford, Berks, Wilts, Dorset, Hants, Surrey, Sussex, and Kent. The summit of this range is Inkpen Beacon, 972 feet, at the meeting-point of Hants, Wilts, and Berks. Very frequently, in many of the counties, the summits exceed 800 feet. Where not covered by "Drift," this Chalk area is frequently in open pasture, or "Downs," and considerably increases the acreage of permanent pasture in some counties, but not in all. Kent, though having a large area of Chalk represented in Geological maps, has comparatively little Down land—the Chalk being much covered with drift. Where the Chalk is bare, as at the north-east part of the county, the land lies fairly low, and is almost wholly arable. The Isle of Thanet equals the north-west of Norfolk in fertility, and resembles it in produce. The somewhat large percentage of pasture in Kent is partly due to the alluvial tract of Romney Marsh, and partly to the alluvial meadows bordering the Thames. Hants, for a Chalk county, has a remarkably small percentage of pasture. Here, as in Kent, the Chalk is mostly covered by drift, and appears only on the sides of the hills. Surrey has only a small proportion of Chalk, and of this only the steep face of the escarpment is Down land. Sussex, on the other hand, has a large area of bare Chalk, forming the well-known South Downs. Very large quantities of sheep are kept here, and most of the farmers have some arable land, which is generally light and available for roots.

Concerning the low lying and more fully cultivated lands, there is not much that need be said here. Speaking generally, and disregarding for a moment the superficial beds, we may say that the more extensive beds of clay carry a large acreage of pasture, whilst the lighter or mixed soils have a preponderance of arable land. The Lias, Kimmeridge, and Oxford Clays are especially important. But through the greater part of the lower country north of the Thames and the estuary of the Severn, there is a widespread covering of Drift, which much obscures the main rock masses, and makes an ordinary Geological map almost useless for agricultural purposes. The stiffest clays are sometimes covered by thick and widespread sheets of gravel or sand, whilst the calcareous or sandy rocks may be covered by clay. Clay-drift over clay, or sand-drift over sand or limestone, has a less striking, but often a not less important influence in modifying the agricultural features of a country. The distribution and character of these various drifts are as yet too imperfectly known to allow of a general description, and any attempt to describe the agricultural geology of a district, ignoring these where they exist, would be absurd.

The importance of the drift-covering is nowhere more apparent than in the Eastern counties (Norfolk, Suffolk, and Essex); and there, too, the value of statistics in illustrating the distribution of crops is very well seen. The only striking physical feature of these counties is the Chalk hills, which, commencing on the Norfolk coast at Hunstanston, range south and south-west through their west and north-west borders. These hills attain heights of 600 and 650 feet in West Norfolk. Their western face is steep, and in Norfolk the Gault, Lower Greensand, and Kimmeridge Clay crop out from below them on their western side. These beds do not appear at the surface in Suffolk, but underlie the Fen district at the north-western corner. In Essex they do not crop out at all, Chalk being the lowest bed of that county. The boundary line between the Chalk and the overlying Tertiary beds is obscured by Drift, but it ranges from Ipswich, by Sudbury, to Bishops Stortford, in Herts, just off the Essex boundary. The Lower Tertiary beds, where seen, are of no great thickness; they are of most importance in the south of Essex, opposite Gravesend: here, too, Chalk reappears at the surface. The London Clay spreads over a wide area in Essex, where are also some small outlying patches of Bagshot Sands. The "Crag" appears on the east and south of Ipswich, and also to a smaller extent in Norfolk, chiefly near Norwich.

The whole of these beds are very largely covered by drift, chiefly of two kinds: a clay containing many fragments of chalk (Boulder Clay), and sands or gravels. Both of these belong to the Glacial series of geologists; but besides these there are deposits of gravel along the valleys, chiefly of the Thames and the Waveney.

The Boulder Clay covers a wide area in the centres of Essex and Suffolk, and also occurs, but to a smaller extent, in Norfolk. The Sands and Gravels occur along the eastern parts of the counties about Colchester, Ipswich, and thence northwards. They are of various degrees of fertility; the tract to the south and south-east of Ipswich, with the neighbouring tracts of Essex, being exceedingly fertile—the "Rich Loam" of Arthur Young. Further north the land is less productive; whilst again in the north-east of Norfolk there is good land. Some of the poorest land of the three counties is on these sands, in the north-east part of Suffolk and the adjacent parts of Norfolk.

The north-western part of Norfolk is occupied by bare chalk, or by chalk overlain by a chalky marl or clay; not the chalky Boulder Clay, above mentioned, but a highly calcareous marl, often burnt for lime. It is on this land, and on the adjacent bare chalk, that the best examples of Norfolk farming are found. There is no great area of bare chalk in Suffolk, it being mostly covered by the barren sands before mentioned (Young's "Western Sand"). There is some chalk land in the north-western corner of Essex.

The London Clay occupies the surface in the southern half of Essex. It forms a stiff clayey soil, compared with which that of the chalky Boulder Clay is only a "strong loam."

A comparison of the three counties, then, gives this result. In Norfolk there is only a comparatively small area of clay, and that is chiefly the chalky Boulder Clay. This forms the heaviest soil in Norfolk and Suffolk. In the latter county the area covered by this clay is larger than in Norfolk. In Essex, in addition to the fairly large area of Boulder Clay, there is a district formed by the stiffer London Clay. The land, as a whole, becomes stiffer in passing through the counties from north to south. The result of this arrangement of the drift soil is plainly seen in the percentage numbers. Of land not returned as under cultivation and pasture there is no great difference; the excess of the former in Essex being sufficiently accounted for by its including a part of the metropolitan area. In the fallow division there is a large increase going south. Rotation grasses decrease in the same proportion. Turnips are large in Norfolk, smaller in Suffolk, and least in Essex. Beans are large in Essex and Suffolk, small in Norfolk. Wheat increases regularly southwards; whilst Barley is least in Essex. The three counties so closely resemble each other in climate, and present so few important distinctions in contour, that this comparison is particularly useful. The proximity of Essex to London may, perhaps, partly account for the excess of oats in that county.*

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* For the foregoing brief description of the Drifts of the East of England I am indebted to a map (with memoir and sections) prepared by Mr. S. V. Wood,

The subject of Climate in its relation to Agriculture has been already discussed in this Journal; particularly in the papers of Messrs. Whitley,* Simpson,† and Russell.‡ Although data are yearly accumulating by which a more perfect knowledge of the climate of Great Britain will be obtained, these papers contain an account of the subject complete enough for practical purposes. On the subject of Rainfall an immense mass of information is now collecting, chiefly through the labours of Mr. G. J. Symons, to whom agriculturists will some day acknowledge themselves to be greatly indebted.

The successful practice of agriculture, as far as climate is concerned, depends, not upon the mean annual or winter temperature, but upon the *summer* temperature. There are two great classes of climate, "insular" and "continental," with every conceivable intermediate variety. In the former, there is no very great variation between the seasons as regards temperature. The other class, or continental climates, has very great variation between the highest temperature in summer and the lowest in winter. Insular climates are only found near large bodies of water, which receive heat or part with it much more slowly than land: hence the equality of temperature in the adjacent districts. The British Isles have an essentially insular climate; the variations being far less than in corresponding latitudes of Europe or America. The Gulf Stream, bringing a current of warm water from the equator, still further modifies our winter climate. The nearest approach to a continental climate in England is made by the eastern-central counties. Here the summer temperature is highest, and the winter temperature lowest.

The following are some of the most interesting results obtained by tabulating the statistics. First, as to *Corn crops.* There is a marked preponderance of them in the eastern part of England. But although the percentage numbers give the comparative corn-producing value of each county, as a whole, they do not at the first glance show the value of the *corn district* of each county. This distinction is important. Take Leicester, for example: here the quantity of pasture land, overlying the Lias, is enormous; and this reduces the county to a low place in the corn list. Yet, if its acreage under corn is calculated on the total *arable* land of the county, it is considerably above the average of the corn coun-

junior, and printed for private distribution by him in 1865. A comparison of this map with Young's 'Map of the Soils of Suffolk,' will show the very close agreement which exists between the distribution of the Drift-beds and the agricultural soils.

* 'On the Climate of the British Islands in its effect on Cultivation,' vol. xi. p. 1. 'On the Temperature of the Sea and its influence on the Climate and Agriculture of the British Isles,' (new series) vol. iv. p. 38.

† 'Climate of the British Islands in its effect on Cultivation,' vol. xi. p. 617.

‡ 'On the Influence of Climate on Cultivation,' vol. xx. pp. 158, 481.

ties. Leicester has 67·3 per cent. of its arable land under corn, whilst the average of the corn counties, so called, is only 60·4 per cent. Even the arable land of the northern counties carries a larger percentage of corn than would at first sight appear. The mean of the four is about 48 per cent.; and Northumberland has nearly 49 per cent.

By comparing the proportional area of each corn crop with the *total area under corn* we obtain the following result:—wheat is very evenly distributed. The most striking variations are in the Welsh counties bordering on the coast and in the north-west of England. The highest percentage is in Hereford, which has 55·4 per cent. of its corn area * under wheat; the lowest is Anglesea, which has only 7·2 per cent. The west-midland counties stand high. The district in which the percentage is largest is that which overlies the New Red Sandstone plain, and the Old Red Sandstone adjoining: the Carboniferous series is but feebly developed in that area.

The distribution of barley has been already referred to in part. Although requiring a high summer temperature, much higher than oats, it requires it for a much shorter time than wheat,—barley ripening rapidly. Hence the growth of barley on the western coasts, where its culture is controlled by *climate.* In the east of England the distribution of barley is regulated by *soil.* Norfolk stands highest amongst the English counties; next to that comes Rutland; then follow Suffolk, Cornwall, and Dorset.

Oats have a very large excess in the western counties, particularly in Westmoreland and Anglesea. Every county of Wales and the north-west of England which touches the coast, excepting Flint, has a high percentage. It is also high in all the northern counties, and again, though in a smaller degree, in the south-east of England.

The large preponderance of permanent pasture in the western counties is mainly due to the influence of climate: the moister air and more equable temperature being especially suited to grass; whilst it is adverse to the production of wheat. Through the eastern part of England, the varying proportions of pasture and corn depend mainly upon *soil.* Leicester, which has already been shown to be truly a wheat county, has its large area of rich pasture land upon the Lias Clays.† The other counties have an excess of pasture, pretty much in proportion to the area of bare Oolitic clays and Chalk Downs which they contain.

Of Potatoes there are high percentages in some of the western

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* By this is meant—not the area of Hereford within which corn is grown—but the sum of the acreage under all corn crops in 1869. This result is particularly worthy of note, as Hereford is not one of the corn counties.

† See Section No. 2.

counties,—especially in Lancashire, Cheshire, and Anglesea. The numbers are also high in Cardigan, Flint, and Carnarvon; all *coast counties.* The low lying lands near the sea in Cheshire and Lancashire have long been famous for this crop. Although large quantities are raised in parts of Cornwall, the effect upon the returns for the county generally is not apparent. Lincoln has the highest percentage amongst the eastern English counties.

Turnips, as would be expected, have a pretty constant relation to bare fallow; the numbers being generally in an inverse relation to each other. Fallow is most where the main fallow-crop is least. This inverse ratio of fallow and turnips appears to be more constant than the direct ratio of turnips and barley. Speaking generally, there is a pretty constant direct relation between fallow, mangold, and beans; all marking stiff soils. But mangold, being a stiff-land fallow-crop, partly takes the place of fallow. In Huntingdon the percentage of fallow is larger than in Cambridge, whilst the percentage of mangold is smaller. Huntingdon has, of all England, the highest percentage of fallow land, and all its productions mark it as pre-eminently a stiff-land county. This a Geological Map shows it to be. Nearly the whole area is occupied by Oxford Clay, in part overlain by Boulder Clay. The north-east part of the county includes some fenland, Whittlesea Mere, &c.

Hops take up a large area in Kent: next to which county come Hereford and Sussex. Besides these counties, it is only in Surrey, Hants, and Worcester, that hops are grown in any quantity. The unequal distribution of this crop is very remarkable, as there appears no sufficient reason why it should not be cultivated in many other districts. Everywhere below the Chalk escarpment, hops might probably be cultivated with great success; and the Vale of Pewsey, for instance, would seem especially suited for them.

## X.—*Annual Report of the Consulting Chemist for* 1870.

The publication of the periodical Reports of the Chemical Committee has awakened the agricultural community to the painful fact, that oilcakes, as well as artificial manures, are frequently sold in an adulterated condition, or at prices much exceeding their real commercial value.

The analytical work in 1870 has increased in an unprecedented degree, no doubt in consequence of the issue of these Reports.

Before 1868 the average number of analyses for members was about 330, for 1867 it amounted to 341. A considerable increase took place in 1868, when 432 analyses were made for members of the Society, and again in 1869, when 465 analyses were sent out from the laboratory. Notwithstanding this steady increase in the three preceding years, as many as 580 analyses have been referred to me during the past year, being the unprecedented increase of 115 analyses over the number sent out in 1869. The appended summary shows that a large number of guanos and artificial manures of the class of superphosphates were examined in 1870, as well as an unusually large number of oilcakes.

Comparatively few of the guanos were adulterated, but many were found damaged by sea-water and of inferior quality. On an average, the proportion of ammonia yielded by the guano analysed in 1870 little exceeded 14 per cent., and in several cases the proportion was less than 13 per cent.

It is to be hoped that the supply of guano from the Guanape Islands will turn out to be of a superior quality than has been anticipated.

I have recently made a number of analyses of Guanape guano for the Peruvian Government, and am glad to be able to report that nearly all the samples were much drier than those analysed in the preceding year. Although not equal in quality to the best Chincha Island guano of former years, the Guanape Island guanos recently analysed by me are about equal to the average quality of last year's importations of Peruvian guano. It remains to be seen whether Guanape guano, which no doubt will be sold as Peruvian, is uniform in character.

By far the greater number of artificial manures—such as special Wheat, Oat, Barley, Potato, and Grass manures—are mixtures of dissolved bones or superphosphates with ammoniacal salts, common salt, dried blood, nitrate of soda, and other nitrogenous fertilising materials. These manures are, therefore, grouped together with superphosphates. As many as 152 samples of superphosphates and similar manures were analysed by me in 1870.

Large sums of money are annually expended in the purchase of phosphatic manures, and as the quality of these manures varies exceedingly, and the actual price at which they are sold does not always correspond with the intrinsic value of the manure, it is highly desirable that purchasers of superphosphate or dissolved bones should buy these manures of a quality guaranteed by analysis. The following analyses of two superphosphates offered for sale in the same place, one at 6*l.* 3*s.* (cash) per ton, and the other at 4*l.* 3*s.*, afford a good illustration of the fact that a considerable saving may often be effected if the composition of rival superphosphates is determined previous to purchase :—

COMPOSITION OF TWO SUPERPHOSPHATES

| | **No. 1.** Sold at £6 3s. nett cash. | **No. 2.** Sold at £4 3s. nett cash. |
|---|---|---|
| Moisture | 15·38 | 18·92 |
| Water of combination and *Organic matter | 9·45 | 6·21 |
| Biphosphate of lime (mono-basic phosphate of lime) | 13·04 | 15·66 |
| Equal to bone phosphate (tri-basic phosphate of lime) rendered soluble by acid | (20·42) | (24·52) |
| Insoluble phosphates | 13·25 | 5·14 |
| Sulphate of lime | 43·10 | 47·37 |
| Alkaline salts and magnesia | 1·03 | ·86 |
| Insoluble siliceous matter | 4·75 | 5·84 |
| | 100·00 | 100·00 |
| * Containing nitrogen | ·33 | ·08 |
| Equal to ammonia | ·40 | ·09 |

These two superphosphates have nearly the same commercial value. No. 1 contains a little bone; No. 2 is a purely mineral superphosphate. I should feel disposed to give from 5*s.* to 7*s.* 6*d.* more per ton for No. 1 than for No. 2. The sample marked No 1 is rather dear at 6*l.* 3*s.*, nett cash, and No. 2 cheap at 4*l.* 3*s.*, nett cash.

Of the 32 samples of bone dust, not one was adulterated, which clearly shows that the unsparing publication of the names and addresses of dealers in adulterated bone dust has had an excellent effect.

With respect to feeding cakes, I regret to have to report that linseed cake is still sold, as genuine and pure, which is largely mixed with rice meal, oat dust, pollard, mill-sweepings, earth-nut cake, cotton cake, and sometimes with more objectionable materials.

Linseed cake, when mixed with rice dust or pollard, is generally comparatively poor in flesh-forming matters, as will be seen by the following analysis of a sample of cake which was found adulterated with oat dust and similar starchy mill-refuse:—

| | |
|---|---|
| Moisture | 14·72 |
| Oil | 12·04 |
| *Albuminous compounds (flesh-forming matters) | 23·25 |
| Mucilage, sugar, and digestible fibre | 35·57 |
| Woody fibre (cellulose) | 8·24 |
| Mineral matter (ash) | 6·18 |
| | 100·00 |
| * Containing nitrogen | 3·72 |

It is, however, quite possible to supplement the deficiency of flesh-forming matters in a cake adulterated with starchy mill-refuse by incorporating with the cake at the same time a meal richer in nitrogen than pure linseed cake. Decorticated nut cake or decorticated cotton cake, being very rich in nitrogen, is sometimes used for that purpose, and the blending of the starchy matters poor in nitrogen with others abounding in that element is so skilfully performed by some notorious cake-crushers, that a cake is produced having almost precisely the same proximate composition as pure linseed cake. It is well to bear this in mind, for the fact that an oilcake on analysis shows the same percentage of oil, flesh-forming matters, woody fibre, &c., as pure linseed cake, is no proof that it may not be, after all, a mixed cake, and be composed of materials inferior in taste, digestibility, and condition to pure linseed cake.

Excellent decorticated cotton cake is sent over to England from America at the present time. When broken up fine, or, better still, when reduced to a coarse powder, decorticated cotton cake is a most valuable feeding cake for store cattle, when these have to be kept chiefly upon straw-chaff and a few roots. A mixture of finely ground cotton cake or meal, linseed cake, and Indian Corn or Palm-nut meal in equal proportions, is also well adapted for fattening stock; and for milk cows, good decorticated cotton cake is preferred, I believe justly, to the best linseed cake.

Green German rape, or Rubsen cake, continues to be scarce, and ordinary rape cake is often so full of mustard that it endangers the life of the animals to which it is freely given. Common rape cake should therefore never be given to stock without having been previously examined for mustard. Most of the samples of common rape cake sent for examination I found utterly unfit for feeding purposes, and I would especially warn the members of the Society not to buy a variety of rape cake which has recently found its way into commerce under the name of yellow rape cake. Several samples of this species of cake I found so pungent that, in my opinion, less than half a cake would in all probability kill an ox.

Satisfactory reports of field experiments on root crops, on potatoes, and on grass land, have been received, and will form the subject of future contributions to the 'Journal.' I may observe, however, in this place, that potash-salts have again proved to be very useful, in 1870, for potatoes and mangolds as well as for clover seeds; and not only when used upon light sandy soils, but likewise when applied in conjunction with superphosphate to poor clay land.

The following are the papers contributed by me to the pages of the February and August numbers of the 'Journal' for 1870:—

1. Field Experiments on Mangolds.
2. On Beetroot Pulp.
3. On a peculiar kind of Swedish Whey-cheese, and on Norwegian Goat's-milk Cheese.

4. Field Experiments on Potatoes.
5. On the Composition and practical value of several samples of Native Guano prepared by the "A.B.C." process of the Native Guano Company.

*Analyses made for the Members of the Royal Agricultural Society, December,* 1869, *to December,* 1870.

| | |
|---|---|
| Guanos (natural) | 64 |
| Artificial guanos | 13 |
| Superphosphates, dissolved bones, wheat manures, and similar artificial manures | 152 |
| Bone dust | 32 |
| Refuse manures | 27 |
| Nitrate of soda, sulphate of ammonia, and potash salts | 31 |
| Marls, limestones, and other minerals | 20 |
| Soils | 14 |
| Oilcakes | 154 |
| Feeding meals | 18 |
| Vegetable productions | 13 |
| Disinfectants | 2 |
| Waters | 30 |
| Sewage | 3 |
| Cider | 1 |
| Treacle | 3 |
| Examinations for poisons | 3 |
| Total | 580 |

(Signed) AUGUSTUS VOELCKER, F.R.S.

## XI.—*Quarterly Reports of the Chemical Committee.*

### DECEMBER.

DR. VOELCKER reports the case of a manure sent to him for analysis, by Mr. C. S. Read, M.P., under the name of Holman's Blood Manure. This manure was found to have the following composition:—

| | |
|---|---|
| Moisture | 30·92 |
| *Organic matter | 22·02 |
| Tribasic phosphate of lime (bone phosphate) | 5·06 |
| Oxides of iron and alumina | 5·10 |
| Sulphate and little carbonate of lime | 18·11 |
| Alkaline salts and magnesia (chiefly common salt) | 6·06 |
| Insoluble siliceous matter | 12·73 |
| | 100·00 |
| * Containing nitrogen | 1·91 |
| Equal to ammonia | 2·32 |

This manure was manufactured by N. R. Holman, manufacturer and dealer in agricultural tillages, Newhall Mills, Attercliffe, and Sheffield. The price was 6*l.* a ton, delivered carriage-paid to any station within 50 miles of Sheffield.

In a trade circular, Mr. Holman speaks of his blood manure as having acquired a world-famous reputation as one of the best and cheapest tillages, and invites his friends and all consumers to an inspection of the numerous testimonials with which he has been favoured. He likewise gives an analysis, of which the following is a copy :—

*Analysis of Blood Manure.*

Medical Institution, Sheffield.

A sample of artificial manure, received from Mr. Holman, was found, on analysis, to contain in 100 parts :—

| | |
|---|---|
| Moisture and organic matters, containing 17·72 of ammonia, equivalent to 14·58 of nitrogen .. | 64·40 |
| Insoluble silicate and sulphate of lime .. .. .. | 11·00 |
| Phosphate of lime, equivalent to 4·34 phosphoric acid .. .. .. .. .. .. .. .. .. | 9·40 |
| Oxides of iron and alumina .. .. .. .. .. | 2·35 |
| Carbonate of lime .. .. .. .. .. .. .. | 5·00 |
| Carbonate of magnesia .. .. .. .. .. .. | 1·80 |
| Alkaline salts (chlorides and sulphates) .. .. .. | 4·45 |
| Alkaline salts (soluble silicates) .. .. .. .. | 1·60 |
| | 100·00 |

March 1, 1845. (Signed) W. Bingley, Ph. D., F.C.S.

In this analysis, the manure is represented to contain more ammonia than the best samples of Peruvian guano. Supposing the sample analysed by Dr. Bingley contained only 10 per cent. of moisture, and not 32, like the sample sent to me by Mr. Read, I am at a loss to understand how the remaining 54·4 of organic matter could have yielded 17·72 of ammonia.

The amount of the richest available nitrogenous organic matter, or even of pure sulphate of ammonia, produces considerably less ammonia than 17·72 per cent. However, presuming the analysis to be correct, the question which would naturally be asked by any intelligent farmer who knows something of the market price of fertilizing materials is: Is it probable that a manure manufacturer will sell an artificial manure at 6*l.* when he can get for the ammonia alone, which is represented to be present in a ton of the manure, over 10*l.*?

Attention is directed to this analysis, because in many instances farmers are led away by printed analyses, which many regard as a sufficient guarantee of the good quality of the manure to which they refer. Whenever an analysis is shown, when an artificial manure is offered for sale, and such an analysis should prove to be satisfactory, we would advise the intending purchaser to obtain in the first place a statement in writing that the bulk of the manure, on delivery, shall be equal in composition with that given in the printed analysis; and, in the next place, he should draw from the various parts of the bulk several pounds of the manure, mix all the samples well together, and forward such a fairly drawn and prepared average to a competent and trustworthy agricultural chemist for analysis. Neither printed analyses nor printed testimonials in themselves have any practical value, and both are often used for the purpose of deception.

The sample of Holman's Blood Manure, analysed by Dr. Voelcker, it will be seen, instead of 17·72 per cent. of ammonia, as represented in the printed analysis, yielded only $2\frac{1}{3}$ per cent.; and instead of 9·4 per cent. of phosphate of lime, only 5 per cent.; and, besides a large proportion of sand and useless earthy matter, it contained 31 per cent. of water in round numbers. Such a manure would be dear at 2*l.* 5*s.*, and Dr. Voelcker would not recommend any one to buy it at 2*l.* a ton.

Mr. C. S. Read has kindly favoured Dr. Voelcker with the subjoined letter, and given him leave to lay it before the Committee:—

"*Holman's Manure.*

"Honingham Thorpe, Norwich, November 16, 1870.

"My dear Sir,—On receipt of your analysis of Mr. Holman's manure, I wrote to him, stating 'that I certainly should not pay for the manure.' At Mr. Holman's earnest request I did not send the manure back, but agreed to his proposition to 'pay whatever it was worth, according to the crop it produced.' I thought that it would be a good opportunity of testing the soundness of your analysis, and accordingly sowed 4 cwt. per acre of this manure and two different kinds of superphosphates, both costing the same price as Mr. Holman charged for his manure, viz., 6*l.* per ton. They were applied for white turnips after peas, and a strip of land was left, upon which no manure of any kind was sown. The two superphosphates have grown a nice little crop of turnips, but I can see no difference at all between the unmanured plot and Mr. Holman's blood manure. I ought to add, that Mr. Holman states, the 'second crop is equally benefited as the first.' I hope, for his sake and mine, it will be *more so*,

"Yours faithfully,

"Dr. Voelcker." "Clare Sewell Read.

The Committee would call attention to the frequent inferiority of certain manures sold under the name of fish-and-blood manures. A sample of such fish-and-blood manure (sent by Mr. N. N. Young, Orlingbury, Wellingboro'), had the following composition:—

| | |
|---|---|
| Moisture | 18·86 |
| *Organic matter | 25·63 |
| Oxides of iron and alumina | 4·43 |
| Phosphate of lime | 1·92 |
| Sulphate and carbonate of lime | 32·72 |
| Alkaline salts and magnesia (chiefly common salt) | 3·69 |
| Insoluble siliceous matter (sand) | 12·75 |
| | 100·00 |
| * Containing nitrogen | 1·20 |
| Equal to ammonia | 1·45 |

This so-called fish-and-blood manure is very poor in phosphate of lime; and as dry blood and flesh yield about 16 per cent. of ammonia on decomposition, the sample analysed, producing not quite 1½ per cent. of ammonia, cannot have contained much blood or fish. It is principally composed of carbonate of lime, earth, and sand, mixed with various kinds of organic refuse matters, a little blood, some fishery salt, and a few fish-bones. Such a manure is barely worth 25*s.* a ton, but was sold at 6*l.* a ton.

With respect to feeding-cakes, Dr. Voelcker reports the case of a linseed cake, which was sold to Mr. Jas. J. Bibby, Hardwicke Grange, Shrewsbury, branded "W H Genuine." This cake he found to be adulterated with earth-nut cake, and to be of the following composition:—

| | |
|---|---|
| Moisture .. .. .. .. .. .. .. .. .. | 9·20 |
| Oil .. .. .. .. .. .. .. .. .. .. | 9·90 |
| *Albuminous compounds (flesh-forming matters) .. | 26·18 |
| Mucilage, sugar, and digestible fibre .. .. .. | 30·84 |
| Woody fibre (cellulose) .. .. .. .. .. .. | 17·36 |
| Mineral matter (ash) .. .. .. .. .. .. | 6·52 |
| | 100·00 |
| *Containing nitrogen .. .. .. .. .. | 4·19 |

In answer to an inquiry for particulars of the purchase, Mr. Bibby wrote that he bought a lot of 5 tons in July, from Messrs. Fields' Mercantile Company (Limited), Shrewsbury, as a genuine cake, at 11*l.* 7*s.* 6*d.* per ton, delivered. Messrs. Fields, the dealers, state that the maker is W. Holt, of Hull.

The following correspondence ensued:—

"Hardwicke Grange, Shrewsbury, November 2, 1870.

"Dear Sir,—I duly received yours of the 18th and 21st ult., with analysis and report on a sample of adulterated linseed cake branded 'W H Genuine,' and, as requested, I write to inform you of the particulars of the purchase.

"The sample is from a lot of 5 tons bought in July from Fields' Mercantile Company (Limited), Shrewsbury, as a genuine cake, price 11*l.* 7*s.* 6*d.* per ton, delivered—'Earles and King's' Liverpool cake being then 12*l.* 7*s.* 6*d.* per ton, delivered. Messrs. Fields, who are dealers, inform me that the maker is W. Holt, Hull. I have written for an explanation, and annex a copy of my letter and of the maker's reply, &c.

"I am, dear Sir, yours faithfully,

"Jas. J. Bibby (*pro* Jos. Winchester).

"Dr. Voelcker, London, E.C."

(*Copy.*)

"Grinshill, Shrewsbury, October 26, 1870.

"Gentlemen,—In July last I bought from you a parcel of 5 tons of linseed cake, branded 'W H Genuine,' which was described by your manager and sold as a genuine linseed cake. I regret to say, however, that the analysis of a sample by Dr. Voelcker shows the cake to be adulterated, and, of course, inferior in quality to genuine linseed cake. I enclose an extract from Dr. Voelcker's letter, and a copy of his analysis; and waiting your reply.

"I am, yours faithfully,

"JOSEPH WINCHESTER.

"Messrs. Fields' Mercantile Company, Shrewsbury."

(*Copy.*)

"*From Fields' Mercantile Company to Mr. Jos. Winchester, Grinshill.*

"Shrewsbury, October 31, 1870.

"We beg to hand you a copy of the letter which we have received from the crushers at Hull, and we trust that it will be acceptable and satisfactory."

(*Copy of Enclosure with the above.*)

"Hull, October 28, 1870.

"DEAR SIRS,—In reply to your favour of yesterday, enclosing 'copy of analysis,' &c., of 5 tons linseed cakes marked 'W & H Genuine,' and supplied to you in July last, we beg to state that the term 'genuine,' as a trade brand, is not understood to signify a pure cake, which, as you are aware, is always sold at 20*s*. to 25*s*. per ton more money; and at the time we sold you the 5 tons referred to we were selling pure cakes at 22*s*. 6*d*. more. The difference between 'pure' and 'genuine' cake, when these brands were first introduced, was simply that the former was made from the finest seed imported, and the latter from a secondary or inferior growth, containing a considerable percentage of non-feeding admixture, such as hay-seeds, &c., and generally more or less grit, which washers have found great difficulty in screening from the seed; in fact, it could not be entirely removed. For some time past, therefore, it has been the general custom of the trade to use fine clean seed also for 'genuine' cakes, reducing the price by the admixture of a small proportion of other good feeding stuff, thus producing what we believe to be a better feeding cake at the same cost. We may add, that we have always supplied to our friends a cake of quality at least equal to any on our market at the same price; and the analysis you have sent us shows that the cake sent you was of a good feeding quality, and, we believe, for feeding purposes, if anything a little cheaper in proportion than a 'pure' cake at 20*s*. to 25*s*. per ton more money.

"Messrs. Fields' Mercantile Company."

(*Copy of Reply to the foregoing.*)

"Grinshill, Shrewsbury, November 2, 1870.

"GENTLEMEN,—I have to acknowledge the receipt of yours of 31st ult., enclosing copy of a letter from the manufacturers of the cake bought from you in July, in reply to the complaint of its being adulterated.

"As the cake was not only sold as branded 'Genuine,' but as a 'Genuine Cake,' I do not consider the explanation at all satisfactory. No trade usage can justify an adulterated cake being sold as 'genuine.'

"I was not aware, till your secretary informed me on Saturday last, that the makers quoted for 'pure' cake a higher price than 'genuine;' and I consider that this fact being known to you ought to have led to inquiries before the sale as a pure cake of that branded 'Genuine.'

"I am, Gentlemen, yours faithfully,

"JOSEPH WINCHESTER.

"P.S.—I send a copy of the correspondence to Dr. Voelcker.

"Messrs. Fields' Mercantile Company, Shrewsbury."

Two other cases, where cakes were sold as pure were found on analysis to be adulterated—one with oat-dust and the other with earth-nut cake and beech-nut cake, came under Dr. Voelcker's notice; but the Committee think that the evidence in these instances, though sufficiently convincing, might not have the requisite legal force to warrant the publication of the names of the vendors.

## March.

In the months of December, January, and February, comparatively few purchases of artificial manures are made by agriculturists, and in consequence a much smaller number of samples are sent to the laboratory for examination than during the spring quarter. Dr. Voelcker has, however, reported on the following cases:—

1. A sample of artificial manure was sent for examination by Mr. Catchpool, Faring Bury, Kelvedon, Essex, with the request to have its value ascertained in comparison with best Peruvian guano. This manure was found to have the following composition:—

| | |
|---|---|
| Moisture | 9·65 |
| *Organic matter | 13·54 |
| Phosphate of lime | 4·99 |
| Carbonate and sulphate of lime | 48·77 |
| Alkaline salts and magnesia (principally common salt) | 3·22 |
| Insoluble siliceous matter (sand) | 19·83 |
| | 100·00 |

| | |
|---|---|
| * Containing nitrogen | 1·12 |
| Equal to ammonia | 1·36 |

The large quantity of carbonate of lime (chalk), sulphate of lime (gypsum), and sand, amounting, together with the moisture in the manure, to rather more than three-quarters of the weight, leaves but little room for the more valuable fertilising consituents of manure. Making no deduction for the bulky, cheap, or absolutely useless matters, for which carriage has to be paid, the intrinsic commercial value of the phosphates and the nitrogenous organic matters (yielding only $1\frac{1}{3}$ per cent. of ammonia) does not amount to much, and the manure certainly would be dear at 2*l.* a ton in comparison with the price at which Peruvian guano is sold.

Dr. Voelcker has written for information with respect to the vendor of this manure, and the price at which it was sold, but has not received an answer as yet.

2. The subjoined analysis of four samples of bone-manure show the great differences in the quality and value of different samples:—

COMPOSITION OF FOUR SAMPLES OF BONE-MANURE SOLD IN CHESHIRE.

| | No. 1. | No. 2. | No. 3. | No. 4. |
|---|---|---|---|---|
| Moisture .. .. .. .. .. | 25·04 | 21·54 | 9·28 | 20·42 |
| *Organic matter .. .. .. .. | 15·28 | 19·75 | 31·23 | 13·74 |
| Phosphate of lime (bone-earth) | 34·10 | 47·72 | 45·49 | 48·01 |
| Sulphate and carbonate of lime | 13·44 | 7·27 | 9·32 | 6·43 |
| Alkaline salts and magnesia .. | 4·01 | | | 3·22 |
| Insoluble siliceous matter (sand) | 8·13 | 3·72 | 4·68 | 8·13 |
| | 100·00 | 100·00 | 100·00 | 100·00 |
| * Containing nitrogen .. .. .. .. .. | 1·37 | 1·95 | 3·54 | 1·34 |
| Equal to ammonia .. .. .. .. .. | 1·66 | 2·40 | 4·29 | 1·62 |

Nos. 1, 2, and 4 are boiled refuse bones of glue makers.

No. 3 is genuine raw bone dust, not very clean, but on the whole, of fair average quality.

No. 1, boiled bones, contains one-fourth of its weight of water, and contains more sulphate of lime, salt, and sand than genuine boiled bone dust.

Nos. 2 and 4 are too wet, but they are otherwise genuine boiled bones; and No. 4 contains rather more sand than it ought.

Assuming No. 3 to cost 8*l.* a ton, the comparative money value of these four samples will be:—No. 1, 5*l.* a ton; No. 2, 6*l.* 15*s.* a ton; No. 3, 8*l.* a ton; No. 4, 6*l.* 6*s.* a ton.*

A sample of guano was sent for analysis by Mr. Samuel Fitton, Cheerbrock Farm, Nantwich, who stated that he bought the guano from Messrs. W. Shaw and Co., Liverpool, at 14*l.* 10*s.* per ton, delivered at a station near Nantwich (less 5 per cent. for cash), guaranteed pure.

The analysis showed that the guano was much adulterated with sand, gypsum, and earthy matter, and in consequence

---

* The samples 1, 2, 3 were sent on February 2 by Mr. Leather, Delamere Lodge, Northwich, and on the 15th the following letter was received from him with sample 4:—

"Dear Sir,—The sample of boiled bones recently analysed by you for me was given to me as genuine by Mr. Robt. Ashworth, of Frodsham. On showing him your analysis, he stated that the sample of bones given me was taken from 'sweepings,' and was not a fair sample. This he appeared to think would explain the large proportion of water as well as sand. He has given me, therefore, a fresh sample, which I forward to you to-day for analysis.

"Yours faithfully,

"SIMEON LEATHER."

In a subsequent letter Mr. Leather gives the following as the prices of the several samples, and the names of the dealers who supplied them:—

| | £ | s. | d. |
|---|---|---|---|
| No. 1. J. Ashworth, Frodsham .. .. .. .. .. .. .. | 6 | 7 | 6 |
| 2. Runcorn Bone Works .. .. .. .. .. .. .. | 6 | 15 | 0 |
| 3. J. Ashworth, Frodsham .. .. .. .. .. .. .. | 8 | 0 | 0 |
| 4. Do. Do. .. .. .. .. .. .. .. | 6 | 5 | 0 |

yielded much less ammonia and phosphates than genuine Peruvian guano.

As far as could be judged, this adulterated guano corresponded to a mixture of about three-fifths of genuine guano by weight, and two-fifths of yellow sandy loam, and similar adulterating materials; and in comparison with genuine Peruvian guano, selling at 14*l.* 10*s.* a ton, it was not worth more than 8*l.* 14*s.* per ton.

In reply to Dr. Voelcker's inquiries, Mr. Fitton wrote as follows:—

"I am sorry the guano is not pure; I enclose the invoice. I bought it from a salesman of Messrs. W. Shaw & Co., his name is Oakes. I told him distinctly when I bought it from him that I should get it analysed. He said he should be glad if I would, as it was a pure guano, and it would be to his advantage."

On receipt of Dr. Voelcker's report, Mr. Fitton communicated the result of his examination to the vendors, and in return received the following letter:—

"The Old Hall, 39, Old Hall Street, Liverpool.

"DEAR SIR,—We have just discovered that our shipper has made a most egregious error in sending you *Upper* Peruvian instead of Peruvian Guano. Will you therefore please return it at once, as the whole cargo is ordered for transhipment. Will you also kindly see Mr. Bowker, and request him to return his also. Will send the same quantity of Peruvian as soon as possible.

"We are, dear sir, your obedient servants,

*pro* William Shaw and Co.,

"R. OAKES.

"P.S.—Shall be in Cheshire to-morrow, and will call at your place."

The guano was returned by Mr. Fitton, and genuine Peruvian sent instead of the so-called Upper-Peruvian.

4. Dr. Voelcker again directs attention to the variable quality of genuine Peruvian guano. Peruvian guano, he regrets to say, appears to be nearly exhausted, and recent importations not only contain a considerable proportion of large stones and fragments of rock, but also fine sand, which cannot be readily detected without a chemical examination. The following analysis of a sample of Peruvian guano affords a good illustration of its increasing deterioration:—

*Composition of a Sample of Guano sent by Mr. John Baker, Hargrave, near Kimbolton.*

| | |
|---|---|
| Moisture | 11·22 |
| *Organic matter and salts of ammonia | 38·89 |
| Phosphate of lime and magnesia (bone-earth) | 23·92 |
| Alkaline salts | 7·73 |
| Insoluble silicious matter (rock and sand) | 18·24 |
| | 100·00 |

| | |
|---|---|
| * Containing nitrogen | 8·75 |
| Equal to ammonia | 10·62 |

This guano is genuine Peruvian guano, but it will be seen that it contains a large proportion of the *débris* of the rock on which the guano was deposited, and yielded little more than $10\frac{1}{2}$ per cent. of ammonia, or only about two-thirds the amount of ammonia which Peruvian guano of fair average quality used to contain.

Messrs. Thompson, Bonar, & Co., the Peruvian Government agents for the sale of guano, have recently acquainted their customers that they have no more Chincha Island guano for sale in London, and they offer now Guanape Island guano at a reduced price, and quote the price of Government Peruvian guano at 12*l.* per ton.

Guanape guano, as far as Dr. Voelcker's experience goes, varies in composition to a greater extent than Peruvian, and the better samples are not equal in value to Peruvian guano. It is, therefore, highly desirable that purchasers of Guanape Island guano or Peruvian Government guano should know what the quality is of the guano that is offered at a reduced price, and they are strongly advised to insist upon being supplied by the dealer with an analysis guaranteeing the quality of the particular cargo of guano which is offered for sale. Like other guanos varying in composition, Guanape guano should not be sold at a uniform price, but at rates corresponding with the intrinsic commercial value of different lots, which can only be ascertained by an analysis that may be fairly expected to be presented by the dealer to intending purchasers.

5. Rape cake is frequently so full of wild Mustard that it cannot be safely used for feeding purposes.

Several cases of rape cake quite unfit for feeding purposes were brought under Dr. Voelcker's notice during the last quarter; and in one instance such cake did serious mischief to the cattle which were fed upon it, being made from seed largely contaminated with wild Mustard seed.*

6. Cases of adulterated linseed cakes have been referred to Dr. Voelcker lately from the neighbourhood of Market Deeping and Hertford, in which beech-nut and earth-nut cake were found in cakes with the mark of the maker indicative of the purity of the article.

In these cases he made inquiries respecting the names of the dealers, but experienced unwillingness on the part of the buyer to have publicity given to the particulars, which deserve exposure.

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* I analysed four pieces of this cake for Mr. Percival Harlam, of Gilnow House, Bolton, who had bought it from Mr. J. Andrew, corn broker, Liverpool.—A. V.

JOURNAL

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ROYAL AGRICULTURAL SOCIETY
OF ENGLAND.

## XII.—*Report of the Farm-Prize Competition*, 1871. By JOHN WHEATLEY, Neswick, Driffield.

THE system of giving prizes for the best-managed farms in the districts of the country meetings, first originated by Mr. Mason last year, is well calculated to illustrate the peculiar practices of different districts, which, if properly registered in the 'Journal,' would eventually form a collection of valuable facts. At the suggestion of Mr. H. W. Keary, who reported on the Oxford competition, the landowners of Shropshire and Staffordshire, encouraged the Society to repeat the experiment this year, and subscribed the two first prizes of one hundred pounds each for the best specimen of arable and dairy farming; and the Society undertook to provide a further sum of one hundred pounds for two second prizes of fifty pounds each, to appoint the Judges, and to pay all the expenses attending the inspection and awards.* In addition to the first prizes, a further sum of fifty pounds was placed at the disposal of the Judges by the local subscribers, to reward any special feature of excellence in the management of any of the competing farms.

It must be gratifying both to the landowners of the district and to the Society that their efforts were so well supported by the farmers, especially in the arable class, in which no less than twenty-three entries were made. The dairy-farming, though an important interest, and occupying a considerable portion of the

* The following is a list of the subscribing landowners in Shropshire and Staffordshire:—The Duke of Cleveland, the Duke of Sutherland, the Marquis of Anglesey, the Earl of Bradford, the Earl Brownlow, the Earl of Dartmouth, the Earl Granville, the Earl of Harrowby, the Earl of Lichfield, the Earl of Powis, the Earl of Shrewsbury, the Viscount Hill, Lord Acton, Lord Bagot, Lord Berwick, Lord Forester, Lord Hatherton, Lord Vernon, Lord Wenlock, Lord Wrottesley, W. O. Foster, Esq., H. F. Meynell Ingram, Esq., J. Pritchard, Esq., the Rev. Walter Sneyd, Major Thorneycroft, the Rev. F. W. Whitmore.

area of competition, was not so well represented; and it is a matter of regret that many farms which have a considerable reputation were not entered.

In Mr. Keary's Report of the Farm Competition of 1870, the unfavourable character of the spring, as affecting the appearance of the crops, was dwelt upon; and we have no doubt that, in such an unusually dry summer, local showers would materially affect the relative appearance of some crops. We had to deal with more favourable conditions, inasmuch as the competing farms were pretty much in the same position as regards the influence of climate.

It may be as well to state that the following were the conditions under which the prizes were awarded:—

1. General management with a view to profit.
2. Productiveness of crops.
3. Goodness and suitability of live stock.
4. Management of grass-land.
5. State of gates, fences, roads, and general neatness.

In addition to the above, we were instructed, in the case of the dairy farms, to pay special attention to the management of the produce, as well as the cleanliness of the dairy.

Armed with these instructions, we commenced our first inspection on the 15th day of May, completing the same on the 28th; and having given to each case a most careful consideration, we were enabled to separate the better specimens for a final review, which we carried out during the week preceding the opening of the Society's Meeting at Wolverhampton. Our plan of operation was, first to go over the whole farm, note the appearance of the crops, condition of the land, state of fences and buildings. The live stock were then inspected, and, finally, answers were requested to a series of questions, the replies to which are, to some extent, embodied in the following Report.

Our Awards were as follow:—

*For the best-managed Arable Farm.*—First Prize, of 100*l.*, offered by the landowners in Staffordshire and Shropshire, to Mr. George Townsend Forester, of High Ercall, Wellington, Salop. Second Prize, of 50*l.*, offered by the Society, to Mr. Thomas Winterton, Alrewas Hays, Lichfield. Highly commended, and a special prize of 25*l.*, given by the subscribers, to Mr. William Brewster, Balderton Hall, Middle, Wem, Salop, for his successful management of good land. Highly commended, and a special prize of 25*l.*, given by the subscribers, to Mrs. Elizabeth Sankey, of Bratton Farm, Wellington, Salop, in recognition of her profitable management. Highly commended, the farms occupied by Mr. George Anderson May, of Elford Park, Tamworth, and Mr. Charles Reynold Keeling, of Yew Tree Farm, Penkridge. Commended, the farms occupied by Mr. John Glover, Bangley, Tamworth, and Mr. Edward White, of Knowle House, Lichfield.

*For the best-managed Dairy Farm.*—First Prize, 100*l.*, offered by the landowners in Staffordshire and Shropshire, to Mr. John Clay, Kinsale, Oswestry. Second Prize, 50*l.*, offered by the Society, to Mr. Matthew Walker, of Stockley Park, Anslow, Burton-on-Trent.

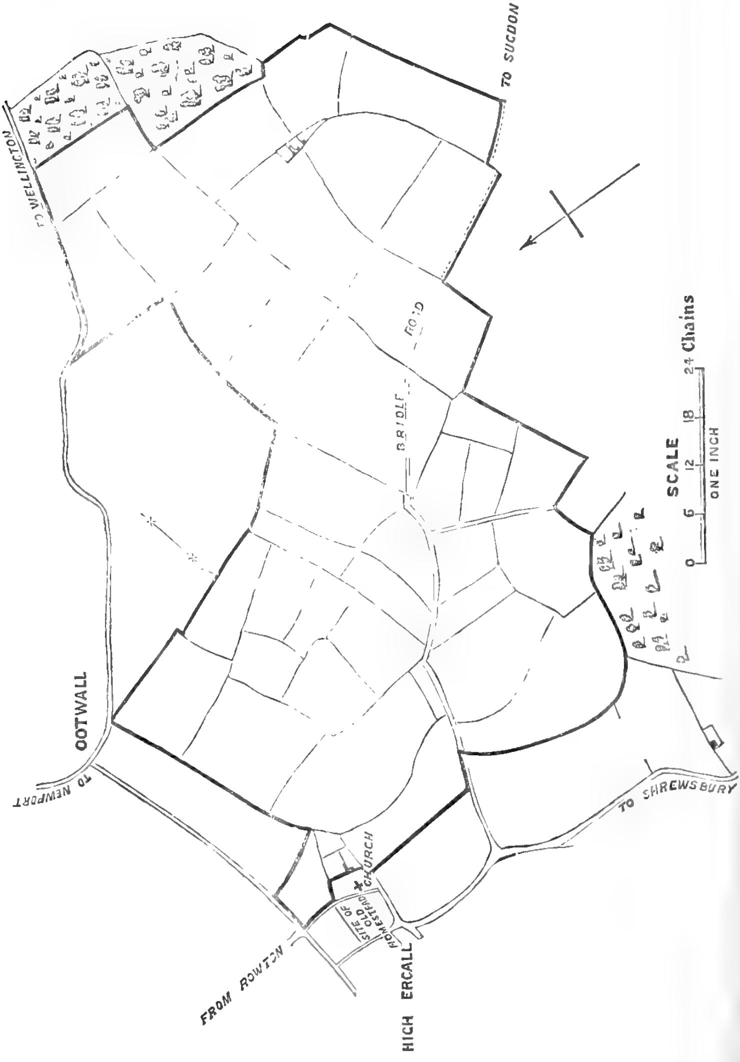
## First-Prize Farm.

This farm, occupied by Mr. George Townsend Forester, as a yearly tenant, is composed of 300 acres of arable land, and 140 of grass, and is situated five miles north-west from Wellington, and eight miles north of Shrewsbury. About half the farm has a substratum of sand and sandy loam, with occasional beds of rock and marly clay; the remainder is upon a subsoil of clay, varying in texture, and intersected by sand-veins, containing a large amount of water, worn pebbles of various sizes, and fragments of rock. One of the largest specimens shown us in the garden was between four and five feet in length, and two feet in diameter. They vary from the above size down to that of a hen's egg. This part of the farm was ploughed originally in high-backed lands, but is now level. The surface-soil is of medium quality, betwixt light and heavy. Mr. Forester entered upon the farm in 1841. The improvements that have been made, principally by the removal of internal fences, will be best understood by a glance at the accompanying maps (pp. 300 and 301), which represent the farm in 1841, and at the present time. It will be observed that in 1841 the homestead and farm-buildings were at one extremity, and in the village of High Ercall; and the fields were small inclosures with crooked fences. The land was also suffering from the want of drainage.

At Mr. Forester's request buildings were erected in a central position by the landlord (His Grace the Duke of Cleveland), suitable roads, of which the farm was previously entirely deficient, being made by Mr. Forester at his own cost. The tenant also laid out and reared the new lines of quickset fencing, materials in the rough being supplied by the landlord.

The perfect cleanliness and excellent condition of the fences bear evidence to the attention that has been paid to this important detail. Once a year the fence-bottoms are thoroughly cleaned, and the fences are trimmed. We do not, however, approve of the form in which the fences are grown. The base is not sufficiently broad for the apex, consequently the drip from the latter has already weakened, and must eventually greatly injure, the lower part of the fence. The drainage of 273 acres of the farm was done by the tenant, the landlord finding tiles. The

*Fig.* 1.—*Plan of Sherlow Farm, Parish of High Ercall, in the year* 1841.



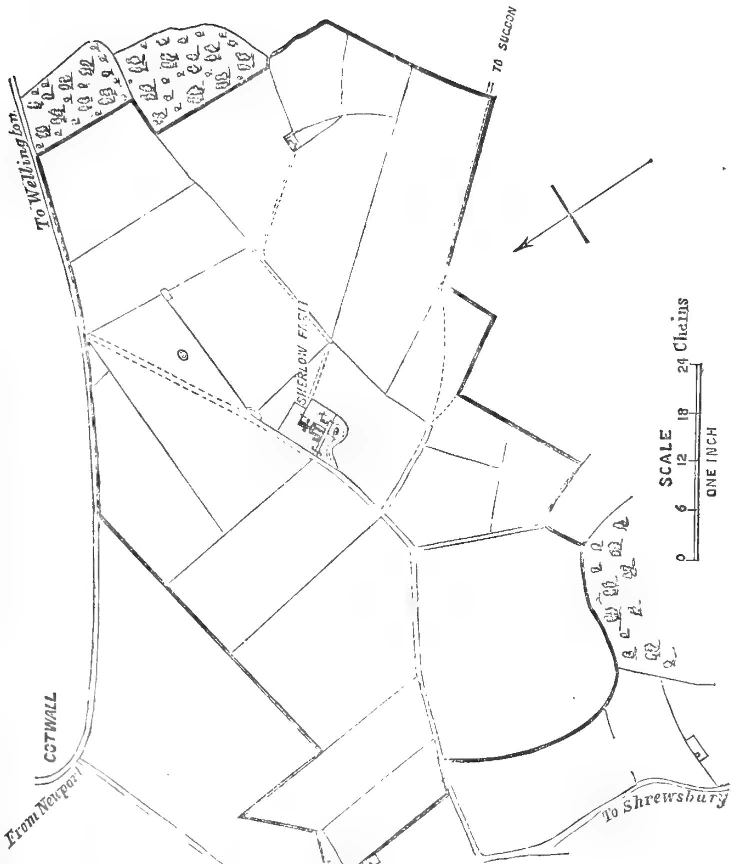



*Fig. 2.—Plan of Sherlow Farm, Parish of High Ercall, in the year 1871.*

drains were laid about four feet deep, and ten yards apart, varying in depth according to circumstances, the ditches were filled in, and watering-places supplied by the drainage were made in the fields. The labour and leading were done by the tenant, costing about 3*l.* 10*s.* per acre. Tiles were supplied by the landlord, two-inch pipes being used, with an increased size for outfalls, at a cost of 3*l.*, making a total outlay of 6*l.* 10*s.* per acre. To us it appeared to have been perfectly done. Since 1869 eighty acres have been drained by the landlord, who charges a percentage of 6*l.* 14*s.* on the outlay, the leading being done, of course, by the tenant. In addition to the roads originally laid out, Mr. Forester has recently made a new road leading from the village of High Ercall, which is a great improvement. At the corner, south-west of the homestead, it is desirable that some fences should still be removed, but at present Mr. Forester is prevented from carrying out the proposed alterations, owing to a difficulty in getting an exchange of land with his neighbour. The system of cropping adopted is the four-course, which is strictly adhered to.

*Turnips.*—Turnips and mangolds always succeed wheat. The stubbles are ploughed from 7 to 8 inches deep in the autumn (no need of any autumn scarifying), after manure has been led direct from the yards, and about 20 cart-loads an acre put on. The following spring the land is ploughed, and worked by the cultivator, artificial manures are applied on the surface at the rate of 6½ cwts. to the acre (Proctor and Ryland's), at a cost of 8*l.* per ton. The land is afterwards ridged, and the seed drilled upon the ridges by a proper drill and roller attached. The ridges are about 26 inches apart. Sundry scufflings take place, and, when the plants are sufficiently grown, and ready for hoeing, they are done by task-work, at a cost of 9*s.* per acre, if gone twice over, or 6*s.* 6*d.* if only once.

One-third of the turnips are fed on the land by sheep; two-thirds are drawn off and consumed either by cattle in the yards or by sheep upon the grass. No turnips are eaten on the land after the middle of March; but all are, if possible, pulled and stored before Christmas. Mr. Forester in future intends trying turnips on the flat, at a distance of 24 inches betwixt the drills; the late dry seasons have caused this proposed change, but we should doubt whether in a season like the present it would be advantageous.

*Mangolds.*—The cultivation is very similar to that for turnips, but the land is more heavily manured in the autumn on the stubbles, which are then deeply ploughed. After thoroughly working the land in the spring with Coleman's cultivator, and harrowing sufficiently fine, artificial manures are sown by hand on the flat, at the rate of 8 cwt. of superphosphate (Proctor and

Ryland's) to the acre; the land is ridged, and then sown with from 5 to 7 lbs. of mangold-seed to the acre, as early in April as the land can be got ready and the season will admit. When the plants are sufficiently grown, they are scarified and hoed at a cost of 6*s.* per acre; sundry scarifyings completing the work. In the month of November they are pulled, and stored by the homestead.

*Barley.*—Barley follows turnips. The portion of turnips left on the land having been consumed by sheep eating oil-cake the land is ploughed as soon as possible, in order to secure the ameliorating influence of winter and spring frosts. It is most important to have a thoroughly pulverized seed-bed for barley, hence the reason that no roots are consumed on the land after the middle of March. Thus treated, a seed-bed can usually be obtained by simply harrowing down the surface, and the cost of cultivation is thereby reduced. The barley is then drilled at the rate of 11 pecks per acre, commencing as early in March as the season will admit. Invariably the earliest sown seed produces the best quality of corn.

*Oats.*—Barley being found the most profitable spring corn-crop, oats are not grown as a rule. This year, however, some old pasture land has been broken up, with a view to relaying, and oats have been taken as the first crop.

These oats are a remarkably heavy crop, secured by merely ploughing the turf and rolling down, the oats afterwards being drilled. This practice is not usually attended with success, but in this case nothing can exceed their present promise of abundance.

*Seeds.*—Clovers are sown after barley, and occasionally in wheat grown after turnips. The land is divided into three equal portions, and a different mixture sown on each, so that on the return of the rotation the same varieties of clovers may not be used. Clovers for mowing are generally sown among the spring wheat, on about one-third of the land in the shift, and are composed of the following mixture—

12 lbs. red clover;
2 to 3 lbs. white clover;
1 peck of Pacey's rye-grass to the acre.

For depasturage, the following is sown on a second third of the course—

6 lbs. of alsike;
2 bushels Italian rye-grass.

And the following, also for depasturage, on the remaining third—

White, trefoil, rib-grass, and parsley, of these altogether 14 lbs. to the acre; with cock's-foot, timothy, and rye-grass, 2 pecks.

The whole of the seeds are sown by barrow-drill.

*Wheat.*—Autumn wheat is sown after ley, which generally consists of 65 acres; in addition to which 25 acres of spring wheat are generally sown after turnips or mangolds. The ley is ploughed as early in August as it can be spared, and if not pressed it is Cambridge-rolled, and left in either of these states till the latter end of October, when it is well harrowed, and afterwards drilled with Browick red wheat, seed at the rate of 10 pecks to the acre being used. Wheat after turnips and mangolds is sown as early in February as the season will admit, and none later than the 1st of March. This land is merely ploughed, harrowed, and drilled with a red Nursery variety, about 13 pecks of seed being used to the acre. No wheat ever needs hoeing, and top-dressings are not applied as a rule.

A small piece of wheat was shown us in the middle of a field that had succeeded kohl-rabi, which had been eaten on the land by sheep, not pulled or stored, but allowed to grow during the winter. The whole field was sown at the same time, but that portion which had grown kohl-rabi was very deficient as compared with the remainder, which had grown turnips and mangolds. Mr. Forester's explanation was that the kohl-rabi, not having been pulled in the autumn, had formed large roots, and had therefore taken much more out of the land than the other crops, which had been stored.

*Beasts.*—Twenty-six pure Hereford cows of the best quality are kept for breeding purposes. Their produce are reared, and mostly sold at $2\frac{1}{2}$ years old about Christmas. It is very rarely that either bulls or heifers are sold for breeding purposes, although their quality would fully justify the practice. The average price of the oxen sold last year, an account of which Mr. Forester gave us, was 31*l.* 3*s.*, and some of these were not quite two years old. He further informed us that they had had no cake during the previous summer until the 10th of August, within 10 weeks of the day of sale. The reason for their not having had cake earlier was that in 1869 he had to cease giving cake owing to the laxative quality of the keep (this would be accounted for partly by the gross nature of the grass). Mr. Forester says that at this time he was not aware of the virtue of cotton-cake as an astringent, and last season (1870) the cattle were doing so well upon the scanty and parched, though comparatively nutritious, herbage, that he feared to change their diet, until the pastures became so bare that it was absolutely necessary to have recourse to extra means of support; he then tried a mixture of cotton-cake with the linseed-cake, with the best effect, and has continued its use ever since.

The cows are kept during the winter upon chopped straw and a few pulped turnips, and as they near calving have an increased allowance of roots. The calves are placed in a roomy shed during the first winter, and given pulped roots, chopped hay, and straw, with an allowance of 1 lb. of linseed-cake per day. They are allowed to run into an adjoining yard for two hours daily. The $1\frac{1}{2}$ year-olds are kept loose in yards, 12 together, given pulped roots and chopped straw, with an allowance daily of 2 lbs. of linseed-cake, continued till grass. The older beasts (oxen), two years old and upwards, are placed in two yards of 12 each, fed in square tumbrils with six stones each of sliced swedes (never mangolds) per day. Mr. Forester prefers, for finishing off beasts, sliced roots in preference to pulping. At first the artificial food consists of 3 lbs. of an equal mixture of linseed-cake and decorticated cotton-cake, and increased the last six weeks to 7 lbs. each, with an addition of 3 lbs. of wheat (when cheap) and barley-meal in equal portions. What heifers or cows are fatted are tied up, and receive a similar quantity of roots and artificial food.

We may here note that the grass land, which forms about one-third of the farm, is naturally weak. The older bullocks are run upon the best portions; the next oldest are kept on useful store land; whilst the youngest, which Mr. Forester calls his scavengers, are running over the leys and picking up what is rejected by everything else. They were a handsome lot, that any shorthorn breeder could not but admire. Their size and condition upon such moderate pastures were evidence of their aptitude for making flesh, for which the Herefords are so justly celebrated. The cows with their calves are summered upon the weakest portions of the grass, and, notwithstanding their poor commons, were, in July, in splendid condition, many of them being fit for the butcher.

*Sheep.*—A flock of 150 Shropshire ewes are kept for breeding purposes, and produce about 225 lambs. These ewes run on the grass during the winter, and when near lambing are supplied with roots, and an allowance of $\frac{1}{2}$ a lb. of linseed-cake per day, which is continued up to May. The lambs are weaned early in June, and placed upon the freshest pastures. Having been taught to eat cake with the ewes, a small quantity is allowed them up to their going on common turnips, when clover-hay is given them in preference to cake, up to their beginning swedes, which are cut for them, and about Christmas they are allowed $\frac{1}{2}$ a lb. of cake, increasing to $\frac{3}{4}$ the last month or six weeks, till the time of their being clipped and sold. The sheep are removed from the turnip-fold to the grass early in March, where they have cut swedes and cake till the second week in April, at which time they are usually sold. A certain number of ewe hoggs are reserved for the flock. 225 sheep are fed off annually.

*Horses.*—Eight plough-horses and one jobbing-horse are kept, and are fed in the following manner:—

From the time spring tillage begins in February, till the vetches or trifolium are ready in May—say 105 days—10 lbs. of corn per day per horse, consisting of either oats, or beans and bran, or Indian corn and bran, or barley and bran.

From the end of May to the end of October or beginning of November—say 160 days—at grass; and when at work during that time, they are baited at midday with trifolium, vetches, clover, aftermath, &c., with an occasional feed of corn on heavy carrying days in harvest, and during wheat sowing, and when work presses, viz., from 60 to 80 lbs. per horse per week.

In the exceptional season of 1870, the aftermath-clover was used up during harvest, and the horses had to be baited with the new hay. They were taken into the stable earlier than usual, and had corn from about Michaelmas till after wheat-sowing—say 40 days—which, with the 105 mentioned above, makes 145 days for the autumn and spring, 1870-71, or, at 10 lbs. per day, 1450 lbs.

The actual amount of corn consumed from September, 1870, to May, 1871, was—

| | lbs. |
|---|---|
| Indian corn, 5 qrs. .. .. .. .. .. .. .. .. | 2,400 |
| Barley (best), 23 bush., at 70 lbs. .. .. .. | 1,610 |
| Barley (light), 40 bush., at 60 lbs. .. .. | 2,400 |
| Bran, 3 tons .. .. .. .. .. .. .. .. | 6,720 |
| Which, divided by 9 .. .. .. .. .. | 9)1,3130 |
| Gives for each horse .. .. .. .. .. .. | $1,458\frac{8}{9}$ |

or $8\frac{8}{9}$ lbs. in excess of the specified allowance. From the conclusion of wheat-sowing till the following February, no corn is given; but they are kept on clover-hay. All hay is mixed with a portion of straw, and cut by Richmond and Chandler's cutter.

*Labour.*—The following is the staff of the labourers ordinarily employed:—

| Weekly Wages. | £. | s. | *d.* | | A. | R. | P. |
|---|---|---|---|---|---|---|---|
| Foreman .. .. .. .. .. | 0 | 16 | 0 | House and garden .. | 0 | 3 | 3 |
| Shepherd .. .. .. .. .. | 0 | 13 | 0 | 2 cottages and gardens | 0 | 2 | 25 |
| Ploughman .. .. .. .. | 0 | 12 | 0 | | | | |
| Ditto .. .. .. .. .. .. | 0 | 13 | 0 | | | | |
| Ditto .. .. .. .. .. .. | 0 | 13 | 0 | | | | |
| Ditto .. .. .. .. .. .. | 0 | 12 | 0 | 2 cottages and gardens | 0 | 1 | 32 |
| Cattleman .. .. .. .. .. | 0 | 12 | 0 | | | | |
| Labourer .. .. .. .. .. | 0 | 14 | 0 | | | | |
| Ditto .. .. .. .. .. .. | 0 | 12 | 0 | | | | |
| Ditto .. .. .. .. .. .. | 0 | 12 | 0 | | | | |
| Ditto .. .. .. .. .. .. | 0 | 12 | 0 | | | | |
| Ditto .. .. .. .. .. .. | 0 | 12 | 0 | | | | |
| Blacksmith, engine-man, &c. | 0 | 18 | 0 | | | | |
| | 8 | 11 | 0 | | | | |

A boy to help cattleman in winter, at 3*s.* to 5*s.* per week.

The men are allowed the twelfth of an acre of potato ground, worked and dunged. They have beer in hay-harvest, and on threshing days. They have piece-work when it can be conveniently let, as turnip-hoeing, &c. Their wives and children do the weeding and most of the root-harvest by the piece. They have their coal carted for them, and their potatoes carted home to their houses. The shepherd has one ton of coal allowed him at lambing time. The foreman gets his breakfast and supper with the household servants on Sunday, and his meals on full threshing days.

ABSTRACT OF LABOUR ACCOUNT FOR THE LAST FOUR YEARS.

| | For the Year ending Ladyday, **1868.** Men fed during Harvest month. Wheat cut by Taskers. | | | For the Year ending Ladyday, **1869.** Men fed during Harvest month. Wheat cut partly by Taskers. | | | For the Year ending Ladyday, **1870.** Men fed during Harvest month. Wheat cut by Reapers. | | | For the Year ending Ladyday, **1871.** Men received Money in lieu of Keep during Harvest month. Wheat cut by Reapers. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £. | *s.* | *d.* | £. | *s.* | *d.* | £. | *s.* | *d.* | £. | *s.* | *d.* |
| Total amount entered in labour account for all farm purposes .. .. | 582 | 6 | 5* | 586 | 5 | 4½* | 565 | 1 | 1* | 594 | 0 | 6½* |
| Deduct extras properly belonging to capital account .. .. .. | 24 | 4 | 11 | 3 | 18 | 9 | | .... | | 15 | 3 | 1 |
| Leaving for ordinary farm labour .. .. | 558 | 1 | 6 | 552 | 6 | 7 | 565 | 1 | 1 | 578 | 17 | 5½ |
| Add estimate for keep of 16 men, 4 weeks at 9*s.*, for the years ending Lady Day 1868, 1869, 1870† .. .. .. .. | 28 | 16 | 0 | 28 | 16 | 0 | 28 | 16 | 0 | | | |
| | 586 | 17 | 6 | 581 | 2 | 7 | 593 | 17 | 1 | 578 | 17 | 5½ |

*Manures.*—The amount expended on artificial manures annually is from 200*l.* to 220*l.*, and on feeding stuffs,—

| | £. |
|---|---|
| Linseed cake, 11 tons .. .. .. .. .. .. | 132 |
| Decorticated cotton, 11 tons .. .. .. .. | 100 |
| Wheat and barley meal, 190 measure .. | 60 |
| Total for manures and feeding stuffs about | 500 |

* This sum includes items on account of making and repairing roads, draining, &c.

† This is our estimate for keep of labourers during the harvest month, and no doubt the men keep themselves for that, or less. But Mr. Forester is of opinion that in Shropshire it costs the farmer more to keep them, owing to the excessive and injurious quantity of beer consumed. When the labourers have money given to find themselves, the work is better, and he thinks more quickly done. The men are then always sober.

*Buildings.*—The buildings were erected in 1848 and 1849 by the landlord, and form nearly a square. On the south side is a range of stables for cart-horses and riding-horses, saddle-room, and carriage-house. The stables are ventilated by cupolas, and are well arranged; cart-horses stand in single stalls, with plenty of space behind, a gutter conveys the liquid into a tank; on the north side of this range of buildings are two open yards of about 60 feet square, capable of holding twelve oxen each; these yards are divided by a stone wall of about 8 feet high, with a wall in front of 4 feet 6 inches, and are well shedded.

On the east side of this is a feeding-shed, to hold fourteen beasts tied up; adjoining which is a root-house, suitable to prepare the food, and whence the beasts are fed at their heads; also adjoining this are compartments to receive chopped straw, as well as the chaff from the machine. The threshing-machine, which is a fixture, and driven by an eight-horse power fixed engine, dresses the corn ready for the market. One of Richmond and Chandler's straw-cutters (large size), French stones for grinding, 4 feet 4 inches in diameter, as well as pulpers, cake-crushers, &c., are driven from shafts by the engine.

On the north side of the range of buildings is a shed used for the cows, and capable of holding thirty-two beasts tied up; adjoining this also is a large root-house, containing shafting to be applied to pulpers, and whence also the beasts can be all fed in front. There are gutters suitable to convey the liquid into tanks, of which there are two to receive it as it is accumulated; this liquid is pumped over the manure in the yards, which is thereby properly moistened and enriched. The system of carrying out the liquid by water-cart, and putting it on the grass has been given up in consequence of no visible beneficial results having accrued from the practice.

*General Remarks.*—It will be evident from the foregoing details that Mr. Forester, from his thorough knowledge of every detail (upon attention to which success mainly depends), is a thoroughly practical farmer, and it is mainly owing to the completeness of every department of his farm, that we have considered him entitled to the first prize, and more especially because the very best results in every case are attained by economical management, rather than by any special novel feature in his system.

Mr. Forester's system of farming is another illustration of the sound and reliable nature of the four-course rotation, and, although we would by no means commit ourselves as to its universal applicability, we may safely state that, under favourable conditions, and where the great difficulties of the growth of clovers can be overcome, as has been so successfully accomplished by Mr. Forester's alternate crops, it will be found difficult to supersede it.

In descending to details we would direct attention to the management and application of the manure. First of all, we think that in cases where the absorption of the liquid element cannot be entirely effected by the straw, its collection in tanks and redistribution over the manure, according as moisture is required for the process of fermentation, is the very best system that can be adopted, as, in this way, manure can be ripened, without the necessity of carting into a hill, previous to its application to the land. Secondly, we are convinced that in cases in which the soil contains a sufficient percentage of clay to render it retentive, the application of manure on the stubble in autumn for the root-crop is good practice, inasmuch as you have thereby a chemical and mechanical effect; the important manurial elements become thoroughly distributed through the soil, and are in the most available condition for the requirements of plants; and the soil is mechanically benefited by the presence of a large quantity of vegetable matter, which tends to keep it open, and assists atmospheric action.

The management of live stock is also particularly worthy of consideration. Whilst the treatment of each class of animal was conducive to its progressive development and early maturity, the results were in all cases obtained without an extravagant outlay in artificial food. We believe that in no instance was more than 10 lbs. of meal and cake allowed for any animal daily. We must not omit to note an element which materially assisted us to arrive at our decision; namely, the simple, comprehensive, and accurate details of the expenditure and returns of each department of the farm; and we are very desirous that Mr. Forester's example in this respect may be more generally followed, as it would assuredly lead to more profitable results.

## SECOND-PRIZE FARM.[1]

This farm is occupied, under yearly tenure, by Mr. Winterton, Alrewas Hays, near Lichfield, and contains about 408 acres of arable land, and 145 acres of grass and meadows. It is five miles north of Lichfield, and is bounded on the east by a road leading to Rugeley. The house and buildings are situated in about the centre of the farm, and are approached by a good road. The land is somewhat undulating and laid out in rectangular fields of varying sizes. A good stream of water runs through the farm, and is made available for the purpose of irrigation. The arable land is composed of three varieties of surface-soil, in about equal portions. The southern part is a thin peaty soil, resting upon what is locally termed "foxstone," or stone brash; the western part is of better quality, having a gravelly subsoil, but it is in very poor condition, Mr. Winterton having occupied for only four years the hundred acres of which it is composed; the remaining or northern portion is a good strong mixed loam, resting upon silty sand at some depth. The peaty soil of the farm has been drained at about 4 feet deep—a precaution that was evidently needed, judging from the discharge of water. The meadows are all good where irrigation is practised, and this Mr. Winterton has at some expense secured upon forty acres. This irrigation is by water from the running stream. The effect upon the grass is really remarkable, considering that nothing but pure water is passed over it, the mowing ground bearing testimony to the great benefit derived; and the irrigated portions which are grazed, produce much more grass and carry an increased quantity of stock in comparison with that not so treated. The remaining grass by the house, which is slightly elevated and rests upon the poor "foxstone brash," shows great weakness; but nothing is more likely to produce so quick and permanent an improvement in its general fertility than the system adopted by Mr. Winterton, which is a continued liberal consumption of linseed-cake by the stock upon it. At present it is a bare pasture, but thickly stocked with Shropshire Down tegs, having cake.

The following course of cropping is adopted:—

Turnips and mangold.
Barley and wheat.
Seeds.
Seeds, second year.
Wheat and oats.
Barley and wheat.

Wheat is taken after two years' seeds, upon the lighter land; but oats are grown after seeds upon the stronger. The second corn crop taken is wheat after oats, and barley after wheat.

*Turnips.*—Beginning the rotation with turnips, the land appropriated to this crop, amounting to about 65 acres, is steam-cultivated in the autumn from 10 to 12 inches deep. The following spring it is worked by Coleman's cultivator, thoroughly cleaned, and artificial manures applied by hand on the surface, namely, 5 cwts. of pulverized bones (button-dust), 1 cwt. of guano, and 3 cwts. of superphosphates (Griffin and Morris's), at a cost of 3*l.* 10*s.* per acre. The land is then scarified, harrowed, and rolled, by which operation the artificial manures are thoroughly incorporated with the soil; and the last week in May, if the season admits, the turnips are drilled on the flat at a distance betwixt the rows of 19 inches. Two-thirds of these are swedes, and the remainder white turnips, which of course will be sown later in June. When grown sufficiently they are scuffled and hoed with a 9-inch hoe by task labour, twice over, at a cost of 9*s.* per acre. Altogether they get three horse-hoeings, which generally complete the work. Half the swedes grown upon the stronger land are usually pulled off and stored near the buildings, to be consumed by the cattle and sheep in yards and feeding-sheds; of the remainder, part is got up and stored on the land, some being left for the older sheep to eat as they grow, with a liberal allowance of cake and corn. Of the turnips grown on the lighter land, not more than one-third is taken off, the remainder being stored upon the land and eaten with fatting sheep, eating cake. Common white turnips (excepting some few led off upon the grass to break in the lambs) are wholly eaten on the land, with the addition of cake and corn, as this portion of the root-crop is generally followed by spring wheat. The cost of pulling and storing the turnips is about 10*s.* per acre.

*Mangolds.*—These also succeed wheat and oats. The stubbles are deeply cultivated in the autumn by steam power, manured upon that cultivation at the rate of 14 cart-loads of manure to the acre, and afterwards ploughed at a depth of 6 or 7 inches for the winter. The following spring the land is worked by cultivators, harrowed, and thoroughly pulverized; and about the middle of April, if the season will allow, the following artificial manures are sown broadcast: guano 2 cwts., superphosphate 3 cwts., and an addition of 2 cwts. of salt to the acre. The manure being scarified in, and the seed deposited by drill upon the flat, at a distance of 22 inches betwixt the rows, sundry horse-hoeings are given in due course, and the work is completed by singling the plants. Early in November they are pulled and stored near the homestead, at a cost of about 6*s.* per acre.

*Barley.*—This crop succeeds mangolds and turnips. The turnip-land is ploughed as soon as the season will allow after the turnips are consumed, at a depth of about 4 inches, the earlier the better to secure the effect of the frost. After this, harrowing only is needed in the spring to prepare the land for the seed, which is drilled early in March, at the rate of 12 pecks to the acre. Golden melon barley is the variety sown, being considered most productive; and the quality generally sown appears suitable to the variety of soil. Where barley succeeds wheat it is differently treated; the wheat-stubble is ploughed early in the autumn and worked in the spring by Coleman's cultivator, so as to thoroughly eradicate any weed-seeds that might happen to grow: thus worked, it is drilled with the same variety and quantity of seed per acre. After the drill 3 cwts. per acre of superphosphate (Griffin and Morris's) is sown by hand, harrowing both the barley and tillage in together. The cost of the manure is 21*s.* per acre.

*Oats.*—Oats are mostly sown upon the portion of two-years-old ley which is on the strongest land. The ley is ploughed in the months of January or February, and allowed to lie in this state till the middle of March, when half the quantity of seed per acre (2½ bushels) is sown broadcast and upon the furrow. This is well harrowed in, and the remainder of the seed is afterwards drilled crossways, the harrow going after the drill to complete the work. Poland oats are the variety sown. We were curious to see the result of what was to us quite a novel system, and we found the appearance of the crops most satisfactory, being more promising than any we had previously seen. Mr. Winterton justifies his practice on the ground that the seed is more evenly distributed in the land and more completely covered, by which means the moisture, so beneficial to the growth of the oat-crop, is retained in the soil. We thought possibly there might be some advantage in this; at all events the oats growing under this peculiar system were very good. If the whole 5 bushels of seed per acre had been sown by hand upon the furrow, Mr. Winterton said it could never be properly covered; but he depended upon the coulters of the drill assisting in the deposit, and if practice justifies such an amount of seed being used, there can be no doubt that some plan of the sort is required to insure the same being properly covered.

*Clover-seeds.*—Seeds are sown amongst barley and wheat growing after turnips or mangolds. The land is generally rolled by a Cambridge roller and the seeds sown by hand. The mixture is red clover 3 lbs., cowgrass 3 lbs., alsike 2 lbs., white clover 3 lbs., plantain 2 lbs., trefoil 3 lbs., parsley 1 lb.; altogether 17 lbs., with 1 peck of Pacey's rye-grass to the acre. A small portion of 5 acres is mown for cart-horses, and the remainder depastured. Sixty-five acres is the usual extent grown; but on account of the failure of the seeds in 1870, this year there is less than usual, and in their place the land is growing vetches and beans, both of which are very good. The vetches are eaten off by Shropshire shearlings, consuming cake and corn, and afterwards the land will be broken up and sown with common turnips for wheat.

*Wheat.*—Wheat is sown after two years' ley, and also after oats and turnips. This ley is upon the lighter land, which is manured in the month of July with farmyard-manure led direct from the yards, where it had been previously turned. Late in September it is ploughed and pressed, occasionally Cambridge-rolled; the last week in October it is harrowed and drilled, commencing with 2 bushels of seed of the Essex red variety, and ending with 2½ bushels to the acre. After oats, the land is first scarified and then manured with farmyard-manure, ploughed and pressed, and drilled with red wheat, mostly in November. That month would be invariably preferred if only the weather could be depended upon. Wheat succeeding turnips is Talavera, and is sown generally in the month of February or March. All second white corn crops are topdressed in the spring with 3 cwts. of superphosphates to the acre, the artificial being harrowed and rolled in.

*Beasts.*—The cattle upon the farm are all purchased: those for summer grazing are bought in February, and occasionally in March; and for winter feeding in August and September. From 100 to 120 beasts, good bred cows and heifers, are annually fed off. Heifers are most approved, and if possible obtained. Half, say 50, are made fat and sold from grass, generally grazed upon the portion under irrigation which is not required for mowing; they have an allowance of 4 lbs. of mixed cotton and linseed cake each per day. The beasts upon the farm were in a forward state, and were a good suitable lot of heifers. These will be replaced in August and September, and thus will have time to get fresh, and fit to be tied up in the stalls by the beginning of October; and the best of these will get ready for sale at Christmas.

Forty are tied up, and the remainder run loose in a yard, preparing to take the places of those sold off. The beasts tied up are fed with pulped turnips, grains, chopped straw, and 6 lbs. daily of a mixture of decorticated cotton-cake and bean-meal; linseed-cake is also given separately twice daily, begining with 2 lbs. and ending with 6 lbs. each beast, with a small quantity of chopped hay and straw.

Mr. Winterton speaks well of grains for his feeding beasts, and allows them half a bushel each daily. They are brought by waggon from Burton-on-Trent, a distance of 9 miles; and he frequently has 1000 bushels stored, as, when well compressed, they will keep for a length of time. The beasts, when loose in the yard, have the same mixture of pulped roots and grains, but a less quantity of cake and meal. Beasts for summer grazing, purchased in February, have also pulped roots, &c., up to grass, and consequently are turned out in a very forward condition. At an off-yard, conveniently situated for supplying that portion of the farm with manure, 12 heifers, purchased about Christmas, were wintered. These have no roots, but merely chopped straw, with an allowance of 4 lbs. of mixed cotton and linseed cake per day, continued up to grass. We saw the animals thus treated when on grass, and their admirable condition proved the advantage of this preliminary treatment; they were then receiving mixed cake, 4 lbs. per day.

All cattle, both summer grazing and winter feeding, have an allowance of mixed cotton and linseed cake daily.

*Sheep.*—Eighty Shropshire-down ewes are kept for breeding, and generally produce about 120 lambs. The ewes during the winter run upon the meadows until the time for irrigation, and afterwards are taken on to the upland grass, being given about a quarter of a pound of cake and a few roots. This food is increased as they near lambing.

The lambs are weaned about the middle of June, and run on the freshest two-year-old ley; receiving half a pound of undecorticated cotton and linseed cake per day, and being taught to eat it from the ewes having had up to this time an allowance of three-quarters of a pound daily of undecorticated cotton and linseed cake.

In September the lambs are taught to eat turnips by having a few loads thrown them on the pastures, and when thoroughly accustomed, they are folded upon common turnips, still having the mixed cake. From turnips, which are generally finished early in December, they go to cut swedes, having an increased allowance of cake until the completion of the turnips, which is generally in April, when they are washed, clipped, and sold. The ewes are fed off annually, and fresh stock purchased. In a temporary shed and yard adjoining the homestead, from 70 to 100 ewes are fed off every year; they are taken up in the beginning of November, and have cabbages and turnips (some few cabbages being grown annually), a little clover-hay, with mixed cotton and linseed cake, 1 lb. per day, a few grains, and half a pint of peas. This we acknowledge is great feeding, and we could almost anticipate the result; but Mr. Winterton says the short time needed to make these sheep ripe is something wonderful, compared to that required by the ordinary outdoor feeding; from six to eight weeks is never exceeded. Caution is taken as to the cleanliness of the yards, which are fresh littered every day; and once a week the manure is entirely cleared away.

From 800 to 900 sheep are purchased annually, principally shearlings. Five to six hundred are fatted upon turnips, the remainder upon grass. Winter-fed shearlings gnaw their turnips, and have a liberal allowance of the usual mixture of cake daily. One thousand sheep are annually clipped, and the same number annually fed off and sold at the auction mart in Lichfield. Two years' seeds give usually an abundance of feed, and that, with the liberal allowance of artificial food, enables Mr. Winterton to graze a large number of sheep during the summer, and many of these go to turnips to top up. Also a certain quantity of vetches are grown annually; these are mown off and given to sheep in nets. At the time of our visit there were 300 shearlings eating cake and being thus treated. The stock of sheep upon the farm at that date, July 8th, was 80 ewes with 120 lambs, and 680 shearlings; the whole eating mixed cotton and linseed cake. The sheep appeared to us of a paying sort, and are generally purchased from the district of Cannock Chase. Though poor, they are very hardy and healthy. Some hoggs we saw on our first visit had been just purchased in their wool, at 38*s.* each, which shows that Mr. Winterton does not buy high-priced sheep to make a jobbing trade of it. He purchases good healthy sheep, and by his liberal allowance of artificial food they are soon got ready for the market, and are thus a most important feature in the profit and loss account. The present price of beef and mutton will always pay for a judicious outlay in artificial food, and Mr. Winterton's corn-crops fully proved the benefit derived from this practice.

*Horses.*—Eleven cart-horses are generally employed, and during the working season have allowed them 62 lbs. of meal each horse per week. The meal is composed of oats, beans, and Indian corn, with 1 bushel of bran, mixed with chopped hay and straw. During the summer, they have green clover and vetches given in the yards. The hours of work are from 7 till 12, and from 1·30 till 5; they are therefore at work only 8½ hours daily. This somewhat accounts for the small amount of corn-food allowed them.

*Artificial Manures.*

| | £. | s. | d. |
|---|---|---|---|
| The amount paid annually for artificial manures is | 274 | 0 | 0 |
| For cake and corn purchased .. .. .. .. | 959 | 16 | 10 |
| Total .. .. .. .. | 1183 | 16 | 10 |

*Harvest.*—The corn is cut by machinery, two of Hornsby's self-rakers being employed. Mr. Winterton informed us that these two machines will, with change of horses, and a man and a boy each, cut beyond 34 acres per day. The corn is taken up and made ready for carrying at 4*s.* 6*d.* per acre; barley occasionally at a less cost. All is tied up and shocked, carried by waggons to the rickyard, and made into oblong stacks sufficiently large to employ an 8-horse-power steam threshing-machine for the day.

*Labourers.*—Ten men are employed through the year and four boys. The labourers live in cottages upon the farm. Mr. Winterton says he cannot speak too highly of this advantage, for it adds greatly to the comfort of the men, giving them many privileges they could not otherwise possess. It allows their wives and families to work on the farm, and the men to be daily with their families at their meals. A cottage and good garden is calculated at 1*s.* 6*d.* per week, which is a reasonable rent, compared to what the labourer might have to pay for a cottage without a garden, probably a mile or two from his work. It is the duty of the farmers, as employers, to protect the labourers; for if they have an exorbitant rent to pay for their cottage, they must have increased wages; and Mr. Winterton is favoured in having a sufficiency of cottage accommodation for the labourers employed upon his farm. These labourers have their cottages and 12*s.* 6*d.* per week during the winter months of 39 weeks, and one quart of beer per day, costing 4*d.* per gallon. Beyond their cottage gardens, they are allowed to plant potatoes in the farm upon one-twelfth of an acre. During the summer months, 13 weeks, their wages are 16*s.* 6*d.* per week, with no beer. Four boys employed have for their winter wages 3*s.* to 3*s.* 6*d.* per week, and during the summer 5*s.* 6*d.* One labourer, acting as shepherd, has, during the winter months, 39 weeks, 16*s.* per week, and, during the summer of 13 weeks, 21*s.*; one quart of beer per day is allowed thoughout the year. The total cost of labour amounts annually to 650*l.*

*Buildings.*—The house is situated very nearly in the centre of the farm, with a good road leading to it; there are also good roads through the farm. The farm buildings have been recently erected by the landlord, the tenant giving the leading, and the landlord charging $2\frac{1}{2}$ per cent. on the outlay. The buildings are very convenient and commodious. A shed for tying-up cattle is very complete, holding 52 beasts, each pair of beasts being divided by stalls of 7 feet in width; from the centre is a roadway 3 feet 9 inches wide, the beasts being fed on each side at the head; the width of the building is 33 feet, which affords sufficient room behind. There are a good barn and a root-house, in which the pulping, grinding, and chopping are done by a fixed steam-engine of 4-horse-power. A yard is situated on the south side of the feeding-shed, with ample shed-room; and on the north side also is a yard as a receptacle for manure from the feeding-shed and cart-horse stables, the latter being very conveniently situated and with every requisite accommodation. As far as the present buildings are concerned, they are most convenient; but we think Mr. Winterton needs another foldyard and a shed for his portable engine and threshing-machine. Everything about the premises indicated order and system.

*General Remarks.*—It would be difficult to find a more marked contrast than is afforded by this and the First-Prize Farm, yet both are examples of a liberal and judicious employment of capital, tending to profitable results. In this case, an unusually large amount of stock is fed by a very heavy outlay in purchased food, and as a consequence of this system the land is maintained in a high state of fertility, which enables it to yield heavy and frequent crops of corn. The returns, moreover, from such a system are higher, though less constant, than where the live stock are principally bred upon the farm.

We were particularly struck with the economical employment of labour, considering the high wages that were paid, and the clean and creditable condition of the land. The total outlay in this department is certainly very moderate.

## Mr. Brewster's Farm.

A sum of 50*l.* having been placed at the disposal of the Judges by the local subscribers, we decided to divide the same into two special prizes of 25*l.* each, to be given to the occupiers of farms, the management of which contained special features of excellence. In the case of Mr. Brewster, whose farm we are about to describe, the point to which we direct attention is the successful management of good land. Mr. Brewster's farm, at Balderton Hall, near Middle, county of Shropshire, comprises 167 acres of arable land, and 165 of old pasture; it is held on a lease of fourteen years, and is situated 7 miles north-west of Shrewsbury on the direct high road from thence to Ellesmere, this road intersecting the farm. The land is on a general incline towards the north, and is divided into various-sized fields of from 10 to 30 acres. It rests partly upon the red sandstone and partly upon clay, but at some depth from the surface soil, which is of excellent quality, and adapted to the growth of every variety of crop, as is abundantly proved by the aspect of the farm this year. The farm has been thoroughly drained, and Mr. Brewster has a plan showing the direction of every drain in each field laid down to scale, from which it would appear that the land is completely gridironed. The drainage was done by the owner when occupier; therefore, as far as his knowledge extended, it was done regardless of expense. We do not say that fewer drains would have served the purpose, but it is most uncommon to see land so intersected. The four-course system is adopted, although Mr. Brewster, holding upon a lease, has liberty to take two white crops in succession,—a permission he has not availed himself of, believing such a system would be less profitable than his own. The preparation for the root-crop is somewhat peculiar, and worthy of notice.

The stubbles are carefully looked over, and the couch-grass forked out,—a plan which ensures perfect cleanliness, for we could not discover a single root. The land is then deeply ploughed for the winter, cultivated in the spring, harrowed down fine, and ridged at 26 inches interval by the double mould-board plough. Upon this is sown by hand artificial manures, 5 cwts. an acre (Proctor and Ryland's), then the following operation is performed:—The intervals betwixt the ridges are deeply stirred with a scarifier drawn by two horses, the tines entering the soil about 6 inches deep; the ridges are afterwards split, and thus a deep and thoroughly pulverised seed-bed is prepared for the roots. One-third of the turnips are consumed on the land; the remainder, as well as the mangolds, are carted to the homestead. The practice of thick-seeding for cereals is upheld: barley is sown at the rate of $3\frac{1}{2}$ bushels, wheat 3 bushels, to the acre; the reason given is, that good land, highly cultivated, requires more seed, in order that the straw may be short and less flaggy, the produce, in consequence, being more certain. No variation in the mixture of artificial grasses is required, as clovers can be depended upon. The mixture commonly used consists of 3 lbs. of cow-grass, 3 lbs. of red, 3 lbs. of white, 1 lb. of trefoil, and 2 pecks of Italian rye-grass to the acre, the latter being occasionally drilled with the barley. The foldyard manure is invariably applied direct from the yards on the young seeds, as soon as possible after the barley-crop has been harvested: a practice which we consider highly scientific, inasmuch as the clover roots, which form so essential a source of food for the following wheat crop, are greatly increased, and at the same time the sheep keep is much improved. Occasionally (both to check slug and to strengthen the straw) 3 tons of lime, at a cost of 10*s.* per ton, are applied to the clover-ley previous to ploughing for wheat.

From 70 to 80 beasts, chiefly purchased, are fed annually: half on grass without cake, and the remainder, which come in the autumn (after running on the pastures till November), are tied up and fed with sliced turnips *ad libitum*, chopped hay and straw, and artificial food, varying from 1 lb. of cake and 4 lbs. of barley-meal up to January; from that time to May, 2 lbs. of cake and 5 lbs. of meal—not a high diet, and as a consequence the process is slow. Probably the production of a very rich description of manure is not requisite on account of the unusual fertility of the soil.

A breeding flock of 150 Shropshire-down ewes is kept; the produce, together with from 80 to 100 purchased shearlings, are fed-off, the management being liberal, but offering no special feature deserving notice. The bill for artificial manures and feeding-stuffs is under 500*l.* Six horses work the farm, and are of a very superior character; Indian corn and bran, with cut hay and straw, form their food during the winter and working seasons, in summer they are turned out to grass.

The corn-crops, from their luxuriance, are so frequently laid and twisted, that Mr. Brewster doubts the practical use of machinery. He mows and ties his wheat at a cost of from 8*s.* to 11*s.* per acre. The barley is mown outswathe, at 3*s.* per acre, and carried loose. The whole of the harvest work is done by Mr. Brewster's regular hands, who are employed during the leading at 5*s.* per day. In fine weather this lasts about ten days. *No beer* is given. Each labourer has a cottage upon the farm, paying the rent to Mr. Brewster, under an agreement to quit at a month's notice. Eight men and two boys are employed, and women occasionally for weeding the corn, the total amount paid for labour being 361*l.* 2*s.* 6*d.*

Mr. Brewster has had some difficulty in establishing his rule with regard to beer, and probably his ultimate success was due to the power he acquired through his cottages. His was the only farm we visited where the obnoxious system did not prevail, and great credit is due to Mr. Brewster for his energy and perseverance. The wages are about 1*s.* per week higher in consequence. We cordially hope that his example may soon be widely followed.

*Buildings.*—The buildings upon this farm are most substantial and complete, being built of stone and furnished with every convenience. There are four yards, well shedded to hold cattle; there is also a feeding shed for tying-up 42 beasts, with turnip-house attached.

The barn is well arranged, containing fixed threshing machinery, driven by a steam-engine of Hornsby's, of 8-horse-power, which, like everything else about the place, was in beautiful cleanly condition. The threshing-machine dresses the corn fit for the market. There are also corn-mills, choppers, &c., driven by shafts. A great outlay was made by the owner, when occupier, in forming three large tanks to receive all the liquid manure, as well as the drainage from the house. These tanks are emptied by a double-action force-pump, worked by the steam-engine; the fluid being pressed down cast-metal pipes through two hydrants into each of the three meadows, which comprise more than 30 acres. Mr. Brewster is not very sanguine as to the benefit of this arrangement, and is only charged a very small percentage upon the outlay.

Seeing that no buildings were spouted, our attention was drawn to the fact, and on inquiring why they were not, we were somewhat amused with the reply that there is a clause in Mr. Brewster's lease stipulating that "*No buildings shall be spouted.*"

The crops on Mr. Brewster's farm were all as good as possible, the turnips remarkably so, and the farm altogether showed a very clean and high state of cultivation.

## Mrs. Sankey's Farm.

Mrs. Elizabeth Sankey's farm was highly commended, and awarded a prize of 25*l.*, in recognition of her profitable management.

This farm contains 230 acres of arable land and 131 of grass, and is situated about $2\frac{1}{2}$ miles north of Wellington, the high road from Drayton passing through it, and the road from Wellington to Shrewsbury bounding it on the south. About 50 acres are at a distance of one mile; this land is of a peaty, boggy nature; half of it is grass, and the remainder arable. The main portion of the farm connected with the homestead is various in texture, some being a mixed loam, and another portion weaker, inclining to sand; the subsoil of the whole is a variety of gravel, the upper surface varying greatly in depth. The four-course system is generally adopted. The foldyard manure is applied for roots in the autumn, led direct from the yards upon the land, at the rate of 20 cart-loads to the acre. These stubbles having been previously well cultivated, the manure is ploughed in for the winter. In the spring, when sufficiently worked, 5 cwts. per acre of Griffin and Morris's artificial manures are sown broadcast; the land is then ridged, and the seed drilled. For white turnips a smaller quantity of artificial manure is used, and they are drilled on the flat. Half of the turnips are consumed on the land, the remainder being carted to the homestead. The land appropriated for mangolds is autumn cultivated, ploughed 8 inches deep for the winter, and worked well in the spring. When sufficiently fine the land is ridged, and manure applied at the rate of 20 cart-loads per acre. It is then split, rolled, and drilled. The whole crop is led off and stored by the homestead. A large portion of the turnip land is followed by spring wheat, a plan which appears to answer well; the clover ley is also followed by wheat, a somewhat unusual practice being adopted. Rye-grass being a large ingredient in the seeds, autumn sown wheat is liable to turn out, therefore the ley is untouched till February, affording valuable pasturage for sheep during the winter; and they are also fed on cake and corn. The land is consequently merely ploughed, harrowed, and drilled with wheat of a white variety. The whole of the wheat, after both turnips and ley, was remarkably good, and most promising. Although not a dairy farm, a good return is made from a dairy of 20 common-bred cows, both cheese and butter being made. The calves are all reared. The produce of one cow's evening meal of milk we saw weighed, with the extraordinary result of 40 lbs. Mrs. Sankey wrote and informed us that the same cow's milk the following morning weighed 38 lbs.

During the winter the cows have pulped roots and chopped straw, with 2 lbs. of cake, given until February; this is increased up to calving, and continued until grass. At the date of our first visit 35 calves of various ages were being fed in a sheltered yard with mown vetches and porridge. Twenty yearlings and two-year-olds were upon the grass, making a total head of 83. Forty-five beasts are fed off annually; they are tied up in the autumn, and have sliced turnips *ad libitum*, with an allowance of 5 lbs. of linseed-cake per day. The younger beasts during the winter are fed on pulped roots, chopped straw and hay, with 1 lb. of cake daily.

100 Shropshire Down ewes are kept, yielding 150 lambs. They commence with artificial food before weaning, and it is never discontinued up to the time of clipping, which is generally in April, when they are sold fat. Beyond this number 100 shearlings are purchased and fed off. All the fat stock is sold at Wellington by auction. Mrs. Sankey's practice is to shear all the lambs at the same time as the ewes, the average value of the fleece being 1*s.* 6*d.*, and it is considered that they thrive and grow better in consequence. Ten breeding sows are kept, and, although the variety is not pleasing to look at, the produce is numerous. About 200 are sold annually, and the returns form a not unimportant item in the balance sheet. Great attention is also paid to the poultry, which, under skilful management, are highly profitable.

The grass land has all been dressed with 5 cwts. per acre of Griffin and Morris's artificial manures. Thirty-eight acres are laid out for irrigation, receiving the sewage from Wellington, and are invariably mown. Twenty acres of outlying grass or peaty bog were of a very worthless character, being full of the tussock grass: on most of this Mrs. Sankey has pared and led off the tussocks, applying half a ton to the acre of Griffin and Morris's artificial manures. The result is wonderful, the herbage having changed from most inferior to really good grasses and clover.

Eight horses are kept, fed during the working season with 75 lbs. of meal, composed principally of beans and bran, the latter in the proportion of one-fifth. The outlay in manures and feeding stuffs is so remarkable for the acreage that we tabulate the figures:—

| | £. | s. | d. |
|---|---|---|---|
| Artificial manures .. .. .. .. .. | 230 | 0 | 0 |
| Cake and corn purchased .. .. .. | 517 | 10 | 0 |
| 16 acres of beans consumed .. .. .. | 128 | 0 | 0 |
| 18 acres of peas consumed .. .. .. | 144 | 0 | 0 |
| | 1019 | 10 | 0 |

The average is close upon 3*l.* per acre, one-third of the land being in grass.

*Labour.*—Six men and two boys are employed through the year. The men live in cottages rent free, and their wages are

11*s.* per week, and two quarts of beer per day, at a cost of 4*d.* per gallon. Each labourer is allowed to plant 10 rods of ground, for which he pays 25*s.*, with potatoes. These wages are continued through the year, and for four weeks during the harvest they have their victuals given them. The boys' wages through the year are 6*s.* per week; weeding is generally done by taskwork at 1*s.* 6*d.* per acre. The account given us for labour upon this farm is much less than on any other we have inspected, amounting to 245*l.* 15*s.* in the year. The land was perfectly clean, and the work in as forward a state as was needed. The corn is invariably cut by machinery, and taken up by the labourers, two additional men only being engaged for the harvest at 14*s.* per week and their victuals. The whole harvest work is done by the day. The corn is threshed by a steam machine worked by a portable engine, which is used for grinding and chopping.

*Buildings.*—These are very primitive and forlorn, and very deficient in accommodation, a fact which reflects still more credit on the enterprising management. So good a tenant is surely deserving of more consideration. We cannot close our notes upon the Bratton Farm without expressing the very high opinion we entertain as to its thoroughly profitable management, which reflects the highest credit both upon the tenant and her manager, Mr. Felton, with whose intelligence and energy we were much impressed.

## Highly Commended Farms.

Mr. George Anderson May's farm, at Elford Park, near Tamworth, which we highly commended, contains 423 acres, 335 of which are arable. He also occupies a farm two miles from this at Edingale, containing 61 acres of grass and 50 acres arable. Elford Park lies six miles north of Tamworth, and is intersected by the South Staffordshire Railway.

The surface is undulating, and the soil principally a strong loam resting on a red clay subsoil. A small portion, about one-third, of the arable is light sheep land. Fields vary in size, none exceeding twenty acres. The grass land on the lower part of the farm is rich, and mostly reserved for feeding. Ten acres irrigated from the River Meuse are mown annually. Mr. May laid out this land at a cost of 10*l.* per acre, and considers the outlay remunerative. The water is put on at intervals during the winter and early spring, and never allowed to remain longer than ten days at a time. The higher grass land near the house is naturally weaker, but it has been greatly improved by feeding stock on it with linseed-cake.

No strict rotation of crops is adopted; the only rule never deviated from is that two white-straw corn-crops are not taken in succession. The proportions of different crops (varying slightly from year to year) are as follow:—Wheat, 90 to 100 acres; barley, 40 acres; beans, 30; roots and cabbages, 50; vetches, 10; seeds, 50. Catch crops of stubble turnips, rape, trifolium, and mustard are taken as opportunity serves, after wheat, seeds, &c. The light land, about 40 acres, is worked in a four-course shift, in order that a field of roots may be produced for the sheep to consume safely on the land. Autumn-sown wheat is grown after beans and clover ley. Spring wheat, which often proves more reliable than barley, follows turnips and vetches. The depastured clover ley is occasionally broken up early in August, and made a pin or bastard fallow, as being a good preparation for wheat. Very exceptionally foldyard manure is applied to the clover ley in the spring. Wheat is generally top-dressed at the rate of $1\frac{1}{2}$ cwt. of nitrate of soda to the acre. Beans are succeeded by wheat, the stubbles being occasionally broken up by steam-power, and thus prepared to receive the seed. Essex rough chaff is the variety of wheat generally sown, at the rate of 7 pecks to the acre. Wheat also follows ley; some growing after rye-grass and clovers, twice mown, was looking particularly well. It had been top-dressed with $1\frac{1}{2}$ cwt. of nitrate of soda, and 1 cwt. of superphosphate of lime to the acre.

The foldyard manure (at the rate of 15 cart-loads to the acre) is applied in the autumn upon the stubbles intended for beans, mangolds, and turnips the following year. The couch-grass having been first carefully forked out, the remaining manure is put on the young clovers.

The management of root crops may be shortly described. The manure having been spread, the land is cultivated by steam power, from 8 to 10 inches deep. Three tons per acre of quick lime is applied, and the land ploughed for the winter; in the following spring it is cross ploughed, and worked by Coleman's cultivator, reduced by harrowings, and upon the surface 6 cwts. per acre of Proctor and Ryland's artificial manure, costing 7*l.* 10*s.* per ton, is sown broadcast for swedes. The land is ridged, and turnips are drilled at widths of 24 inches. Nothing is special in the after operations. In November half the turnips are stored upon the land, and the remainder carried to the homestead and there stored. The land for the growth of mangolds receives a very similar treatment as regards the preparation, but $8\frac{3}{4}$ cwts. of artificial manures (Proctor and Ryland's) are applied. The mangolds are sown on the ridge, and the whole crop is led off and pitted by the homestead. Mr. May pays great attention to live stock. He has a celebrated flock of

Shropshire Downs, and is a ram breeder. His flocks consists of 200 ewes. Fifty or 60 of the best ewes are put to the ram in the beginning of September, it being considered important to have ram lambs early. About a fortnight before the rams are introduced, the ewes are put on fresh keep—rape or grass with cake—afterwards they are spread out thinly over the stubbles and pastures, and pick up mangolds and turnip-tops, or anything else that can be spared until January, when they have cut roots with chopped straw and a little meal. This diet is continued up to lambing and afterwards. The lambs are weaned in June, and receive artificial food, to which they have become accustomed when with the ewes; white turnips are also thrown on their pastures to teach them. From thence they are put on the turnips, where they are liberally fed with cut roots, and 1 lb. of malt-dust till February—after which time they get 2 lbs. of oil cake, and a portion of malt-dust with decorticated cotton-cake. The wethers are finished off upon seeds, still eating cake, and are usually sold from June to August. The rams, we suppose, will have an increased amount of artificial food, an accurate account of which few breeders are in a position to give. The ram hoggs which we saw were very forward in condition, and we thought them a superior class. Sixty ewe hoggs are reserved for the flock, about half the remaining ewe hoggs and young draft ewes are sold with the rams by auction: 40 rams are sold annually in the autumn, at an average of from twelve to fifteen guineas each. For the last twelve years from 100 to 120 beasts have been fed annually, principally bought from neighbours and at fairs, from December to April. They are fed in yards, on pulped roots and chopped straw, the most forward beasts having in addition from 2 to 4 lbs. of meal and cake per day. They are sold from June to the end of the year. Such has hitherto been the system; possibly the difficulty of purchasing beasts to leave a fair profit has induced Mr. May to alter it. This year he is milking 25 cows, rearing their calves, and selling milk to a co-operative factory at $6\frac{1}{2}d.$ per gallon. The heifers are to be bulled at two years old, 6 cows drafted each year, and a similar number of heifers introduced. The bullocks are to be grazed at 3 years old; such is the programme.

Nine horses are employed on the farm, steam power being hired for autumn fallows.

| | £. |
|---|---|
| Cake and corn consumed, annually .. .. .. .. | 450 |
| Artificial manures .. .. .. .. .. .. .. | 150 |

Abstract accounts are kept of stock, crops, labour, artificial food, and manures, and on the 6th of April each year a valuation is made.

The buildings are very primitive, and need alteration. A 4-horse-power engine is used for cutting straw, pulping roots, and grinding the corn.

Mr. May's farming is deserving of high commendation, as by an economical system of management he produces good crops, and the land is in a very clean, fertile condition, great attention being paid to the management of live stock.

Mr. Charles Reynolds Keeling's Farm, near Penkridge, containing about 360 acres, we also highly commended, for its cleanliness, as well as for the good crops growing. Owing to the natural infertility of the soil and its porous nature, the crops are dependent upon a constant supply of artificial manure, and especially for securing a good root-crop, which the system adopted by Mr. Keeling is likely to produce. The present appearance of the roots is remarkably promising, and the amount of sheep stock carried upon the farm, and most liberally fed with artificial food, is the main source of Mr. Keeling's successful cultivation. This farm has been so ably and thoroughly described by Mr. Evershed, in the 'Royal Agricultural Society's Journal' for 1869, that it is needless for us to repeat the description. We can only add that the artificial food and manures purchased last year amounted to 794*l.* 4*s.* 10*d.*, bearing out our opinion that such crops upon so inferior a soil can only be obtained by artificial means, and that success is dependent upon, and may be measured by the liberality or illiberality of the tenant. The present crops fully testify to the former characteristic of Mr. Keeling.

## First-Prize Dairy Farm.

This farm is held under yearly tenure, and is occupied by Mr. John Clay, Kinsale, Oswestry, Salop. It contains 200 acres of grass, and 128 of arable land, is situated four miles east of Oswestry, midway between it and Ellesmere, and is intersected by the road leading to Oswestry. It has great convenience by road and canal, the latter, the "Shropshire Union," running through it, and boats can unload lime and manure into the fields adjoining. The land is undulating, soil a strong loam, various, with a subsoil of clay, gravel, and sand. By the canal are some meadows that had a very rough uneven surface, and soil of a peaty nature; those have been greatly improved, by deep draining, and a great expense has been incurred by the tenant in filling up and levelling, which is a marked improvement.

On the north side of the farm, several small fields have been laid down to pasturage, which were very poor and unproductive as arable. Their fences to the extent of 700 roods (of 8 yards) have been grubbed and cleared away by Mr. Clay. The whole has been drained from 4 to 6 feet deep as needed, and is now (though originally in five fields) in one large grazing pasture of 52 acres, well sheltered by a wood bounding it on the north. This new grass has been brought to its present good state and quality by the application of bones, Mr. Clay having given it in two dressings one ton of pulverized bones to the acre in the last three years. After seeing this field no misapprehension can exist as to the value of bones for grass land. The old meadows and grazing ground have been boned at the rate of $\frac{1}{2}$ a ton to the acre, and Mr. Clay purposes continuing this application every eight years.

The whole of the farm has been drained by the landlord, Mr. Wright of Halston, near Oswestry,—the grass land about 6 feet deep, and the arable 4 feet—and it appears to have been perfectly done. Nothing can excel the cultivation of the grass on this farm; it is most prudently stocked, and as the bones have produced the best herbage, continued changes keep both stock and pastures in a thriving condition. Fifty-two milking cows were kept, and there were besides 12 two-year-olds, 11 yearlings, 3 bulls, and 15 calves when we visited the farm. All looked healthy and well: the arable land is worked on the four-course system, growing good and clean crops: manure is applied to the clover root after harvest, at the rate of 12 cart-loads to the acre, some being reserved for mangolds. Half of the clovers are mown and made into clover-hay, the remainder are depastured by sheep and young beasts.

*Turnips.*—The stubbles are autumn cultivated, and in the spring crossploughed, and thoroughly worked; when ready, and as soon as the season admits, the land is ridged and 7 cwts. an acre of Lawes's superphosphate is sown upon the ridges, at a cost of 8*l.* per ton. The ridges are afterwards split, and the turnips drilled, a roller attached to the drill completing the work. The cost of hoeing is 8*s.* per acre by task; width of drill is 26 inches, and the plants are hoed with a 9-inch hoe. Every turnip is drawn off and stored by the homestead.

*Mangolds.*—The land for mangolds is prepared in the same way as for turnips; the addition being, to the 7 cwts. per acre of "Lawes," 14 cart-loads of manure applied in the previous autumn. The roots are pulled and stored early in November.

*Barley.*—This crop succeeds turnips that have been grown upon the lighter land, which has been ploughed early in the winter, in fact, as soon as the turnips are carted off. This practice generally gives a fine tilth in the spring, and needs only harrowing to prepare for sowing; seed is drilled at the rate of 12 pecks to the acre, and no top-dressing is needed, as is fully borne out by the present luxuriant appearance of the growing crop.

*Oats.*—Upon the remaining part of the turnip-land oats are taken. Having been ploughed early, it is merely harrowed, and by the middle of March drilled with from 4 to 5 bushels of seed per acre. No artificial manures are given. Upon this strong variety of soil a great advantage is derived by getting a winter's tilth, and by the heavy dressing of Lawes's manure, of which, no doubt, some portion is unconsumed by the turnip crop. A fine even tilth is a most important matter towards securing a good spring corn-crop upon land of this texture. At all events both oats and barley were very good crops.

*Clovers.*—Clover seeds are sown amongst the barley and oats, half being for mowing. The mixture of seeds is as follows:—for mowing—red clover, 8 lbs., trefoil 4 lbs., and Italian rye-grass 1 bushel to the acre. For pasturage—red clover 6 lbs., white, 4 lbs., alsike 3 lbs., with 1 peck of Pacey's, and $\frac{1}{2}$ a peck of Italian rye-grass to the acre. These seeds generally grow strong, and in ordinary seasons carry a stock of young beasts, as well as the ewes and lambs; no doubt assisted by the manuring of the young seeds after harvest.

*Wheat*—Upon the ley, in the month of August, 3 tons per acre of lime (costing 7*s.* per ton) are applied, with a small admixture of soil. If able to spare the grazing, the ley is broken up and made a pin or bastard fallow, say early in August; and in October it is again ploughed 5 inches deep, harrowed, and drilled. This system is most approved of when available, as it gives greater certainty of securing a plant of wheat, which we should think fully requisite after Italian rye-grass. The variety of wheat generally grown is red, and is sown at the rate of 2 bushels of 75 lbs. per acre. The crop of wheat did not look well, being deficient in plant. Complaint was made of the season, but we yet think that Italian rye-grass is concerned.

*Beasts.*—A stock of 52 cows is kept for milking and to make cheese, their produce being reared. The cows during the winter are kept in the cow-shed (an admirable building), and fed with pulped roots, chopped straw, grains, and oil-cake. This food is increased and improved after January. All the cows have a weekly allowance of 90 measures of grains, 40 measures of malt dust, and 12 lbs. of linseed-cake, as well as an increased amount of roots, which is continued up to grass, and until the grass has become sufficiently good. In fact, Mr. Clay says he gives it up when the cows do not heed it.

The two-year-old heifers are kept in an open yard with a good shed, and allowed a small quantity of pulped roots and chopped straw; merely sufficient to keep them in an improving state, being turned out daily into a grass field adjoining the yard. The year-olds are well cared for, and placed in two very commodious yards, with every comfort and shelter; they have pulped roots, chopped hay, and an allowance of 1½ lb. of linseed-cake daily. This food is mixed for twenty-four hours, which causes it to be in a warm state when given. Such treatment is most essential, after the care bestowed upon them as calves; for they are allowed new milk the first fortnight, and afterwards it is mixed with skim-milk. Up to six months old they are fed daily with a thick porridge of linseed-cake, Indian corn-meal, pea-meal, and hay-tea, mixed with last or coarse curds, given to them warm. Their appearance, I am sure, bespoke the good food and attention bestowed on them.

*Sheep.*—Fifty Shropshire-down ewes are kept and put to the ram, producing an average of about a lamb and a half to a ewe. The lambs are generally sold off fat from the ewes in July, excepting 20 ewe lambs to keep up the flock. These ewes run on the grass during the winter, and on the clover leys in summer to feed their lambs.

*Pigs.*—Six sows are kept for breeding, the produce of which are occasionally, at eight weeks old, sold for breeding purposes. These pigs being of a very good variety (white) are eagerly sought after; at this age they make from two to five guineas each. Those unsold are kept till seven months old, and made fat upon Indian corn and pea-meal in equal portions, mixed with whey from the house. Indian corn-meal alone, Mr. Clay says, is much too heating, hence the mixture. About 100 pigs are bred and sold annually, this part of the pig establishment proving a great source of profit.

*Buildings.*—A great amount of credit is due to Mr. Clay in the arrangement of the buildings, which have been recently erected; the landlord allowing him to have his ideas carried out as to the requirements of the farm. This has been done most effectually, and every convenience has been studied and secured. The cow-shed is 100 feet long and 33 feet wide, holding 50 cows; it has a road-way down the centre, ample width for standing, is well ventilated, and is, in fact, all that is needed for the purpose. Adjoining this is a store-room for pulped roots, cut straw, meal, &c., into which place the cut straw falls from the cutter above, and the pulper is driven near the place. All pulping, chopping, grinding, &c., is done by a small fixed 4-horse-power steam-engine, made by Clay of Ellesmere, with shafting and pulleys. There are two most appropriate small yards to hold young beasts, facing the south, which are well shedded. These yards adjoin the store-room, out of which a roadway leads for the purpose of feeding at their heads, cribbing being under the sheds.

*Manures.*—The amount annually expended in artificial manures and feeding stuffs is as under :—

| | £. | s. | d. |
|---|---|---|---|
| Bones, and Lawes' superphosphate .. .. .. | 200 | 0 | 0 |
| Linseed-cake .. .. .. .. .. .. .. | 96 | 0 | 0 |
| Indian corn and beans .. .. .. .. .. | 201 | 11 | 10 |
| Peas .. .. .. .. .. .. .. .. .. | 33 | 12 | 6 |
| Malt coombs and bran .. .. .. .. .. | 65 | 0 | 0 |
| Grains .. .. .. .. .. .. .. .. | 38 | 4 | 0 |
| Lime .. .. .. .. .. .. .. .. .. | 33 | 12 | 0 |
| | 668 | 0 | 4 |

*Horses.*—Seven cart-horses are employed, and those of the best quality for the purpose; during the season of working they are allowed, in equal portions, bran and Indian meal, 70 lbs. per week for each horse; in the summer they are turned out to grass; at the time of our visit they were on grass, and in high condition.

The corn is all mown by the scythe, and principally by task-work. It is made ready for carting at a cost of 8*s.* per acre, and is threshed by a steam-machine hired for the purpose.

*Labour.*—The labour account, including the maid-servants employed in the house, amounts to 349*l.* 4*s.*: this comprises the wages of

6 men, 48 weeks, 12*s.* per week.
6 men, 4 weeks, 24*s.* per week.
3 boys, with board, 9*s.* 3*d.* per week.
3 maids, with board, 9*s.* 6*d.* per week.

*Fences.*—The management of the fences is excellent, and, under the circumstances, great credit is due to Mr. Clay, for in the place of white-thorn they are composed of hazel; they are very neat, and the pains taken to shore them up with grass-sods greatly adds to their appearance, as well as their benefit; they are kept trimmed, and are a pattern to the district.

The present appearance of Mr. Clay's farm and the amount of stock upon it furnish conclusive evidence of the benefits to be derived from a liberal and judicious use of artificial manures and feeding stuffs. In this particular case it has enabled the farm to carry more than double the amount of stock that it did formerly; and it has, we should say, nearly quadrupled the money value of the total produce. When Mr. Clay entered upon this farm, seven years ago, it was in so poverty-stricken a condition that it had been for some time without a tenant, and its present improved state is due to the energy and enterprise of the tenant, encouraged and assisted by a landlord in whom he places implicit confidence.

*Dairy Management.*—The following remarks on the dairying have been written by our colleague, Mr. Jackson :—

The household consists, besides two younger children at school, of Mr. and Mrs. Clay, and a son and two daughters from twenty to twenty-five years old, a dairy-help, a dairy-vessel cleaner, and a housemaid. Mrs. Clay early divided with her mother the duties of the dairy, as do now her daughters with her, by a pleasing weekly interchange—alternately one week assisting to secure domestic comfort, and the next sharing the heavier work of the dairy.

Mr. and Mrs. Clay's duties begin at 6 A.M. in summer; all the others require to be at their post at 4·30 A.M. Fires have to be lit in the kitchen cooking-range, to prepare for breakfast, and under the vessel-boiler to heat the previous evening's milk. The eighteen pans of milk—about 50 lbs. each—have first the cream to be removed, and then carried with stretched arms, to avoid waddling, to the cheese-tubs in the dairy, where the two clean-scoured cheese-tubs have been brought from the dairy vessel-shed, together with ladder and milk-sieve; the vessel-boiler is filled with clean water, and one pan of milk put to heat, in order, with the new milk, to bring up the temperature in both tubs to 82° or 84°; and this, Sundays not excepted, has all to be done before five o'clock every morning, from which hour one of the Misses Clay and the other maids are, until about 6·30, employed in milking, with Mr. Clay, jun., and the cowman.

The cream from the evening's milk having been carefully warmed and equally distributed in the cheese-tubs, and the temperature of the whole of the milk in both tubs having been brought to 82° to 85° Fahr., according to the state of the atmosphere, an egg-cup filled with Fulwood's Liquid Annatto is put into each tub, when the rennet is added. This rennet had the preceding day been separately prepared for each tub, by cutting two small strips from each of three "vells" or "bag-skins" (the salted and dried stomach of a calf that had never fed except on milk); and each set of strips had been soaked in about a pint of warm water for twenty-four hours. When the milk in both tubs has been well stirred with the rennet and colour, the lids or wooden covers are put on, and left to stand until coagulation has taken place, namely, in from sixty to ninety minutes, and while breakfast intervenes.

When the new curd is perfectly formed, a curd-breaker is passed, slowly and carefully at first, and then more rapidly, through the newly formed custard of both tubs. By about 8·30 A.M., the curd has sunk and the whey come to the surface, the dairy servants having previously lifted out of the furnace or whey-pan the two cheeses made the previous day, weighing with the vats nearly 100 lbs. each, deposited them in the press-room, and well cleaned the whey-pan. The whey from both cheese-tubs is easily removed with one of Mr. Manock's patent newly invented "whey pumps" or separators, and with a tin tube from the pump to the whey-pan. This operation occupies forty-five minutes, until the pumping ceases, and the curd is removed to the drainer, when both tubs are trundled out to the vessel-shed to be scoured and scalded, and put to sweeten ready for the next morning. It is but simple justice to say that not a spot is left on the floor of the dairy.

The drainer is an oblong trough or vat on wheels, patented by Mr. Cornes, of Barbridge, Cheshire, and took a prize at Oxford last year. In this trough the curd is cut up with the hand, on the old plan, instead of with the curd-mill, turned, pressed, and ultimately separated into small particles, to allow the whey to drain freely from it. The curd, when sufficiently dry, is put into the vats. Salt is mixed with the curd to the taste of the dairymaid; but with a view to ascertain the proportion of salt to curd, both were weighed on the last day of our inspection, and the result was 1 lb. of salt to 35 lbs. of curd, when dry for vatting. On that day, this was done by 11 o'clock, and the cheese put away to go into the whey-furnace when the furnace was sufficiently cooled.

During the time taken up as described in breaking the curd and vatting the cheese, the temperature of the whey in the furnace or whey-pan rises by about 10·30 A.M. to 175 degrees, when the cream begins to rise to the surface in fine curds, called fleetings, which are removed carefully with a skimmer. When a pot and a half, say about twelve gallons, has been thus obtained for churning, and the heat has risen to 180 degrees, a coarser kind is taken, technically called "men's fleetings," because they serve the men-servants or labourers for breakfast, and are very nutritious. The heat having steadily risen to 185 degrees, a still coarser kind is taken, and this, while hot, is mixed with Indian meal and oilcake for rearing calves, which do exceedingly well upon it.

As soon as the fleetings have all been taken, a tap is turned, that connects the furnace by a pipe with a cistern in the pig's food-house, into which the whey passes, and becomes food for pigs, on which, with Indian meal, they grow and fatten well.

The cheese is either so well managed, or the pastures are so favourable to the cheese drying under press, that but one lever and four stone presses are used, only six cheeses are under press, *i.e.* three days' make down-stairs, two being made per day. Thus the turning under press is a light affair (compared with the ordinary case of ten to fifteen cheeses under press), and occupies only about thirty minutes. The two cheeses that are taken from under press have their edges nicely pared, and the sides smoothed with a hot iron; and this process on both cheeses occupies Mrs. Clay over one hour, and is very nicely done.

The cheeses up-stairs, although 70 to 80 lbs. each, are firm, and look well, notwithstanding that they are only turned twice a week. The fodder-cheese had been sold previous to our visit at 70*s.*—a very extreme price for this spring. Mrs. Clay's cheeses have taken various prizes at the local shows, and one of the lots exhibited at Wolverhampton this year was highly commended; and, on conferring with the Judges of cheese, we learned that the samples only required time to mature and become fine. We tasted one of the older cheeses, which was rich and mild as cream, and equal to the best Stilton.

The dairy, milk-room, press-room, and dairy-scullery, are well adapted to their purpose. Even while the work is being done their neatness and cleanliness are marvellous, and the domestic department has an air of comfort and taste rarely to be found in association with domestic dairying, and only attainable where there are daughters to divide the duties, and sufficient dairy servants to do the heavy dairy work.

## Second-Prize Dairy Farm.

This farm, consisting of 143 acres of grass and 117 of arable land, is occupied, under yearly tenancy, by Mr. Matthew Walker, and is situated at Stockley Park, about 4 miles north-west of Burton-on-Trent, and near the vale of the River Dove. This valley extends to Uttoxeter, and is considered a rich pasture district, principally devoted to dairy farming, and comprising some first-class dairy-farms and farm-buildings. Adjoining Mr. Walker's farm resides his landlord, Sir Oswald Moseley, who has erected a most elaborate and complete covered homestead for his own home-farm dairying; and in the neighbourhood is the noted Castle Hay's Dairy Farm, so favourably noticed by Mr. H. Evershed in his Essay on the Agriculture of Staffordshire, in the Society's 'Journal' of 1869.

Mr. Walker has not the advantages of his neighbours: he has neither the convenient buildings, nor the rich pasturage; and the arable portion of his farm is of so retentive a clay that it is with some difficulty made to produce paying crops. Indeed, were it not for his heavy outlay in feeding-stuffs and artificial manures, this part of the farm would soon become profitless. Even now we consider that some of it might advantageously be laid down to grass. The course of cropping adopted is the following:—(1) turnips, mangolds, and cabbage; (2) barley and wheat; (3) seeds; (4) oats; (5) wheat.

The manure is generally applied for green crops in the autumn, and occasionally upon a portion of the seeds. Very few turnips are grown, but principally mangolds and cabbage, which are heavily dressed with Proctor and Ryland's artificial special manure. Barley succeeds this crop, and is drilled at the rate of 3 bushels to the acre. Seeds are sown with barley, viz., red clover and trefoil, together 12 lbs., with 1 peck of Italian rye-grass, to the acre; they are principally mown and made into clover-hay. Oats are sown in the spring, the variety being Canadian, at 4½ bushels to the acre, and when malt-dust can be procured, they are top-dressed at the rate of half a ton to the acre: this is found to be a good tillage. Wheat is sown after oats, which ends the rotation. Hallett's Pedigree and Browick Red are the varieties of wheat usually sown. None of the crops were first-rate, but from the nature of the soil they were as good as might have been expected. The grass-land had a much better appearance; and one pasture, which is irrigated, produces a rich and bountiful herbage. Mr. Walker has greatly improved some of the grass on the higher land by foldyard manure, which in time, if continued, will make the produce nearly, if not quite, equal to that on the lower part of the farm. His system of stocking the pastures by continued changes keeps them thriving, and doubtless is the proper mode of grazing, having also a beneficial effect upon the milking cows. Forty-eight cows are kept for milking, and the milk is made into cheese. Fifteen heifer calves are reared, and bulled when two years old, to keep up the stock; the cast cows are milked through the winter, and their milk is made into cheese; when near calving they are sent to market and sold. Cows, in the winter, are tied up in a cowshed; and Mr. Walker informed us that 50 cows and 20 yearlings consumed weekly 120 bushels of grains and 1 ton in weight of mangolds, pulped and given with chopped straw, and an allowance of 1 lb. of Indian corn-meal each per day. The yearlings are kept loose in a covered yard. The cows, when approaching calving, are allowed an increased quantity of meal. Artificial food is continued through the summer, and 48 cows were having, at the time of our visit, 120 bushels of grains and 56 stones of sharps weekly, costing 8*l.* per ton. They are fed morning and evening. Grains are bought at Burton at 4*d.* per bushel, and the meal and grains are mixed daily. The stock of beasts upon the farm comprised 48 cows, 2 bulls, 21 year-and-a-half-olds, and 16 calves, making a total of 107 head.

A small flock of 33 Shropshire-down ewes is kept, producing, on an average, a lamb and a half to a ewe. The lambs winter upon the grass, with an allowance of artificial food and a very small quantity of roots. They are sold off after clipping and when fat.

*Pigs.*—A very valuable class of pigs is kept for breeding, Mr. Walker paying the greatest attention to this department.

The piggeries are admirably arranged, all under cover, having —what is not usually seen—ample room in each subdivision. This building contains also every accommodation needed for preparing the food. A pipe brings the whey from the house, and empties itself into a tank; a copper is fixed for boiling, which will hold 150 gallons, and the food is prepared by putting into this quantity of water about 2 bushels of Indian meal. The water is allowed only to simmer, and the mess is then ready for use. Twelve sows are kept for breeding, and the usual practice is to sell the pigs, for breeding purposes, at the age of 12 weeks. They frequently make from 4 to 5 guineas each. Mr. Walker's success at the various shows furnishes sufficient evidence as to the superior quality of his pigs.

The pigs receive every attention, and consume a large amount of food. Mr. Walker gives his last year's account of artificial food for pigs at 360*l*. 9*s*. 6*d*. A covered yard adjoins the piggery, where the drape sows usually run and are fed, as also the yearling beasts during the winter; this covered yard was made at Mr. Walker's expense.

There is nothing specially worthy of notice in the treatment of the horses. Eight are worked on the farm, which is rather a large number for the amount of arable land.

*Manures.*—The manure-hill is greatly increased by the amount of spent hops which are brought from Burton; in the winter 5 tons a week are trodden, and during the summer the floors of the sheds are covered, for the cows to stand upon, morning and evening. The amount paid for purchased food, as well as artificial manures, is as under:—

| | £. | *s.* | *d.* |
|---|---|---|---|
| Artificial manures .. .. .. .. .. .. | 105 | 14 | 0 |
| Food for pigs .. .. .. .. .. .. | 306 | 9 | 6 |
| Ditto cows .. .. .. .. .. .. | 269 | 6 | 5 |
| Ditto sheep .. .. .. .. .. .. | 11 | 2 | 6 |
| Ditto horses .. .. .. .. .. | 50 | 10 | 7 |
| | 743 | 3 | 0 |

Still, with this annual outlay, which is certainly excessive, the arable land is of so heavy and retentive a nature, that the present appearance of the crops does neither Mr. Walker nor yet the manure justice for such liberal treatment.

A mill is also upon the farm and in Mr. Walker's occupation; it is driven by a water-wheel, and grinds all the corn used on the farm besides grinding for hire. Six labourers are employed (including the miller)—three single men and three boys—through the year, and the labour-bill is 302*l*. 3*s*. 9*d*.

*Cheese-making.*—The following is Mr. Jackson's Report on the Dairying:—

Mr. Walker has made on an average over 4 cwts. of 120 lbs. of cheese per cow, even the last three bad years—his winter-made cheese fetching 81*s*., and the summer made more than 83*s*. per cwt. of 120 lbs. He has also gained the three first prizes of the Staffordshire Agricultural Society, and the Society's three silver medals for the best cheese in both classes, thick and thin. Last year he took the first prize of A. Bass, Esq., M.P., open to all Staffordshire and fifteen miles from the borders. He has taken two first prizes for cheese of the Derbyshire Agricultural Society, together with a number of local cheese prizes; and as the system of cheese-making practised by Mr. Walker has not been described or known, except in that important dairy district, a special visit was made with a view to record some of his more peculiar features of dairy management.

1st. Mr. Walker gives his cows through the summer two feeds of grains per day, viz. 17 stones, at 4*d*. per stone, and 8 stones of Indian meal, at 1*s*. per stone, costing for fifty cows 13*s*. 8*d*. per day. This will explain the large quantity of cheese made per cow per year, and the exceptional richness of the milk, 90 lbs. of which yielded 3 lbs. 4 ozs. of butter, as shown in Table No. 3, p. 341. It was remarkable, in the month of July, to see how eagerly the cows left their pastures and rushed to their stalls; and Mr. Walker considers that the cheese and butter pay for the food, and leave him a profit in the increased fertility of his pastures.

2nd. He, by rearing a large number of female calves, is enabled to draft off his worst milkers, and by putting them late to the bull they milk through the winter and part of the second summer, when they generally fetch high prices for winter milkers; and thus he makes cheese through the winter.

3rd. The cows are milked by the men, Mr. Walker and his farm pupil assisting; and the importance of good milking may be illustrated by the case of Mr. Brown, of Preston, one of the competitors, who thus writes:—"I give high prices for my cows, I keep them on expensive food, and to hear and see them badly milked is a trouble I cannot bear. So well as my cows did the last year, considering the season, I am satisfied they would have done much more if my milkers had been up to their work. It is my determination to have only those that would go about their work in a way so as to give the cow an apparent pleasure in giving her milk, rather than hold it back, as she will do to an indifferent milker. Again, I strictly enforce habits of cleanliness, a vessel of clean water and a towel being kept in or near the shippon, in order that each milker should keep his hands perfectly clean. It is the want of proper attention to these matters of detail that is the cause of so much ill-flavoured cheese and butter being sent into the market." We have no doubt that the milking is better done by males, and in Mr. Walker's case it has the advantage of giving those employed in the dairy an extra three hours per day for their work, which they really need.

The milking commences at 5 o'clock, night and morning, and ends from 6·15 to 6·30 o'clock—one of the milkers carrying the milk, with a yoke and swing tins, crossing the farmyard, through the kitchen, and into the cheese-making room, where each night the milk is poured into four milk-coolers. These coolers are placed in a trough made of Staffordshire bricks and cement, into which the dairy-help has pumped spring water. After remaining in the water for about three-quarters of an hour, having been frequently stirred, the milk is poured into one of the two cheese-tubs, such as are known in the district as "Travise's Patent," and for which Messrs. Mellard, of Rugeley, last year obtained a prize at the Oxford Show. These tubs or vats, made of block tin, stand on wooden stages about 10 inches high. One tub is 3 feet 4 inches and the other 3 feet 1 inch in diameter, and both are 2 feet deep. Each tub has a perforated follower called a sinker; and for putting pressure on the sinker is a wooden frame with a contrivance above, resembling those of the lever cheese-presses, but having a much heavier weight—say of 40 or 50 lbs. In the front of the tubs are two vents, the one about 6 inches above the other, to each of which a screw plug is fitted, and withdrawn at pleasure to let out the whey. The first milk from the coolers being poured into the tubs or vats—the same coolers are refilled with milk, and replaced in the cooling trough, into which the help has again for about ten minutes been pumping spring water. The milk, both in the coolers and the vats gets a frequent stirring until bed-time, to keep the cream from rising.

The household consists of Mr. and Mrs. Walker, a farm pupil, three little children, a cowman, a pigman, waggoner, and two lads; the dairy-help, vessel cleaner—who is also housemaid—and the nurse girl, Mrs. Walker acting as dairymaid.

The dairy duties begin in the morning at 5 o'clock—the vessel-cleaner or housemaid lighting the cooking-range fire, and the dairy-help the vessel-boiler fire. The dairy-help is fortunately strong, active, and interested in her duties. She is intrusted to skim, scald, and purify the whey "top" or cream—a barrel churn being used—and in July about 30 lbs. of butter per week was taken, or over half a pound per cow for fifty cows. But some cream is now being taken off the evening's milk, in consequence of the cheese being so rich and tender, for although one of the samples of cheese exhibited at Wolverhampton was commended, and the other highly commended, they were, as stated by the cheese Judges, wanting only in firmness.

The morning's milk, when brought in from the cows, is poured into the cheese-making tub by the milk carrier, in such proportions as directed by the help; when she and the housemaid take from the cooling-trough one of the milk-coolers, of the evening's milk, and lift it on the side of the vessel-boiler; then both mount the boiler, and gently let down the milk-can into the boiling water, and when it is sufficiently heated they again bring it and pour it into the cheese-making tubs; and this process is repeated until the new milk and the old in tub No. 1—for two cheeses—is raised to about 80°, and in No. 2 tub—for one cheese—to about 90°; there being in No. 1 tub double the quantity of milk, for two cheeses, it will retain more heat, so that by the time coagulation has taken place the heat in both will be nearly equal; and no further heat is applied in the process of cheese-making. Were heat applied as in the Cheddar, or slip-scalding process, there would, we apprehend, be no danger of excessive richness in the cheese, and much labour would be saved. When the temperatures already indicated have been obtained, an ordinary-sized teacup twice filled with rennet is put into No. 1 tub, and once filled into No. 2 tub; and a table-spoon twice filled with liquid annatto—prepared by Mr. Hodway, of Tutbury—is put into No. 1 tub, and once into No. 2. The contents then being well stirred, the tubs are left uncovered; but previous to the stirring, about $2\frac{1}{4}$ lbs. of salt is put into No. 1 tub, and half the quantity into the other. This is done instead of salting the curd, and is a new feature; the small quantity of salt put in the milk is accounted for by the cheese being salted under press; and although this may be well for *thin* Derby or Leicester cheese, it would not do for thick cheese like Cheddar or Cheshire.

The rennet and colour are added at 6·20 A.M. to No. 1 tub, and at 6·30 A.M. to No 2; in the first, coagulation was complete by 7·20, and in the other by 7·50 A.M., probably the extra 20 minutes in the second case may be taken as an indication that the smaller quantity of milk had cooled too rapidly, which could be avoided by the use of the steam or hot-water vat.

The mode of preparing the rennet is new, interesting, and cheap. A gallon of the greenest or poorest of the whey is kept, put into a saucepan and gradually heated and skimmed until it has thrown up all the curds. A pint of strong brine is then added, and the whole boiled for ten minutes and put to cool until, say, 85° temperature, when 3 dried vells or "bag skins," kept from the previous year in salt pickle, are put into the liquid and well rubbed in it. Then the three last bag-skins are taken from the former rennet, distinguished by being tied together, and these six are left in the rennet, which on the second day is fit for use, and serves for about two weeks.

When the men servants had breakfasted, they carried the whey tubs from the whey-room to the kitchen, and poured their contents into a cast-iron head, and so the whey passed to the pigs' food-house. Putting the contents of each tub at 112 lbs., a man on each side managed it, without much slopping, at ten journeys, the weight of the whey exceeding half a ton.

The rennet and colour having been added as described, breakfast intervened, while coagulation was taking place up, to 7·20 A.M. The help had hitherto acted as dairymaid, leaving Mrs. Walker free for domestic duties, and to scatter her bounty to a numerous and no doubt profitable progeny of poultry.

After breakfast I noted the following course of operations:—

The dairy-help commenced by lifting the presses and turning 18 cheeses, rubbing each on the edges and sides with salt, and pricking or stabbing with a thick skewer each side of the 3 cheeses from the previous day, and putting clean dry cloths on them all. Mrs. Walker, at 7·20 A.M., proceeded to break up the curd or custard, with an ordinary tin curd-breaker (save that the handle was placed at an angle of 45° to enable it to be worked under the beam over the cheese tub, which supports the screw and lever, by which pressure is put on the sinker), by passing the breaker up and down, slowly at first, to prevent any loss of curd in the whey. When finishing, the breaker was used more freely. A great improvement on these breakers is the American frame, with a series of sharp thin steel knives, which cuts the tender curd instead of bruising it. When No. 1 tub was finished, the sinker was slowly let down on the curd to settle it more rapidly than by its own specific gravity. The same process was repeated on No. 2 tub; and at 8·10 A.M. the whey tubs, which had been carried out by the men to the vessel-shed, were brought cleaned by the housemaid. A hair sieve—with a contrivance for hooking it inside the whey-tubs—was then placed under the vents of No. 1 tub, and the upper plug withdrawn, until the tub was sufficiently filled, so that Mrs. Walker and the help could carry it into the whey-room and pour its contents into larger tubs on the stage, which required considerable strength. When the whey from No. 1 tub had been drawn down to the upper vent, a strong wooden frame was placed on the sinker, and slight pressure applied by the contrivance from above. This done, the same operation was repeated on No. 2 tub. At 8·25 A.M. the frames and sinker from No. 1 tub were removed, and the whey drawn from the lower plug, and then Mrs. Walker and the help, each with a large knife, standing on the wooden stage and leaning on their breasts over the edge of the tub, proceeded first to cut the curd into cubes, and then into slices of from a quarter to half an inch thick, in order to set the whey at liberty. At 8·50 A.M. the sinker and frame were returned, and increased pressure applied; next, the curd in No. 2 tub was subjected to like treatment. At 10·20 A.M. No. 1 tub was in like manner cut up, and increased pressure applied; and for the third time at 11·20 A.M. No. 2 was thus treated for the third time at 12 o'clock, then both were left to stand until after dinner. Having to stoop under the beam or frame, which passes over the tub, renders the position of the cheese-maker difficult, and, if she be a mother, perilous, as may be inferred from a neighbouring farmer stating that his wife advised him to give a wholesale order for busks, for she broke so many while cutting up the curd. At 2·15 P.M. the frame and sinkers were again removed from tub No. 1, and the curd cut into slices of about 2 inches thick, when the curd-mill, consisting of two wooden barrels or cylinders, thickly studded with wire spikes, was used; and, as the curd was firm and tough, considerable power was needed to turn it. Under the mill was placed a mould or cheese-vat 18 inches over, and about 4 inches deep; over this was spread a clean dry cheese-cloth, and the ends brought up to the sides of the mill to prevent any crumbs from falling, and when half the curd from No. 1 tub was ground, the cloth was folded over the cheese, and it was removed to the lever press. In like manner the curd was ground for the other cheese, and also for the one cheese from No. 2 tub. After remaining under the presses for four days, and turned daily, the cheeses will be taken to the cheese-room, where, until they are about three weeks old, they will be daily rubbed with the hand and turned over; after this they will be turned alternate days until sold, when about two months old.

As I left before 4 o'clock, I give the following sketch of what remained to be done before bed time, or 10 o'clock P.M.:—

The three newly made cheeses had to be thrice taken from under the press and pricked with a skewer, the last time about 9 P.M. Both the cheese-tubs, with the sinker and wooden frame, and also the curd mill, had to be carefully cleansed and scalded; the whey room, cheese-making room, and kitchen floors to be well washed down; some 20 cheese-cloths to be washed and put to dry for morning; water pumped for this, and also to twice fill the milk-cooling trough; the evening's milk to be cooled, stirred, and treated as before described. The evening's milking vessels had to be all well washed and cleansed, the whole or part of the upstairs cheese to be turned and rubbed, and to what has already been described, must be added the household duties of this weak staff. Churning, butter-making, baking, cooking, washing, mangling, and a host of other domestic duties in a family where there are seven males, four females, and three young children to be fed and cared for. It is not very wonderful that Mrs. Walker, the daughter of a successful and retired dairy-farmer, at one time resolved that she would not be the dairy-maid; but the difficulty of getting hired servants to successfully manage a dairy eventually broke down her resolution, and she now smiles at her work, though this round of duties knows no cessation, for the cheese-making here continues all through the winter. I therefore feel that I cannot better conclude than in the words of Mr. MacAdam in his admirable treatise on 'Domestic Dairying:'—

"At present there is heard from many quarters a loud and earnest appeal for sufficient rest and leisure, and fewer hours of labour, and no class has better cause to turn this appeal into a demand than those employed in cheese-making. It is no uncommon thing to find them engaged from 5 o'clock in the morning till after 8 at night, in milking, making, and turning cheese, or cleaning the dairy and utensils; and this Egyptian bondage is seldom lightened by the repose and sanctity of the Sabbath, for the thoughtlessness, or prejudice, of landlords and farmers, or a false motive of economy, often compel them to continue their drudgery on that day. Surely such a state of affairs is worse than a want of profit, and far more reprehensible than a lack of success. Must these have no leisure, no recreation, no culture, nothing save the protracted hours of labour and a stinted allowance of rest? Must all their energies of mind and body be directed to the accomplishment of such tasks as selfishness or apathy is pleased to impose, and which circumstances compel them to perform?"

When Mr. MacAdam penned the above, he was an advocate for 'Domestic Dairying.' He and his sons are now managing several American Cheese Factories, and he advocates their adoption in England with still greater prospects of success.

## General Remarks.

*Dairy Management.*—Hitherto no register of results has been kept in the majority of home dairies showing the pounds of milk taken to make a pound of cheese or butter, by which means alone the value of milk for such purposes can be compared. The experiments with churns at the Oxford Show last year had a value beyond what was expected, bringing to view how small a quantity of butter was obtained from the milk experimented upon; and the large prizes offered for dairy-farms this year have afforded an opportunity of getting from the competitors the quantity of cheese and butter, and the labour required under the best home-dairy management. In the first of the annexed tables the quantities are those yielded by the different modes of cheese-making at successful dairy-farms.

No. 1.—A Table showing the lbs. of Milk under domestic Dairying to make one pound of pressed Cheese.

| Date. | Name of Competitor. | Number of Cows. | Milk in lbs. | Cheese when pressed. | lbs. of Milk to make 1 lb. of Cheese. |
|---|---|---|---|---|---|
| | | | | lbs. | |
| July 3 | Mr. M. Walker, Stockley Park, Staffordshire .. | 42 | 1244 | 124 | $10\frac{1}{31}$ |
| ,, 13 | ,, ,, ,, | 41 | 1193 | 112 | $10\frac{73}{112}$ |
| ,, 26 | Mr. J. Clay, Kinsale, Oswestry, Salop .. .. | 50 | 1483 | 144 | $10\frac{43}{144}$ |
| ,, 6 | Mrs. Sankey, Bratton Farm, Wellington, Salop .. .. | 18 | 478 | 45 | $10\frac{28}{45}$ |
| ,, 13 | Mr. George Jackson, Tattenhall Hall, Cheshire .. | 95 | 2520 | 256 | $9\frac{108}{128}$ |
| June 14 | Mr. Thomas Cooke, Handley, Cheshire .. .. .. | .. | 1430 | 140 | $10\frac{3}{140}$ |

No. 2.—A Table showing the average quantity of Milk per Cow per day.

| Date. | Name of Competitor. | Number of Cows. | Milk in lbs. | Average per Cow. |
|---|---|---|---|---|
| | | | | lbs. oz. |
| July 3 | Mr. M. Walker, Stockley Park, Staffordshire .. .. .. .. | 45 | 1324 | 29 6 |
| ,, 13 | ,, ,, ,, | 45 | 1269 | 28 3 |
| ,, 8 | Mr. J. Clay, Kinsale, Oswestry, Salop .. .. .. .. .. .. .. | 50 | 1574 | 31 8 |
| ,, 7 | Mrs. Sankey, Bratton Farm, Wellington .. .. .. .. | 18 | 478 | 26 8 |
| ,, 4 | Mr. Mays, Elford Park, Tamworth .. .. .. .. .. | 20 | 645 | 32 4 |
| ,, 13 | Mr. George Jackson, Tattenhall, Hall, Cheshire .. .. .. .. | 95 | 2520 | 26 8 |

No. 3.—A Table showing the value of Milk for Butter-making.

| Date. | Name of Competitor. | Number of Cows. | Milk in lbs. | Butter in lbs. | Butter per lb. | Milk per gallon. |
|---|---|---|---|---|---|---|
| | | | | | *d.* | *d.* |
| May 27 | Mr. May, Elford Park, Tamworth .. .. | 20 | 322 | 10 | 13 | $4\frac{1}{18}$ |
| July | Mr. White, Knowle House, Lichfield—a week's milk .. | 10 | 1782 | 50 | 17 | $4\frac{3}{4}\ \frac{4}{891}$ |
| ,, 27 | Mr. M. Walker, Stockley Park, Staffordshire .. .. .. | 5 | 90 | 3.4 oz. | 14 | 5 |
| ,, 26 | Mr. J. Clay, Kinsale | 8 | 250 | 8.6 oz. | 14 | $4\frac{1}{4}\ \frac{4}{25}$ |

In American cheese-factories 10 lbs. of milk has produced rather more than 1 lb. of cheese. But as at both the Derbyshire cheese factories last year it required 11 lbs. 8 ounces of milk to make 1 lb. of ripe cheese, it became an interesting question whether English farm-dairies could do better. If 6 lbs. or 8 lbs. per cwt. be allowed for loss between the cheese when taken from under press and when marketable, it will be evident from the tables that in the month of July the best farm-dairying did not get from milk more cheese than was obtained by the Derbyshire Cheese Factories.

*General Cultivation.*—We were much pleased with the general cultivation of the districts in the two counties through which we travelled. The fences were the most apparent drawback, but we acknowledge the difficulty of making either good or attractive the present old crooked fences upon banks, which are so very general. Our first visit of inspection was at the time fallows were being prepared for turnips, and nothing could exceed the excellence of the system adopted. Autumn cultivation is almost invariably practised, and frequently by steam-power. So thoroughly do they cultivate and pulverize the soil, that success is next to a certainty; and with the autumnal application of foldyard-manure, and the heavy dressings of artificials in the spring, many farms, besides those specially brought under our notice, were in a high state of fertility, bearing out this principle—that the successful cultivation of green crops is the foundation of all good and profitable farming. No doubt, as a rule, the arable land is well managed; but we could not approve of the system of sowing such large quantities of rye-grass amongst the clovers; for it must have (and this the growing wheat-crop proved), a deleterious influence upon the success of that crop. Some system should be adopted, as in other counties where clover-sickness prevails, to alter the rotation so as to replace the clovers by a green crop, either peas, beans, or vetches; whichever of these crops be introduced must be governed by its adaptation to the soil. The sowing of such a large quantity of rye-grass was the only feature of which we did not approve, and seeing, as we did, the universal thin plant of wheat sown after ley, we became even more convinced that this was the cause. The grass-land, as a rule, is well managed, but where bones and artificial manures had been applied there was a marked improvement in the quality of the herbage. Irrigation appears on the increase, and wherever it was considered practicable to obtain water for this purpose it was made available, and we heard of many instances of tenants having borne the whole expense of securing it. As a rule, the buildings were inadequate to the requirements of many farms; and, as we travelled, our attention was frequently drawn to this particular, as well as to many steadings in a dilapidated condition. This, we trust, may not continue long in the present age of improvements, and especially where tenant-farmers are so liberal in their outlay for manures. Good tenants, assuredly, must be deserving of sufficient and commodious buildings, without which they cannot fully carry on the proper cultivation of the land. We were glad to find cottage accommodation upon farms for the labourers; and in all instances they were highly appreciated by the tenants. Only one farm in our inspection, namely, Mr. May's, of Elford Park, whose farm we highly commended, was without this convenience. His labourers had to walk two miles night and morning; and the difficulty of securing good workmen with this drawback, is, Mr. May informed us, becoming constantly greater.

We cannot close our remarks without acknowledging the very kind reception we received throughout our inspection, and the marked attention given us, as well as the willingness to render every detail connected with profit and loss. It was also satisfactory to find that there was not one competitor who was unable to give us the information which we required.

(Signed) JOHN WHEATLEY.
W. SANDAY.
G. JACKSON.

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## XIII.—*The Present Condition of the English Agricultural Labourer.* 1871. By JOHN DENT DENT, M.P.

A QUARTER of a century has passed away since Mr. George Nicholls wrote his Prize Essay in the 'Royal Agricultural Society's Journal' on the condition of the English agricultural labourer, with suggestions for its improvement. At no period probably has a greater change taken place in the condition of all classes of society than during these twenty-five years; and it is a fair matter for inquiry whether the agricultural labourer has made as much progress as the rest of his countrymen. Some people, no doubt, believe that his position has been comparatively unaltered—nay, that in many respects he is worse off now than he was five-and-twenty years ago, inasmuch as the enclosure of waste lands, the enlargement of farms, and the consequent necessity for a greater amount of capital being invested in agricultural undertakings, have deprived him of privileges, and removed beyond his reach means of improving his social condition, to which he might otherwise legitimately aspire. Added to this, some will say that he is unimaginative, ill-clothed, ill-educated, ill-paid, ignorant of all that is taking place beyond his own village, dissatisfied with his position and yet without energy or effort to improve it, oppressed by his employer, and neglected by his landlord. Even supposing these charges to have a portion of truth in them as regards the labourer in some of the southern and western counties of England, where agriculture is almost the only source of employment open to him and his family, and where the influence of railway communication has not been sensibly felt, it certainly is not true of this class in the greater portion of the United Kingdom. And we are enabled, from the inquiries that have recently been made under the authority of Parliament, to form a very fair opinion of the present position of the agricultural labourer in England, and to contrast it, not only with that of other classes dependent upon manual industry for their support, in this and other countries, but with his own position twenty or twenty-five years ago.

Perhaps nothing has done more for the agricultural labourer than the opening out of the country by railway enterprise, and the facilities thereby afforded for the movement of superfluous labour from one district to another. In 1846, when Mr. Nicholls wrote his essay, there were but 3036 miles of railway open in the United Kingdom, carrying about 48,000,000 passengers per annum. In 1869, the number of miles open was 15,145, and the passengers carried in that year were 305,668,071, exclusive of season ticket-holders. The application of machinery to all purposes of agriculture during this period increased to an immense extent. In the prize-list of the Royal Agricultural Society for 1847, a single prize of 20*l.* was offered for the best threshing-machine applicable to horse or steam power; and this appears to be the only allusion to steam-power in the prize-list for the year. Of late years so numerous have been entries of different classes of steam-engines to provide motive power for dressing corn for market and for preparing food for stock, that it has been found necessary to try the fixed engines only in one year, and to postpone the trials of the important class of portable engines to another season. The scythe and the reaping-hook are fast passing out of fashion; the heavy work of the mower and the severe strain upon the reaper have been almost entirely removed by machinery; while steam, not satisfied with its mastery of the indoor work of the farm, has already been used in twenty-seven counties of Great Britain to prepare the soil itself for the future crop.*

With this rapid advance of mechanical discovery in aid of the labour of the farm, the men who have to work and to guide

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* Agricultural Returns, 1870, page 16.

the inventions of the engineer must necessarily progress in skill and ability, and fit themselves to earn the higher wages which are paid to those who attend similar machinery in the factory and the forge. In this, as in every other department of agriculture, there is ample scope for improvement. A better education, both elementary and technical, is wanted for the agricultural labourer; this, combined with more comfortable and healthy dwellings, would stimulate his mental faculties and improve his working powers, and so enable him to earn a better wage for himself without becoming a more costly servant to his employer.

Recent Parliamentary inquiries have thrown much light on these matters, and for those who wish to pursue the subject farther it may be well to indicate the sources from which much of our information is derived. On the 18th of June, 1865, the Commissioners who had been making inquiry into the employment of children, young persons, and women, in trades and manufactures, were authorised to extend their investigations to the system of organised agricultural gangs, which existed in some of the eastern counties. The Report of that inquiry, and the evidence on which it was founded, were presented to Parliament, in 1867, and led to an Act being passed for the Regulation of Agricultural Gangs, and to a further extension of the Commission, on the 18th of May in that year, in order "to inquire into and report on the employment of children, young persons, and women, in agriculture, for the purpose of ascertaining to what extent, and with what modifications, the principles of the Factory Acts could be adopted for the regulation of such employments, and especially with a view to the better education of such children." The Commissioners made their first and second Reports, with two accompanying volumes of evidence, in 1868 and 1869, on the English counties; and their third and fourth Reports, with appendices of evidence, on Wales and Scotland respectively, in 1870. These volumes present a mass of information, not merely on the employment of women and children, but on the rate of wages, the food, lodging, education, and social position of the labourer, and incidentally on the cost of his labour to his employer, and on the variation of wages according to the system of agriculture pursued. In 1870, a Report on the Wages of Agricultural Labourers in Ireland was made; and Reports from her Majesty's diplomatic and consular agents abroad respecting the condition of the Industrial Classes in Foreign Countries, were presented to Parliament in the same year, and include some interesting information as to the agricultural labourer.

Mr. Nicholls * pointed out four methods of improving the condition of the agricultural labourer:—

* 'Royal Agricultural Society's Journal,' vol. vii. p. 5.

1st. By enlarging the field of labour.
2nd. By extending the benefits of education.
3rd. By providing comfortable cottages.
4th. By providing cottage gardens.

At the time of Mr. Nicholls's essay there was in many counties a surplus of agricultural labour; and during the winter months it was no unusual thing for many men to be thrown out of work, and to be dependent on poor relief, or on the exertions of land-owners who created employment for them; but although this may still be the case to a limited extent, as a general rule an over-supply of agricultural labour is unusual. In many districts a spirit of change has come over the class, and there is a constant movement in search of higher wages and more lucrative work; and the only way to retain good men upon farms is by improving their houses, and making their wives reluctant to leave a comfortable home; but even then the young people are looking forward to fresh fields of employment where they receive higher pay for work, and are migrating from the country into the towns to an extent which may probably hereafter afford a legitimate field of inquiry for those who are anxious to retain the best agricultural labourers in their own districts. In the manufacturing counties of the North there is not only the temptation to go into the towns, but there are frequently also situations in their own sphere of labour which afford excellent openings for agricultural labourers. The prosperous manufacturers and tradesmen of our northern towns take every opportunity to buy or to rent land, and set up, either the model farm on an extensive scale, with high-bred shorthorns, and every appliance of modern husbandry, or the more moderate establishment of twenty or thirty acres of land, with dairy, pigs, and poultry. In either case there is a field for well-paid good agricultural labour; and in the smaller establishments it is no unusual thing for a steady man and his wife to receive from 18*s.* to 20*s.* per week, and a house rent free, to look after the horse, cow, dairy, poultry, &c.; and, to our own knowledge, many of the best and smartest of the young married agricultural labourers obtain such situations, and with prudence and care are soon enabled to save very satisfactory sums from their wages. Again, the general police force and the ordinary staff of railway servants hold out special advantages and attractions, and have their ranks mainly filled from men of this class. Of late years another sphere of employment has presented advantages which are scarcely sufficiently appreciated. A recent Parliamentary return estimates the "equivalent weekly wage of a private soldier, including food, lodging, clothing, &c., in the cavalry and artillery, at 15*s.* 9*d.*; in the Foot Guards, at 14*s.* 6¼*d.*; in the infantry of the line, 13*s.* 5¼*d.*," and this exclusive of pension, and supposing short service to be adopted; while at the end of the term of service there is no difficulty in obtaining remunerative employment, if we may take the experience of Captain Walter, the admirable commanding officer of the corps of Commissionaires in London, who says in his last report, May, 1870:—"The wages of the men continue to increase. They can now readily obtain the highest rate for their various services that the labour market affords, and the applications of employers are still so much in excess of the supply that during the last twelve months nearly 100 more situations might have been filled had that additional number of men been available. It seems to me that there is always an abundance of employment for men, provided they are sober, honest, and capable of giving a day's work for a day's wage." And while these extraneous sources have widened the field of employment, the use of machinery, which has eased the burden of toil, has not lessened the demand for labour in agriculture itself. Improved cultivation, more general and thorough management of root-crops, the extension of sheep farming, and winter feeding of stock, induced by the high prices of wool and meat, have all tended to increase employment on the best-managed farms, and to equalise it during the different preiods of the year. On this point, Mr. Culley, writing of Oxfordshire farming, says*:—"The greater use of machinery and the increase in the size of farms, which may be said to run in couples, have not only conferred a great benefit on the farmer, and the country at large, by increasing its productive power, without, at any rate as yet, diminishing in any appreciable degree the number of persons for whom agricultural labour finds employment, but they have also tended to equalise the manual labour required during the different seasons of the year, and to provide more skilled labour at higher wages for industrious and intelligent labourers, than which no greater benefits could be conferred on the agricultural class." We may remark also that the use of machinery and the greater development of stock breeding and feeding not only equalise the demand for labour at different seasons, but also introduce higher rates of pay for the service rendered. In many of the reports from which we quote, the carter, the shepherd, and the cowman are described as receiving wages varying from 2*s.* to 3*s.* per week, and other allowances, in addition to the average wages of their class; and a new name appears in many returns from farms, viz. the "engine-man," earning about 18*s.* or 20*s.* per week. Where the steam-plough is used it is also a general custom to give from 1*s.* to 2*s.* a week extra wage, not only to the engine-driver, but to

* Second Report, 1869, p. 80.

the other men employed, who are called the "steam men." We have reason to believe that most of the engine-drivers themselves are agricultural labourers who have very soon been trained to the use of the engine. By many of our local agricultural societies prizes are offered for the best stokers and engine-drivers, and the competitors are usually men of the rank of the ordinary agricultural labourers. In confirmation of this, Mr. Jacob Wilson, of Woodhorn Manor, thus writes to us:—"I have made an investigation into the antecedents of men at present employed by our 'Northumberland Steam Cultivating Company.' I find we are at present employing about ninety men, and of these about sixty were formerly ordinary, but intelligent, farm labourers, receiving 14*s.* or 15*s.* per week. They are now making from 20*s.* to 23*s.* I know of several instances of sharp and intelligent lads, whom I have selected and put forward in this way with most encouraging results. Our experience proves that the best engine and steam-plough men are those selected from our farms, and the worst are those who have been employed in going about the country with hired threshing-machines, &c. But you must remember that all our farm-labourers down here are well-educated." This distinction of wage appears to us one of the most desirable improvements in the treatment of agricultural labour. It has been too much the custom to pay a uniform daily wage; and we have frequently known old and inferior men offended at a difference being drawn between themselves and their younger and more intelligent rivals, whose daily labour was worth almost double their own.

From these and other causes there has been a general rise of wages throughout the United Kingdom, although it has not been quite equally distributed. Mr. Stanhope says*:—"In Lincolnshire, not only has the amount of work to be done increased by better cultivation and by the reclamation of untilled tracts, while the population has remained almost stationary, but in addition to this, the younger portion of the labourers are being attracted into the towns, leaving only the old and ignorant behind. It is from this cause that the question of how to keep their labour at home has become a vital one to employers. Wages have already risen, and seem likely to rise." Mr. Henley says, of Northumberland, "how considerably wages have advanced in the district in the last year, especially for women." The present Bishop of Manchester takes a less favourable view of the position of the agricultural labourer, and says generally that the difficulty in dealing with the education and improvement of this class arises not from their apathy, but from their poverty.

It may be a matter of interest, therefore, to compare the present

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* First Report, 1868, p. 91.

wages of the agricultural labourer in the lowest-paid English counties with what they were twenty years ago. Mr. Coode, in a report to the Poor Law Board, quoting Mr. Caird as his authority, puts the average earnings of the agricultural labourer in Gloucestershire, Wiltshire, Suffolk, Cambridge, Berkshire, and Dorsetshire, in 1851, at 7*s.* 1½*d.* per week.* Bishop Fraser, who certainly does not overestimate these earnings, puts wages in Gloucestershire, on the Cotswolds, at 10*s.* per week, with occasional piecework; in the vale of Newent, 11*s.*, exclusive of drink; in the Vale of Berkeley, 12*s.* to 13*s.*† In Wiltshire, Mr. Norman says, wages are put by farmers at an average of 12*s.* to 14*s.*; by labourers themselves somewhat lower; but the final result of his observation is, that the wages of all classes of agricultural labourers, have increased greatly during the last twenty-five years in that county: still, notwithstanding this increase, the labourers appeared to be in a more unsettled and dissatisfied condition than in any other district he visited.‡ In the Bishop of Manchester's reports on Norfolk, and Mr. Portman's § on Cambridgeshire, the lowest weekly wage is put at 12*s.*, except in a small district of the latter county, where it is stated to be 10*s.* In Berkshire,‖ Mr. Culley went very fully into the question of average earnings and cost of labour, and the lowest weekly wage he puts at 11*s.* to 12*s.*, while men in higher positions were earning up to 18*s.* In Dorsetshire,¶ which is still one of the lowest-waged counties in England, Mr. Stanhope puts the lowest wage at 8*s.*, with a cottage and certain perquisites, of which the money value is not so easily ascertained; and his opinion is that the ordinary Dorsetshire labourer earns from 10*s.* to 12*s.* per week—carters and shepherds receiving some 2*s.* more; and, in addition, generally the cottage-gardens are large, and the redeeming feature of rural life in this county is the large amount of land held by the labouring classes. We have lately, through the kindness of Mr. G. Sturt, M.P., received further particulars from six districts of the county of Dorset, which generally confirm Mr. Stanhope's figures; and also the fact before mentioned, that the use of steam power in agriculture is accompanied by a substantial increase in the wages of the men employed in connection with it. The wages we have quoted are the average weekly wages, not including piece and harvest work. They certainly compare advantageously with those given by Mr. Coode, and, we may say, are generally confirmed as to their correctness by the returns of agricultural of something like 75 per cent. increase in the wages of agricul-

* Supplement to Mr. Coode's 'Report on the Law of Settlement and Removal,' 11th August, 1854, p. 17.

† First Report, p. 23.

‡ Second Report, 1869, p. 58.

§ First Report, 1868, p. 94.

‖ Second Report, 1869, p. 78.

¶ Ibid., p. 4.

labourers' weekly earnings, issued by the Poor Law Board for the spring and summer quarter of 1870. But if we take the higher-wage counties—Cumberland, Lancashire, Cheshire, West and East Ridings of Yorkshire, the average wage in which was estimated at about 13*s.* per week in 1851, we shall find in these counties now the ordinary wage 13*s.* to 15*s.* per week, with the addition of harvest-money and piecework, indicating here also a rise of wages, though not perhaps proportionately so great as in the lower-waged counties.

Mr. Sackville West, writing on February 1, 1870, of the condition of the Departments of the Gironde and the Dordogne, in France, describes the agricultural labourer as in an unsettled condition, although his wages have doubled during the last thirty years. The superior attraction of town labour, the rise in prices of all kinds, and the objection felt by women to field-work, together with the excessive subdivision of landed property, are causing a disturbance of labour which is a serious hindrance to cultivation; while of all the evils incident to the labourer's condition the conscription is the worst, the severest burthen upon the land, and perhaps more injurious to rural life than any of the other causes mentioned. At the same time Mr. West considers that in these departments the condition of both proprietors and labourers is not bad, but rather progessive and improving. In Prussia, Mr. Petre reports: "The want of trusty farm-servants is beginning to be felt by the landowners and farmers. A large and more varied field of employment has been opened by the development of industry and by increased facilities of locomotion. A yearning for independence, and for the possession of a house of their own, prevails even amongst the poorest of the farm-servants. They receive now higher wages and better food than formerly, and their condition is altogether different from what it was. Improvements have been introduced on most of the well-managed properties as regards the way in which the farm-servants are lodged, but much still remains to be done in this respect. They generally sleep in the hayloft, or in a garret in the cowhouse." Of Austria, Mr. Lytton, in December, 1869, writes: "In 1867 the average yearly wages of an agricultural labourer in Austria were from 3*l.* to 4*l.*, exclusive of board and lodging, which is provided by the employer. As a general rule the agricultural labourer is well fed, and the quantity of food he has the reputation of consuming has given rise to the proverb, 'what the plough makes, the ploughman takes.' The rate of wages for agricultural labour has risen considerably throughout Austria during the last three years, and is still rising." The reports of the different Poor Law Inspectors in Ireland made to the Government in 1869, give an average tural labourers in that country during the last twenty years. The value of agricultural labour in the United States, and in our North American and Australian colonies, requires no comment; and our object in alluding to the position of this class of labour in the great countries of Europe, is to indicate that even in the old world its value is appreciably and universally increasing.

It seems unnecessary to go into further detail to show that in all parts of England there has been a general and sensible rise in the wages of the agricultural labourer, but we may briefly point out how much his wage varies in different localities, and how some other circumstances affect his position. The Commissioners roughly estimate that weekly wages range from 9*s.* or 10*s.* in the South and West of England up to 18*s.* in the Northern and Midland districts. In addition to this comparative cheapness of his work, the southern labourer has to contend against the disadvantage of high-priced fuel. The Durham or Derbyshire man has coal almost at his door, costing 6*s.* per ton at the pit-mouth, or 9*s.* to 10*s.* at the nearest railway station, while the Berkshire man receives as part of his wages a ton of coals once a year, carried by his employer, and valued at 25*s.* per ton;* while a friend of our own considers that his labourers, in a Surrey parish, buying their coals in small quantities, do not pay much less for them than 30*s.* per ton, delivered at their houses.

In the Northern and Midland Counties, again, the labourer very often has the advantage of such an allotment of grass land as enables him to keep a cow, and to obtain milk for his children, besides realising some money by the labour of his wife and family on his own land, without their going out to work for hire; and there is perhaps no method by which the landlord can more certainly add to the comfort of the married labourer than by letting to him grass for a cow. Almost equally good is the plan adopted by the farmer in Northumberland and parts of Scotland, of keeping a cow for each of his men. Mr. Culley quotes abundant evidence to show how well the system works in Derbyshire, and says: "I believe it would be impossible to overestimate the value of such a provision of milk as is within the reach of the families of most of the Derbyshire labourers. There are features, too, in the manner in which it is sometimes obtained, which tend to show how the condition of the labourer and his family may be improved without the danger of making him above doing his duty in that state of life to which it has pleased God to call him. . . . Many labourers in the north of Derbyshire rent, with their cottages, six

* Second Report, 1869, p. 107.

or eight acres of grass land, with a shippon attached, and are thus enabled to keep two cows during both winter and summer. Others rent a smaller quantity of grass land, which they mow, and graze their cows during summer in one of their master's fields, or more commonly in the nearest nobleman's or gentleman's park." * Mr. Stanhope also says: "In the Western counties and in Rutland a few landowners are accustomed to let to some of their labourers two or three acres of land, in order to enable them to keep a cow. In Cheshire a modification of this plan is found in the 'ley' or run for a cow, assigned at a small rent in some villages to those labourers who desire it. The inquiries which I made into this system lead me to form a very favourable estimate of the inducement to thrifty habits, and of the comfort it afforded." † From our own experience in Yorkshire, we can testify to the good effects of this custom in providing milk for the children, and in encouraging industrious and prudent habits in the family generally; and we may quote a letter from Sir G. O. Wombwell in confirmation: "I inclose my agent's letter about the cow-keeping. The holdings answer admirably. I find when a man has a cow and grass, it makes him settle down and take an interest in the village and estate, and the children go regularly to school. When I have a cottage and cow-keeping to let, I never have any difficulty in getting a first-rate labourer. In this way I can build cottages to pay me 4½ per cent." And his agent, Mr. Smith, thus describes the practice pursued. "In the village of Coxwold we let 32 cow-keepings to the cottagers, and in Oulston 18, for which they pay 3*l.* each for the summer gait in the cottage pasture from Mayday to Michaelmas; and for their winter keep they each have from 1½ to 2 acres, according to quality, partly in small fields to themselves, which is preferred; and in remaining parts, where the fields are too large for one holding, they are staked out in allotments as above, at a rent of about 3*l.*, and, with the summer gait added, making 6*l.* for each cow for the year. They generally keep good cows, and it is not uncommon for them to purchase meal or linseed-cake in addition to the hay and grass."

Perhaps one of the greatest evils which affect the condition of the labourer in the Southern, Western, and South Midland Counties, is the practice of giving beer or cider to the men in lieu of wages. This custom not only prevents a fair share of the wages going for the support of the family, but generates that love of drink, which throughout the reports of the Commissioners is alluded to as the curse of the labourer. Bishop Fraser says, "I was happy to find in almost every part of the counties which

* Second Report, 1869, p. 115. † Ibid., p. 27.

I traversed a very general testimony borne to the fact that drunkenness in country places is decreasing rather than increasing. Still, admitting the improvement, there is too much cause for that loud cry which rises both from farmers and clergy that the curse of the village is the house that sells beer."* Mr. Culley contrasts the Northumberland labourer with those in Berks and Bucks in these words: "Last but not least, it is not his habit to drink beer; except at the annual hiring, he hardly knows what a beershop means, and his children suck at the milk-bowl, instead of himself at the beer-jug. Of all the temptations to improvidence which beset the South Midland labourer there is none to compare to the beershop; and I may conclude this report as the wife of a farm-labourer wound up her address to me, 'Sir, them ale-houses is our curse!'"† The same cry comes from Shropshire, in some parts of which county the condition of the agricultural labourer appears to be very unfavourable. "Another great evil," says Mr. Lee, bailiff to the Earl of Powis, "is the system of giving beer or cider. The usual allowance every day is three quarts, but at harvest the quantity is unlimited on most farms, to encourage men to work. With the temptation thus thrown in their way, it requires a steady man to resist it." Mr. Stanhope says, "Above all other evils is part payment in beer or cider. A last objection to the system is, that it often extends to the women and children also. On many farms in Dorset and Salop, a large proportion of the whole outgoing for labour is paid in this way: the women and boys receive it in proportion to their money wages; and thus the latter are taught from the outset of life to require during work the stimulus of drink."‡ A relieving-officer in Hertfordshire says, "Our labourers have neither pig, nor cow, nor poultry. When they are thrown out of work, they come immediately upon the rates; all they think about when they have money is drink. In harvest men can earn 24*s.* a week, and they seem no better during that season than any other; they drink the difference, and get ill on it." In Devonshire the cost of each man's cider is estimated at 1*s.* 4*d.* a week the year through, a sum which would nearly pay the house-rent for the family. It would not be difficult from the reports to multiply evidence of the evils which result from this system, and we are happy to find that in every county there are many employers who are attempting to do away with the custom, although they have to contend with great difficulties on account of the prejudices of the labourers themselves in its favour.

A practice of somewhat similar character is not unusual in

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* First Report, 1868, p. 43. † Second Report, 1869, p. 138.
‡ Ibid., pp. 27, 28.

Yorkshire, viz., giving a portion of the wages—7*s.* or 8*s.* per week—in money, and the rest in food, or, as it is locally called, "meating" the man. It is very probable that by this custom the labourer himself is no sufferer, but it is very hard on the family, as the surplus for their maintenance, already small, is too often still farther diminished by the Saturday night's visit to the alehouse.

In considering the remuneration and position of the labourer, we cannot exclude the share which the women and children of his family bear in supporting the household. On this question of employment of women and children in agriculture the greatest differences of opinion exist. There is an almost unqualified testimony to the healthiness of the work, except in the case of boys employed with horses, whose hours of work are cruelly extended, and of very young children employed in weeding wet corn in the fens, who often have to travel long distances to and from work. But on the moral aspect of this labour we find very considerable variance of feeling. In North Northumberland and Scotland the employment of female labour is carried to a great extent, but the women workers are almost always adult and unmarried. Thus in Glendale Union, Mr. Henley found that of 373 adult women workers only 29 were married; and this is a district which in respect to the education of the poor, the material prosperity of the labourer, and the healthiness of the people, will compare most favourably with any other in England. In the Fourth Report of 1870, at page 68, is an instructive table comparing the employment of labour in England and Scotland:—

| District. | Acreage. | | | Males. | | | | |
|---|---|---|---|---|---|---|---|---|
| | Arable. | Pasture. | Total. | Between 8 and 10. | Between 10 and 13. | Between 13 and 18. | Over 18. | Total Males. |
| South-East of Scotland | 55,090 | 5,519 | 60,609 | 1 | 52 | 190 | 1130 | 1373 |
| South Midland, England | 43,071 | 18,108 | 61,179 | 36 | 285 | 505 | 1884 | 2710 |

| District. | Females. | | | | | |
|---|---|---|---|---|---|---|
| | Between 8 and 10. | Between 10 and 13. | Between 13 and 18. | Over 18. Married. | Over 18. Unmarried. | Total Females. |
| South-East of Scotland | .. | 29 | 193 | 260 | 681 | 941 |
| South Midland, England | 3 | 5 | 33 | 436 | 49 | 526 |

The five English counties are thus represented in the acreage:

—Beds, 2725; Bucks, 8442; Oxford, 16,536; Berks, 25,762; and Herts, 7714.

From these tables, and from Mr. Henley's report, we must conclude that the school age of children in the Northern Counties, where adult unmarried female labour is employed, is prolonged considerably farther than in the generality of agricultural counties in England, where the age of ten is almost universally suggested by employers, labourers, and indeed by many of the clergy themselves, as the inferior limit at which the children should be set to work. Nor in the North does the employment of young women in the fields appear so repulsive or distasteful to public opinion as it does farther South. Mr. Henley says of the Northumbrian women, "Physically they are a splendid race; there are many who hold the opinion that field-work is degrading, but I should be glad if they would visit these women in their own homes after they become wives and mothers. They would be received with a natural courtesy and good manners which would astonish them. Let the visitor ask to see the house; he will be taken over it, with many apologies that he should have seen it not "redd up." He will then be offered a chair in front of a large fire, with the never absent pot and oven, the mistress, meanwhile, continuing her unceasing family duties, baking, cooking, cleaning, &c. Not one word of complaint will he hear; but he will be told, that though "working-people," they are not poor; and a glance at the substantial furniture, the ample supply of bacon over his head, the variety of cakes and bread on the board, and the stores of butter, cheese, and meal in the house, will convince him of the fact. When he inquires about the children, he will hear that though they have not much to give them, the parents feel it to be their sacred duty to secure them the best instruction in their power, and '*that* they are determined they shall have.' The visitor will leave that cottage with the conviction that field-work has had no degrading effect, but that he has been in the presence of a thoughtful, contented, and unselfish woman." *

On the other hand, Bishop Fraser says that female labour in the fields, "almost unsexes a woman in dress, gait, manners, and character; everywhere women are found to be less and less disposed to go out to work upon the land." In Lincolnshire "there is a growing disinclination on the part of the women themselves to go out to field work, and when all the families are well off and the children in great demand, the respectable women have almost ceased to go." † In Northamptonshire, Mr. Norman says,

* First Report, 1868, p. 54. † Ibid., p. 76.

"On the whole it is quite clear that it is the exception rather than the rule for a woman to go to work in the fields." * In Hampshire, "where wages are low, the employment of women it almost universal, and does lead to a want of love of home, and to a neglect of the best interests of the family." † Mr. Stanhope, in his general remarks on Dorset, Kent, &c., says, "The increasing disinclination of women to undertake anything but light and occasional out-door labour was everywhere apparent." ‡

There can be no doubt that much discouragement is thrown by the clergy and landowners upon the employment of women in outdoor labour, and that the immoralities and hideous vice exposed by the reports on the gang system created a great distaste to such employment. The prevalence of bastardy, and the great number of illegitimate births in Scotland and Northumberland, lead many to connect the employment of women in agriculture and this sin as cause and effect. Again, too, it is generally stated and believed that such women make bad housewives and mothers, and drive their husbands to the public-house by their improvidence and neglect of comfort at home.

As to immorality, Mr. Henley quotes the Rev. Thomas Knight, of Ford, who says, "There can be little doubt that the employment of females in agriculture is one of the causes of the low state of morality in this district. Yet in justice it ought to be mentioned that, though the tone of morality is low, the crimes of infanticide and adultery are unknown. The women who have once fallen never become utterly depraved, but generally marry and turn out good wives." § Again, in Lincolnshire, Miss Boucherett says, "Field work is often rough for girls, but it is not necessarily immoral. What has given it a bad name is that it is the only means girls who have lost their characters have of getting an honest living." Mr. Boyle, writing of Wales, says, "Opinions generally were expressed in favour of women's labour, that it does not demoralize the women themselves, and that their homes are quite as tidy as those of the women who are at home all day. Certainly, speaking from my own experience, it was impossible to judge from the appearance of a cottage whether the mistress works out or not." ‖ Mr. Culley contrasts field-work favourably with plait-work and lace-making, as far as morality is concerned; and, remarking on the prevalence of immorality as measured by illegitimacy in Scotland, he observes, "There is a very strong indication that farm labour cannot be charged with being the cause of this in rural dis-

* First Report, 1868, p. 111.
† Second Report, 1869, p. 35.
‡ Ibid., p. 14.
§ First Report, 1868, p. 59.
‖ Third Report, 1870, p. 60.

tricts, for there are large numbers of Highland and Irish girls employed exclusively in farm labour, of whom it may be said they make no contribution to the illegitimate births." *

Undoubtedly, however, the opinion of the majority of those in England who have studied the labourer's social position, and are anxious to elevate and improve it, is condemnatory of the employment of female labour as being unfeminine, and tending to coarseness of manner and feeling; and the opinion of an Oxfordshire clergyman very fairly expresses the general sentiment: "Farm labour is very injurious to women morally; they gain coarse, rough, and immoral habits; it is very injurious domestically, their homes and families are miserably neglected."

At the same time it is very clear that, with improved agriculture, a great deal of light work, such as weeding, stone-gathering, potato-harvesting, fruit-gathering, not to speak of hay-time and harvest, demand labour in addition to that of adult males; and the question we have to solve is, whether this work shall be done by young children of both sexes under thirteen years of age and by married women, or by young unmarried women above thirteen. Domestic service and dressmaking are supposed to be more refined pursuits than field work, but both these employments furnish a large proportion of the class who are a blot upon our civilization. One of the great problems of the day is to find suitable honest work for unmarried women. Our towns are already thronged with many who are crying out for work. Field work is not unhealthy; it need not be immoral. May we not have a lesson to learn from the Scotch and the Northumbrian; and should we not pause before we condemn the labourer's daughter, who, by working in the field, can earn an honest livelihood, and allow her younger brothers and sisters to have their education more fully carried out, and her mother to perform the duties of the household. By this work, too, she may, while remaining part of the family group, provide herself with some means to stock the house at her marriage, and be as fit a wife for the agricultural labourer as if she had been in domestic service. In Scotland, the girl's providing at marriage generally consists of a chest of drawers, blankets, bed and table-linen, and crockery; the man provides beds, tables, chairs, and dresser, &c. To carry out this system of labour, we require more cottages on the farms, and those of a superior class, in order that families may live together near their work. Doubtless, if the work of the farm could be done by men and boys over 13 years of age, entirely without women's help, and other fields of remunerative and

* Fourth Report, 1871, p. 66.

healthy labour could be found for women, there *is* much that is rough and unfeminine in field work, and contrary to our ideas of the woman's place in life; but as between the system of married women and young children under thirteen going out to work on the one hand, and young adult females on the other, those who read the reports on North Northumberland and East Lothian will, we think, find much to be said in favour of the customs of these counties.

Educational questions have been much discussed of late, and recent legislation on the subject has not yet come into operation, so that our remarks on this subject will be brief. During the last twenty-five years, mainly owing to the exertions of the clergy, great advances have been made, and opportunities afforded, for the education of the labourer. There are now very few districts in England where his children are not within reach of a good elementary school, well provided with appliances for education, and under the care of a certificated master or mistress; and we may hope that, under the influence of the recent Education Act, the remaining blank places will speedily be filled up. Many of us cannot help remarking, amongst the generation now growing up in our villages, the result of what has been and is being done in this direction. The clergy tell us that the young people who come up for confirmation are much more able to read and understand the lessons given to them than they were formerly; and the circulation of the penny newspaper of the locality is now not unfrequent amongst the labourers as well as the farmers. New schools are built on all sides, or old ones enlarged and fitted for modern requirements; but the number of absentees, the irregularity of attendance, and the early age at which children leave, are great drawbacks to satisfactory progress. Parents are often most unreasonable in keeping children away for some small work at home—for a fair, for a feast, or for some trifling indisposition—and then complain that their children do not get on with their schooling; and, unfortunately, there is still too much of the feeling that children are sent to school not for their own benefit, but to please the squire or the parson. The teaching power in many village-schools is insufficient, and the younger children do not receive the individual attention which at that period of life they require. At present, from five years of age to ten seems to many parents and employers the limit during which we can have regular attendance at school; and although we hope to see the school age generally extended to twelve or thirteen, still, taking things as we find them, we must endeavour to work more patiently and determinedly with the children who attend; and certainly those who have had experience in teaching know how much personal supervision such little children require. There is another defect in our system for which the teacher and the parent are each responsible, and that is, the neglect of preparatory work at home, out of school hours. The English labourer's child is apt to consider book-work over on leaving the school-room, and is not expected or encouraged by parent or teacher to prepare any school-work at home. In Scotland this is very different. "It is an almost universal practice for schoolmasters to give the children tasks to prepare at home, and they, especially the younger ones, are very generally helped by their parents in the preparation of their tasks."* One ploughman's wife, in the Carse of Gowrie, says, "When they are at school my husband hearkens them their lessons every night to see if they have them. I think they would be long in learning if we didn't examine them at home." Another, in Berwickshire, "They always get their lessons over-night, if they don't get them over-night, there is not much time in the morning, and they must have them before they go to school. I help them a little when they need it, and I should think all the mothers help the children with their lessons." Were this system of interest and help on the part of parents more common amongst our English labourers, we should not so often hear them complain of the slow progress of their children; but we must in this, no doubt, have patience, and hope that each generation, being better educated itself, will more fully appreciate the advantages offered to the generation to follow. In connection with our elementary schools there are openings for other efforts at improvement; such as industrial schools to teach house-work to girls, and gardens in which out-door experimental work might be done. But, hitherto, examples of this kind have not been numerous. In addition to the considerable cost of such an establishment, and the personal supervision required to carry out the system, and provide situations for the girls when educated, there is often a prejudice on the part of parents, who consider that their children are sent to school to learn book-work, and not to do any menial work for the mistress or the manager of the school. At the same time we could, from our personal knowledge, point to successful schools of this kind whose pupils are always in demand for household service.

To many of the schools are attached clothing and shoe-clubs, which encourage prudence on the part of the parents, and wholesome self-restraint and reliance on the children. The influence of managers and teachers on their pupils may often beneficially extend beyond the school life in these matters, and we know schools where a little care of this kind has led to the happiest results,

* Mr. Culley, Fourth Report, 1871, p. 73.

and where savings-bank deposits of no small amount have been accumulatated by old pupils during the earlier years of farm service, nearly all of which were commenced at school, or after the first year's service, and continued in consequence of the personal attention of the managers or teachers, and the confidence reposed in them by their pupils.

The following extract from the letter of a Yorkshire clergyman on this subject illustrates its working:—"I find that, in 1856, I began taking small moneys from the children in school, and taking care of their pence. This was sometimes drawn out to buy a prayer-book or other little thing, sometimes ceased altogether, but generally ran on to 17*s.* 6*d.*, when it went into the savings-bank. Soon after, I began to look after the farm-servants at Martinmas. Farm-servants now earn at eighteen what their fathers did at twenty-three. A man before he is twenty-five should easily save 50*l.* I had in my care twelve or fourteen savings-bank books the other day. Several of my old scholars deposit independently of me, and others near Leeds prefer building societies. You may safely say I average 80*l.* a year from those who have been here at school. In seven years one of my old boys, whom you may take as a good specimen of a steady fellow, now twenty-four years of age, has saved 55*l.* 14*s.* 6*d.*, another, who went out in 1864, has 31*l.* 7*s.*, another, who went in 1867, has 37*l.* 14*s.* 8*d.*, and one, who commenced in 1858, has 109*l.* 3*s.* 8*d.*, besides helping his mother."

In considering the position of the agricultural labourer we cannot omit from our notice the question of his rising to become the occupier of land. Many writers of the present day have lamented the tendency of landowners to enlarge the size of farms, and consider that thereby the labourer is losing the opportunity of leaving the ranks of those supported by manual labour, and of rising into the position of a tenant-farmer. The last agricultural statistics present returns which certainly show a larger number of small holdings than we had anticipated. In England, of the total acreage under crops about 10 per cent. is in farms of from 20 to 50 acres, and 15 per cent. in farms of from 50 to 100; thus one-fourth of the cultivated land of England is held in small farms, in addition to 7 per cent. in occupations of from 5 to 20 acres. We have before alluded to the great advantages which belong to the small grass holdings enabling one or two cows to be kept, and there is also a general concurrence of opinion in favour of the garden or field-allotment system, provided that the allotments do not take a man away from his wage-earning work. In fact, this system has taken deep root in every county, and is now looked upon with favour by the farmers themselves, if the allotments do not exceed a quarter of an acre in extent, as the cultivation of this quantity does not appreciably interfere with a man's daily work. On the other hand, there is a great amount of evidence to show that the small farmer, espepecially if he have to hire labour, is harder worked and not so prosperous as the well-paid labourer, and that the prevalence of small farms in a district rather tends to a low range of wages and inferior cultivation. The truth is, that modern successful farming requires capital, and if an occupier have not capital in money, he must have the capital of the worth of his labour to put into the land.

Mr. Henley speaks of the small farmers of Durham as "an honest, industrious race, and though, in their hard struggle to live, their children fail to obtain sufficient school instruction, being usually taken from school at an early age, as their parents were before them, to pick up a bit of schooling where they can, yet they hold a position that bridges over the distance between capitalists and labourers." * Mr. Stanhope, speaking of the small freeholders of Lincolnshire, who are usually in the Fen district or the potato-growing country of the Isle of Axholme, says,—"The small freeholders are a class in many cases very little raised above the hired labourers, and more hardly worked and less well fed and housed. They are very numerous in many parts of the Fens. In the Isle of Axholme there are many hundreds, and as a great part of the land that is sold is being cut up, their number is probably increasing. Their children are worked earlier and have less schooling than those of hired labourers." †

Similar testimony as to the hard-working, industrious habits of the small farmers in the dales of Yorkshire and in some parts of Cambridgeshire is given by Mr. Portman, who says—"These small occupiers cultivate their land by themselves and their children, rarely employing a labourer. The loss, therefore, of their children's labour, even at 9 or 10 years of age, would be fatal, as they are too poor to hire labour." ‡ In the small-farm districts of Dorsetshire, "the occupiers cultivate the farms with the help of their families, and require little, if any, hired labour. The population in consequence is less well off than in the districts just described, for the wages are lower; there is very little piece-work, and many men are thrown out of work in winter." § In Shropshire, Hampshire, and Devonshire, the evidence is the same. In Wiltshire, Mr. Bolam, Lord Ailesbury's agent, speaks of small holders "as a body almost worse off than many of the labourers, because their capital is small, their work

* First Report, 1868, p. 57. † Ibid., p. 74. ‡ Ibid., p. 97.
§ Second Report, 1869, p. 3.

is fitful, at times very hard, at others slack, and their want of education and training prevents them from profiting by this start beyond the ordinary farm-labourer." At one time Cumberland and Westmoreland were the home of small owners and occupiers; the "statesmen" of these counties cultivated their own land, and, in addition, five-and-twenty years ago, there were many small tenancies. The Rev. R. C. Patteson, rector of Melmerby, a gentleman well acquainted with the social state of Cumberland, places this matter in a striking point of view. He says: "Far more capital is now required to stock a farm; labour is much more expensive. But not only is more capital required to stock a farm, but small farms are let at extravagant rents, and in the end (and I have seen many failures) become simply nests for poverty or sinks of the capital laid out upon them. The condition of the day-labourer is far better than that of a small farmer with little capital. The day of small farms is over. They will die a lingering death, but their day is over. Their days are told, and I think their death is for the benefit of the nation. I don't think the numbers of the petty landowners is decreasing so rapidly as that of small farmers, but as the purchase value of land increases they too must die out. It is astonishing what sums these men will give or borrow for land. It is almost their only idea of investing their money, no wonder that so many statesmen are poorer than small farmers, more pinched than their labourers."*

From the general tendency of this evidence it seems pretty clear that we must not look to raising the position of the agricultural labourer by making him a small farmer, although, doubtless, there are instances of well-merited success as well as of failure in this direction. Generally speaking, on a small farm he will have to save money rather than to make it; and he may do this as a labourer more frequently than some suppose. Before marriage there is not much difficulty in many parts of England for careful men and women to lay by money to stock and furnish their houses on their marriage; and the facilities for small investments in building societies and other securities is now much greater than it formerly was. It is previous to marriage that the kindly interest of the employer or the minister of religion may be most useful, and a few words of advice will often inculcate a habit of saving not easily forgotten in after years. With a young family comes a time of pressure, but even then the allotment, and, if possible, the cow gait, afford opportunities for extra exertions and for extra comfort. But there are two great hindrances to this prosperity—on the man's side, love

* Second Report, 1869, p. 144.

of drink and the society of the ale-house;—on the woman's, gossipping habits, and the want of good management and thrift. How often have we seen side by side families placed apparently in similar circumstances, and earning similar wages, and yet the house, the garden, and the children of the one comfortable and prosperous, and of the other untidy, mismanaged, and wasteful; either because the husband is fond of drink, or the wife is an unthrifty manager. A hind's wife in Northumberland truly said to Mr. Henley, "she had known two families next door earning the same money, the one saved enough to buy the cottage, the other could not live. It was all drink, so there is the difference."

We cannot inculcate habits of prudence, or look for a higher social life in the agricultural labourer if he is badly housed; and in the matter of cottages we have still much to accomplish. The field of labour is widened, fresh sources of employment are open to him, a higher and better paid class of labour in his own sphere arises from the employment of steam, and farmers begin to appreciate the necessity and advantage of finding continuous work for men all the year through; but, in order to keep the best men at agricultural labour, more comfortable homes are required. The habits of social life are so changed that the farmer no longer sits at the head of the board with his hired servants as of old; and a great demand is therefore made for cottages on the farm, in which married carters and shepherds may live, or where the servant lads may be boarded with the hind. There are great advantages both to the farmer and to the labourer from the residence of the labourer upon the farm; and the distance from the school, the shop, and the church, are drawbacks which are perhaps counterbalanced by the distance from the beer-shop, and by the practice of the village tradesmen sending round their carts at certain intervals to the outlying cottages, which is not unusual in some districts. But building cottages on farms, and generally making labourers' homes what we should wish them to be, is a task not easy of accomplishment, and can never be done until the land of England is in the hands of proprietors who not only have the wish, but the means to carry out a work which in itself gives only a small pecuniary return for the outlay. Honour is due, not only to the great territorial magnates of England, who have made their estates rich with comfortable homes and pleasant dwellings for the labourers upon them (and there are many of these whom we might name); but still more to many a landlord of only limited means and interest in his property, who is manfully striving to do what is right for his people, and sacrificing his own pleasures for what he conceives to be his duty to those who are to some extent dependent upon him. Landlords are doing this all over England, and we will only quote one passage from many as an example of how the work is going on:—

"In speaking of the state of cottages, I am exhibiting a dark picture, as if it was the fault of a class, many of whom are powerless to change it, and few of whom are answerable for it. We are calling on the landowners of to-day to remedy the evil growth of many past generations, and nine-tenths of those who reside in the four counties which I have visited are already busy at the work, as far as their means will allow. I could point out to you two very large estates in these counties, upon the general improvement of which, cottages having a large share, the whole income has been spent for many years past." *

The pictures drawn of the labourers' homes in these reports are often painful; but we must remember that in towns these evils equally claim our notice, and that the value of free air and wholesome dwellings is only slowly appreciated by those whose social position in life is much higher than the labourer and the artisan. One good and promising feature of the present time is that the labourer himself is beginning to appreciate a good cottage, and is ready to pay for it; and that he is not so willing to go into the old tumble-down dwellings he has been hitherto accustomed to inhabit. We must not forget also the favourable difference of rent paid for cottages and gardens in the country as contrasted with the town, when we are comparing the position of the artisan and the agricultural labourer. It was but recently that, looking over Baroness Burdett Coutts's noble improvements in Bethnal Green, we found families, consisting of a father, mother, and even three children in two-roomed apartments, without any larder or pantry, about 12 feet by 9, in Columbia Buildings. For these rooms, including the use of the common laundry and wash-house, and other accommodation, the weekly tenant paid 3*s.* 6*d.* per week; and we were assured that the rents of the small houses in the neighbourhood were even higher.

English landlords will not shirk their work; and they are generally recognising the improvement of cottages as a part of their duty, essential for the good cultivation of the land, as well as for good morals; and every one who travels through the country sees not only commodious farm-buildings, enlarged fields, and higher cultivation, but also well-built and commodious cottage dwellings, rising amongst the squalid homes which even yet disgrace our land. These improvements will never be accomplished without the personal interest of the landlord, and the free and unfettered application of capital to the land.

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* Mr. Culley, Second Report, 1869, p. 95.

We may have different views on these matters: some of us may think that land laws check this application; others may justly point to the good done under existing laws by men to whom such work is an hereditary pride; but of this we may be sure, that whatever tends to make the labourer more comfortable and healthy in his home, fits him better for work, and will in the end bring its reward equally to himself, the landlord, and the tenant-farmer.

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## XIV.—*On Field Experiments on Root-Crops.* By Dr. Augustus Voelcker, F.R.S.

Strongly impressed with the conviction that faithfully recorded field experiments, performed by men on whose integrity, powers of observation, skill, and intimate acquaintance with ordinary farm operations, implicit reliance can be placed, are well calculated to extend our knowledge on many matters of much practical importance to the agriculturist, I have for years past endeavoured to engage the co-operation of my agricultural friends in an enterprise which I took in hand nine years ago, and in which I have since taken a lively interest.

The performance of accurate field experiments is a work beset with many difficulties, and necessitates no small amount of labour and self-denial.

Happily, the encouragement which my friends have hitherto given me in this work, induces me confidently to expect a continuation and extension of their support in future years.

Isolated field experiments have but little value at the best, and hence both time and energy are wasted in a great measure if individuals engage in the making of experiments which are not conceived in a philosophical spirit, and not calculated to bring to light really useful information.

In all the field experiments which have been carried out under my superintendence in past years, I have carefully avoided to test in the field the prepared manures of different makers. Apart from other considerations, such a proceeding would have been undesirable, because experiments of that kind are not calculated to increase our knowledge of the true action of various fertilizing matters and their rational application in agriculture.

It may no doubt be of some use to an individual farmer to ascertain by actual trial in the field which of a number of rival artificial manures will give him the best crops of turnips or mangolds; but after all, it may be asked, what information is gained by such experiments that cannot be obtained far more economically and rapidly in nine cases out of ten by the careful analysis of the different artificial manures? The time, fortunately, has now passed when the action of manures and the functions of the soil and the atmosphere in relation to plant-life were shrouded in impenetrable mystery. We now know very well that a manure must contain certain specific fertilizing constituents in order to produce a good crop of wheat, grass, or roots. Nobody at all acquainted with the chemical names of the chief fertilizing constituents of artificial manures need be told that guano which on analysis yields 15 per cent. of ammonia is likely to produce a better crop of wheat than another sample containing only 10 per cent., or that a superphosphate or turnip manure which contains 20 per cent. of soluble and 10 per cent. of insoluble phosphates in the shape of bones is a better manure than that of a maker who sells badly dissolved coprolites containing, it may be, only 15 per cent. of soluble phosphate.

Moreover, such field experiments are often very deceptive in their results, for, generally speaking, farmers who go to work in a practical fashion in testing, as they think, the money value of various prepared manures, take little or no notice of the previous agricultural conditions of the land upon which the different manures are tried, nor of the effects which certain fertilizing matters produce under specially favourable or adverse circumstances. It thus happens that on land in a high agricultural condition a really poor and cheap manure often gives as good a crop of turnips as a good and intrinsically valuable turnip manure.

In a bad and very dry season it is well known that concentrated artificial manures often do harm to crops, whereas no injury to them results from the application of indifferent and all but valueless compounds sold as artificial manures.

To mention only another instance, I would say that I know it to be a fact, that on sandy soils, altogether deficient in lime, a superphosphate comparatively poor in soluble phosphate has a better practical effect on turnips than a superphosphate, which is very rich in soluble phosphate, and more expensive in consequence. The results of field trials upon turnips with the two kinds of superphosphate on such a sandy soil would lead the purely practical experimenter, as he is fond to style himself, to the erroneous conclusion that the better and dearer superphosphate is not nearly so good as the really less valuable and cheaper sample; whereas the same experience teaches the thinking farmer, to apply to such land a good superphosphate sparingly and mixed with ashes, avoiding thereby a great excess of acid soluble phosphate, which if not neutralized by the soil is injurious to the young turnip plants. These are only a few examples, showing how field trials may lead men astray.

Any one who reads the numerous testimonials which are given in good faith by highly respectable men in proof of the value of certain artificial manures that are all but worthless, must feel convinced how difficult it is to ascertain by solitary experiments the money value of manures.

In the present state of British agriculture the employment of artificial manures has become a necessity on most farms, and hence it is most desirable that the money laid out for artificials should be expended in the purchase of fertilizers which are really worth the price at which they are sold, and capable of answering the purpose for which they are used. In many instances farmers do not trouble themselves to enquire what are the most suitable fertilizing agents for particular crops on the kind of soil upon which the manure is to be used. Consequently they are not in a position to buy in the best market the special manuring matters which are required for a particular crop. If a farmer wishes to lay out money to the greatest advantage in the purchase of artificial manures, he should discard the recommendations of competing manure manufacturers; he should endeavour to procure at the cheapest rate and in a separate form all the various fertilizing substances which are best adapted to a particular crop on a given soil, and to prepare himself the several mixtures which are sold under various names at a much higher price than that at which he can make them.

For the foregoing reasons, I have taken no interest in testing against each other, in the field, compound artificial manures, prepared by different makers. My object has hitherto been mainly to institute manuring schemes, which are calculated in the course of time to elucidate general principles, capable of being reduced to practice by individual farmers.

Adopting this course in all the experiments that have been carried out hitherto under my direction, I have seen no reason to deviate from the plan laid down for my own guidance. I trust that the experiments on which it is my privilege to report on the present occasion will afford useful hints to practical men in the selection of the various artificial manures which are required by a particular crop.

*Experiments on Swedes in* 1869.—The first series of experiments on which I have to report was undertaken by my friend and former pupil, Mr. G. Y. Wall, jun., at the Lizards, near Sedgefield, Ferryhill, county of Durham, on a clay loam upon the Carboniferous geological formation. The field was divided into twelve equal and adjoining plots of $\frac{1}{20}$th of an acre each. The twelve plots were treated as follows, as regards manure:—

| Plots. | Name of Manure. | Quantity of Manure per Plot. | Rate per Acre. |
|---|---|---|---|
| 1 | No Manure .. .. .. .. .. .. .. | .. | .. |
| | | lbs. | cwts. |
| 2 | Mineral Superphosphate .. .. .. .. | $16\frac{1}{2}$ | 3 |
| 3 | Mineral Superphosphate .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Muriate of Potash .. .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| 4 | Mineral Superphosphate .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Peruvian Guano .. .. .. .. .. .. | $5\frac{3}{4}$ | 1 |
| 5 | Peruvian Guano .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| 6 | No Manure .. .. .. .. .. .. .. | .. | .. |
| 7 | Mineral Superphosphate .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | Muriate of Potash .. .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| | and | | |
| | Sulphate of Ammonia .. .. .. .. .. | $5\frac{3}{4}$ | 1 |
| | | ton. | tons. |
| 8 | Rotten Dung .. .. .. .. .. .. .. | 1 | 20 |
| | | lbs. | cwts. |
| 9 | Mineral Superphosphate .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | Muriate of Potash .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| | and | | |
| | Nitrate of Soda .. .. .. .. .. .. | $5\frac{3}{4}$ | 1 |
| | | cwts. | tons. |
| 10 | Rotten Dung .. .. .. .. .. .. .. | 10 | 10 |
| | and | lbs. | cwts. |
| | Mineral Superphosphate .. .. .. .. | $8\frac{1}{4}$ | $1\frac{1}{2}$ |
| 11 | Bone Dust .. .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Mineral Superphosphate .. .. .. .. | $8\frac{1}{4}$ | $1\frac{1}{2}$ |
| 12 | No Manure .. .. .. .. .. .. .. | .. | .. |

The manures were sown by hand, and green-top swede-seed drilled in on the 27th of May, 1869, the delay having been caused by the continuance of dry weather.

The season was not very favourable for root-crops; however, a good plant was obtained, and a fair crop, considering the season, was grown upon the unmanured land.

The swedes were harvested on the 1st of November, and the tops and bulbs weighed separately, when the results given on the following page were obtained.

In this series of experiments mineral superphosphate was used alone, and in conjunction with potash-salts, as also in combination with potash and sulphate of ammonia, and with potash and nitrate of soda.

An opportunity was thus given to ascertain whether it is advisable to use for swedes a purely mineral superphosphate, or to mix it with salts of potash, or with both potash and ammonia-salts, and also whether sulphate of ammonia may be replaced in a root-manure with advantage by nitrate of soda.

PRODUCE per ACRE of CLEAN ROOTS and TOPS of SWEDES obtained in EXPERIMENTS made by MR. G. Y. WALL, at the LIZARDS, near SEDGEFIELD, FERRY-HILL, COUNTY DURHAM.

| Plots. | MANURE. | Weight of Manure per Acre. | Produce per Acre. Roots. | | | Tops. | | |
|---|---|---|---|---|---|---|---|---|
| | | cwts. | tons. | cwts. | lbs. | tons. | cwts. | lbs. |
| 1 | No Manure .. .. .. .. .. .. | .. | 10 | 11 | 67 | 2 | 7 | 67 |
| 2 | Mineral Superphosphate .. .. | 3 | 15 | 1 | 105 | 2 | 16 | 56 |
| 3 | Mineral Superphosphate .. .. and Muriate of Potash .. .. .. | 3 / 2 | 15 | 15 | 99 | 2 | 19 | 83 |
| 4 | Mineral Superphosphate .. .. and Peruvian Guano .. .. .. | 3 / 1 | 16 | .. | 28 | 2 | 10 | 42 |
| 5 | Peruvian Guano .. .. .. | 3 | 19 | 14 | 71 | 3 | 10 | 56 |
| 6 | No Manure .. .. .. .. .. .. | .. | 10 | 16 | 98 | 2 | 8 | 4 |
| 7 | Mineral Superphosphate .. .. Muriate of Potash .. .. .. Sulphate of Ammonia .. .. | 3 / 2 / 1 | 17 | 15 | 56 | 2 | 13 | 28 |
| 8 | Rotten Dung .. .. .. .. | tons 20 | 19 | 9 | 42 | 3 | 19 | 1 |
| 9 | Mineral Superphosphate .. .. Muriate of Potash .. .. .. and Nitrate of Soda .. .. .. .. | cwts. 3 / 2 / 1 | 18 | .. | 8 | 3 | 7 | 56 |
| 10 | Rotten Dung .. .. .. .. .. and Mineral Superphosphate .. .. | tons 10 / cwt. $1\frac{1}{2}$ | 16 | 10 | 2 | 2 | 19 | 98 |
| 11 | Bone-dust .. .. .. .. .. .. Mineral Superphosphate .. .. | 3 / $1\frac{1}{2}$ | 14 | 13 | 14 | 2 | 10 | 42 |
| 12 | No Manure .. .. .. .. .. .. | .. | 10 | 12 | 36 | 2 | 6 | 70 |

In most of the experiments which I have set on foot of late years, I have suggested to leave three plots unmanured. One plot at each end of the experimental field, and one in the centre, it will be seen, received no manure of any kind in the case before us.

The produce of the three unmanured plots calculated per acre was—on

| | tons. | cwts. | lbs. |
|---|---|---|---|
| No. 1 .. .. .. .. .. .. | 10 | 11 | 67 |
| „ 6 .. .. .. .. .. .. | 10 | 16 | 98 |
| „ 12 .. .. .. .. .. .. | 10 | 12 | 36 |

or the average produce of these three plots amounted to 10 tons 13 cwts. 67 lbs. It appears from these results that the field on which the experiments were made was uniform in character, and throughout in the same agricultural condition. On comparing the average weight of roots on plots Nos. 1, 6, and 12, with the produce of each manured plot, we obtain the following increase as due to the fertilizers used.

TABLE showing increase in Swedes of each Manured Plot over the average produce of the Unmanured Plots, calculated per Acre and increase per Cent. :—

| Plots. | MANURE USED. | Increase. tons. | cwts. | lbs. | Increase per Cent. |
|---|---|---|---|---|---|
| 2 | Mineral Superphosphate .. .. | 4 | 8 | 38 | 41·35 |
| 3 | Mineral Superphosphate .. .. and Muriate of Potash .. .. .. | 5 | 2 | 32 | 47·88 |
| 4 | Mineral Superphosphate .. .. and Guano .. .. .. .. .. .. | 5 | 6 | 73 | 49·93 |
| 5 | Guano .. .. .. .. .. .. | 9 | 1 | 4 | 84·75 |
| 7 | Mineral Superphosphate .. .. Muriate of Potash .. .. .. and Sulphate of Ammonia .. .. | 7 | 1 | 101 | 66·43 |
| 8 | Rotten Dung (full dressing) .. | 8 | 15 | 67 | 82·29 |
| 9 | Mineral Superphosphate .. .. Muriate of Potash .. .. .. and Nitrate of Soda .. .. .. .. | 7 | 6 | 53 | 68·57 |
| 10 | Rotten Dung (half dressing) .. and Mineral Superphosphate .. .. | 5 | 16 | 47 | 54·50 |
| 11 | Bone Dust .. .. .. .. .. and Superphosphate .. .. .. | 3 | 19 | 59 | 37·23 |
| | Average produce of Unmanured Plots per Acre .. | 10 | 13 | 67 | .. |

Peruvian guano, it will be seen, gave the best results; 3 cwts.—which is by no means a heavy manuring—beating, in its immediate effects upon the root-crop, 20 tons of rotten dung, and producing an increase of 9 tons 1 cwt. 4 lbs. over the average yield of the unmanured plots.

Next in order to the guano follows the plots manured with a heavy dressing of rotten dung. The latter, it will be seen, produced nearly 4 tons of tops, or $8\frac{1}{2}$ cwts. more tops than the Peruvian guano plot No. 5. An excess of organic matter, especially if rich in nitrogenous and ammoniacal compounds, as is well known, favours too much the development of the tops, and prevents the swelling and proper maturity of the bulbs.

I hardly expected the result which was obtained with 3 cwts. of guano, for a mixture of guano and superphosphate, generally speaking, answers better for root-crops than either applied separately. The land on which the experiments were tried was probably not in a high agricultural condition, which may account for the highly beneficial effect of guano upon the crop of swedes.

On cold soils, and in the northern parts of England, Peruvian guano, I have noticed, is frequently used for root-crops with greater advantage than on very free-growing land, or in the south of England.

On looking at the preceding tabulated results, it will be seen that muriate of potash has been of considerable service to the swede crop, and that the further addition of either nitrate of soda or sulphate of ammonia to a mixture composed of mineral superphosphate and muriate of potash, proved very beneficial to that crop.

The mixture containing nitrate of soda had slightly the advantage over the compound of superphosphate, muriate of potash, and sulphate of ammonia; but the difference in the weight of plots No. 7 and No. 9 is too small to be noticed, and the result obtained on these two plots certainly does not indicate the superiority of nitrate of soda over sulphate of ammonia in the mineral manure.

The least effective of all the manures used in these experiments was the mixture of 3 cwts. of bone-dust and 1½ cwt. of superphosphate; for this mixture actually gave rather a smaller increase than 3 cwts. of superphosphate alone.

On the whole we may learn from these experiments that compound artificial manures containing readily available phosphates, salts of potash, and a fair amount of nitrogen, either in the shape of ammonia, or in the form of nitric acid, were more serviceable to the swede crop than purely mineral superphosphate; that such compound manuring matters largely increase the produce, and that they may be used with economy by root-growers.

*Experiments on Swedes made, in* 1869, *at Tubney Warren, Abingdon, by Mr. James Kimber.*

The same manuring scheme which was adopted in the preceding experiments was carried out by Mr. Kimber, who, however, left only two, instead of three plots, unmanured.

One of the main objects I had in view in all the experiments in 1869 was to ascertain under what circumstances potash-salts might be usefully employed as manuring agents for root-crops, and this I sought to attain by trying precisely the same manuring matters in various localities and soils.

The field on which Mr. Kimber's experiments were tried, he informs me, had been down with sainfoin five years previous to 1868. It was then broken up, and in 1868 grew a crop of wheat, manured with a moderate dressing of Peruvian guano.

The various manures used for the experiments upon swedes were sown broadcast, and the land afterwards ploughed. The swede seed was drilled on the 19th of June. An excellent plant came up, and the roots got on remarkably well, the weather being favourable until July, when a long period of hot and dry weather set in, which was very trying to the root-crops in 1869 in many localities.

On the 27th of August, the weather being still very warm and trying for root-crops, Mr. Kimber made the following notes respecting the appearance of the various experimental plots:—

| Plot:— | | |
|---|---|---|
| 1 | No Manure .. .. .. .. .. | Roots bad. |
| 2 | Mineral Superphosphate .. .. | Good roots. |
| 3 | Mineral Superphosphate and Potash-salts .. .. .. .. | Good roots, tops fresher and more healthy than on Plot 2. |
| 4 | Mineral Superphosphate and Peruvian Guano .. .. .. | About the same as Plot 3. |
| 5 | Peruvian Guano .. .. .. .. .. | Better than Plot 3 and 4. |
| 6 | Mineral Superphosphate, Potash-salts, and Sulphate of Ammonia .. .. .. .. .. | Much about the same as Plot 5. |
| 7 | Rotten Dung .. .. .. .. | The best plot of all. |
| 8 | Mineral Superphosphate, Potash-salts, and Nitrate of Soda .. | About as good as Plot 5. |
| 9 | Rotten Dung and Mineral Superphosphate .. .. .. .. | Fresher and better than Plot 8. |
| 10 | Bone-dust and Mineral Superphosphate .. .. .. .. .. | Inferior to the preceding plot. |
| 11 | No Manure .. .. .. .. .. | Like No. 1. |

The differences in the appearance of the various plots were striking at the time the field notes were taken by Mr. Kimber. The plots 1 and 11, without manure, looked miserably poor and stunted throughout the summer; the autumn of 1869, however, being mild and very favourable to root-crops, the swedes made much growth on the unmanured plots, and the differences in the appearance of the swedes in the experimental field were gradually obliterated, and a fair crop was obtained on the unmanured plots.

The roots were taken up in the middle of November, topped and tailed, and then weighed, when the results detailed on the following page were obtained.

The average produce of the two unmanured plots, Nos. 1 and 11, was 11 tons 2 cwts. 76 lbs.

A glance at the preceding experiments shows, amongst other particulars,

1. That mineral superphosphate alone materially increased the produce, and gave a better result than a mixture of bone-dust with half the amount of superphosphate employed on Plot 2.

2. That the addition of guano to superphosphate in the case before us had no beneficial effect whatever.

RESULTS of SWEDE EXPERIMENTS at TUBNEY WARREN, ABINGDON.

| Plots of $\frac{1}{20}$ of an Acre. | Kinds and Quantities of Manures per Acre. | | Produce per Acre. | | | Increase over Average Produce of Unmanured Plots per Acre. | | |
|---|---|---|---|---|---|---|---|---|
| | | cwts. | tons | cwts. | lbs. | tons | cwts. | lbs. |
| 1 | No Manure .. .. .. .. .. | .. | 10 | 10 | 60 | | .. | |
| 2 | Mineral Superphosphate .. | 3 | 16 | 3 | 84 | 5 | 1 | 8 |
| 3 | Mineral Superphosphate .. and Potash Salts .. .. .. | 3<br>2 | 16 | 7 | 56 | 5 | 4 | 92 |
| 4 | Mineral Superphosphate .. and Peruvian Guano .. .. | 3<br>1 | 16 | 3 | 64 | 5 | 0 | 100 |
| 5 | Peruvian Guano .. .. | 3 | 15 | 6 | 108 | 4 | 4 | 32 |
| 6 | Mineral Superphosphate .. and Potash Salts .. .. .. and Sulphate of Ammonia .. | 3<br>2<br>1 | 16 | 11 | 8 | 5 | 8 | 44 |
| 7 | Rotten Dung .. .. .. | tons<br>20 | 19 | 10 | 60 | 8 | 7 | 96 |
| 8 | Mineral Superphosphate .. and Potash Salts .. .. .. and Nitrate of Soda .. .. .. | cwts.<br>3<br>2<br>1 | 17 | 3 | 64 | 6 | 0 | 100 |
| 9 | Rotten Dung .. .. .. and Mineral Superphosphate .. | tons<br>10<br>cwt.<br>1½ | 19 | 3 | 84 | 8 | 1 | 8 |
| 10 | Bone-dust .. .. .. .. and Mineral Superphosphate .. | 3<br>1½ | 15 | 15 | 80 | 4 | 13 | 4 |
| 11 | No Manure .. .. .. .. | .. | 11 | 14 | 92 | | .. | |

3. That 3 cwts. of Peruvian guano per acre produced a smaller crop than an equal weight of mineral superphosphate.

In Mr. Wall's experiments Peruvian guano gave the best results, even rotten dung not excepted. The difference in the effect of guano in the north of England and in the county of Oxford, where Mr. Kimber's farm is situated, no doubt, is due principally to difference of climate in the two localities; for it is well known that guano does not exert its full fertilising effect upon root-crops in a very dry season, and sometimes even does positive harm.

4. That the addition of potash-salts to superphosphate increased but slightly the efficacy of the latter.

5. That the effect of nitrate of soda in the combination in which it was used in Plot 8 was rather better than that of sulphate of ammonia in the same combination.

6. That the dung—which, it may be stated, was well rotten, and of a very superior character—gave by far the heaviest crop, and that nearly as good a crop of swedes was produced when, instead of 20 tons of dung only, 10 tons of farmyard-manure and $1\frac{1}{2}$ cwt. of superphosphate were used.

The soil of the experimental field was in a good agricultural condition, but of a light character; and on such land well-rotten dung, apart from its fertilising effects, is particularly useful in a dry season, as it has a tendency to preserve the moisture in the land, and thereby sustain the life of root-crops better than artificial manures. On light soils I also find nitrate of soda, in combination with superphosphate and potash-salts, generally to be more beneficial to root-crops than sulphate of ammonia mixed with the same fertilisers.

### *Experiments on Swedes made by Mr. Charles Hunter, in* 1869, *at Blennerhasset Farm, Carlisle.*

The same series of experiments was likewise kindly undertaken for me by Mr. Charles Hunter, who superintends Mr. W. Lawson's experimental farm at Blennerhasset, in Cumberland.

The soil of the experimental field was a light gravelly loam. It was in turnips in 1867, and in oats in 1868. It was exposed in ridges to the action of the atmosphere during the winter; the ridges were twice split in spring, the land harrowed down, and the manures sown broadcast. The soil was then ridged up and the seed sown on the 19th of May.

The swedes were taken up on the 8th of November, topped, cleaned, and weighed, when the results exhibited on the next page were obtained.

The 3 unmanured plots yielded respectively 12 tons, $14\frac{1}{2}$ tons, and $16\frac{1}{2}$ tons of clean swedes; and there was, it will be seen, a difference of $4\frac{1}{2}$ tons of roots per acre in the weight of the crop on plot No. 1 on one end, and on plot No. 12 at the other end of the experimental field, and of $2\frac{1}{2}$ tons between Plot 1 and the central unmanured plot. These differences in the produce of roots on the 3 unmanured plots are too great to be overlooked; they seem to point out clearly that the field was in a poorer condition in one end than in the middle, and best at the opposite end. Unfortunately, this want of uniformity in the agricultural condition, and probably of depth of soil in the experimental field, vitiates in a measure the results of the experiments. Still, with all their faults, these field trials prove distinctly that superphosphate alone has not nearly so good an effect upon swedes on light land than mixtures of superphosphates with potash-salts.

Results of Swede Experiments at Blennerhasset Farm, Carlisle, in 1869.

| Plots of $\frac{1}{20}$ Acre each. | Manures and Quantities per Acre. | | Produce of Clean Swedes per Acre. | | | Increase over average produce of Unmanured Plots. **No. 1.** and **No. 6.** | | |
|---|---|---|---|---|---|---|---|---|
| | | cwts. | tons | cwts. | qrs. | tons | cwts. | qrs. |
| 1 | No manure .. .. .. .. | .. | 12 | 0 | 0 | 0 | 0 | 0 |
| 2 | Mineral Superphosphate .. | 3 | 13 | 7 | 2 | 0 | 2 | 2 |
| 3 | Mineral Superphosphate ..<br>and<br>Muriate of Potash .. .. | 3<br><br>2 | 15 | 15 | 0 | 2 | 10 | 0 |
| 4 | Mineral Superphosphate ..<br>and<br>Peruvian Guano .. .. | 3<br><br>1 | 15 | 10 | 0 | 2 | 5 | 0 |
| 5 | Peruvian Guano .. .. | 3 | 15 | 12 | 2 | 2 | 7 | 2 |
| 6 | No Manure .. .. .. .. | .. | 14 | 10 | 0 | 0 | 0 | 0 |
| 7 | Mineral Superphosphate ..<br>and<br>Muriate of Potash .. ..<br>and<br>Sulphate of Ammonia .. | 3<br><br>2<br><br>1 | 18 | 12 | 2 | 5 | 7 | 2 |
| 8 | Rotten Dung .. .. .. | tons<br>20 | 23 | 10 | 0 | 10 | 5 | 0 |
| 9 | Mineral Superphosphate ..<br>and<br>Muriate of Potash .. ..<br>and<br>Nitrate of Soda .. .. | cwts.<br>3<br><br>2<br><br>1 | 18 | 2 | 2 | 4 | 17 | 2 |
| 10 | Rotten Dung .. .. ..<br>and<br>Mineral Superphosphate .. | tons<br>10<br>cwts.<br>1½ | 21 | 2 | 2 | 7 | 17 | 2 |
| 11 | Bone Dust .. .. ..<br>and<br>Superphosphate .. .. | 3<br><br>1½ | 18 | 12 | 2 | 5 | 7 | 2 |
| 12 | No Manure .. .. .. | .. | 16 | 10 | 0 | 0 | 0 | 0 |

Thus the produce on Plot 2, manured with superphosphate alone, amounted to 13 tons $7\frac{1}{2}$ cwts. per acre, whilst the addition of 2 cwts. of muriate of potash raised the crop to $15\frac{3}{4}$ tons calculated per acre.

We have here an excellent example, showing how desirable it is to leave in all field trials 3 plots unmanured. Many anomalies which characterise some field experiments, I feel convinced, would frequently admit of a rational explanation if 3 plots, one at each end of the experimental field and one in the centre, were left unmanured; for the produce of these unmanured plots would show at once whether the field was uniform or not, as regards its condition and actual productive powers.

*Experiments on Potatoes made at Blennerhasset Farm, Carlisle, in 1869, by Mr. Charles Hunter.*

Half an acre was divided into 10 equal parts, of $\frac{1}{20}$th of an acre each, which, as regards manure, were treated as follows:—

| Plot. | Kind of Manure used. | Quantity per Plot. | At the rate per Acre. |
|---|---|---|---|
| | | lbs. | cwts. |
| 1 | No Manure .. .. .. .. .. .. .. | .. | .. |
| 2 | Mineral Superphosphate .. .. .. .. | $22\frac{1}{2}$ | 4 |
| | and | | |
| | Muriate of Potash .. .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| | and | | |
| | Sulphate of Ammonia .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| | | ton | tons |
| 3 | Good Rotten Dung .. .. .. .. .. | 1 | 20 |
| | | lbs. | cwts. |
| 4 | Mineral Superphosphate .. .. .. .. | $22\frac{1}{2}$ | 4 |
| | and | | |
| | Muriate of Potash .. .. .. .. .. | $22\frac{1}{2}$ | 4 |
| 5 | No Manure .. .. .. .. .. .. .. | .. | .. |
| 6 | Mineral Superphosphate .. .. .. .. | $22\frac{1}{2}$ | 4 |
| | and | | |
| | Muriate of Potash .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| | and | | |
| | Nitrate of Soda .. .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| 7 | Peruvian Guano .. .. .. .. .. .. | $22\frac{1}{2}$ | 4 |
| 8 | Mineral Superphosphate .. .. .. .. | $22\frac{1}{2}$ | 4 |
| | and | | |
| | Common Salt .. .. .. .. .. .. | $22\frac{1}{2}$ | 4 |
| | | tons. | tons. |
| 9 | Good Rotten Dung .. .. .. .. .. | 1 | 20 |
| 10 | No Manure .. .. .. .. .. .. .. | .. | .. |

The year 1869 was not favourable for potatoes. The rainfall at Blennerhasset in the months of May, June, and July of that year, was only about two-thirds of the average, and in August only one-half.

The want of rain in these months greatly checked the growth of the potatoes; and the heavy rainfall of September came too late to be of much benefit to the crop. Moreover, a sharp frost in the first week of September destroyed the potato tops, and checked the further growth.

The potato sets—Regent's—weighed from 1 to 2·2 ounces, averaging 1·6 ounce. They were planted on the 30th of April in 32 drills and 10 inches apart.

The soil of the experimental field was a fair gravelly loam, getting somewhat stiffer towards the plots 8, 9, and 10. The field was in oats, out of ley, in 1868. It had lain in grass for about 4 years, during which period it had been frequently irrigated.

The potatoes were dug up on the 24th of October, and sorted into large, medium-sized, and small potatoes, which were then carefully weighed.

The following Table embodies the weights of the produce of each plot in large, medium-sized, and small potatoes, the total produce calculated per acre, and the increase of each plot over the average yield of the three unmanured plots Nos. 1, 5, and 10:—

RESULTS of POTATO EXPERIMENTS in 1869, at BLENNERHASSET FARM.

| Plots. | Manures Used. | Produce in lbs. per Plot of $\frac{1}{20}$ of an Acre. | | | Total Produce per Acre. | | | Increase over Average Produce of Unmanured Plots. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Large | Medium | Small | tons | cwts. | lbs. | tons | cwts. | lbs. |
| 1 | No Manure .. .. .. | 186 | 120 | 15 | 3 | 8 | 4 | | .. | |
| 2 | Mineral Superphosphate .. and Muriate of Potash .. .. and Sulphate of Ammonia .. | 513 | 182 | 94 | 7 | 0 | 100 | 3 | 8 | 97 |
| 3 | Good Rotten Dung .. .. | 580 | 209 | 115 | 8 | 1 | 48 | 4 | 9 | 45 |
| 4 | Mineral Superphosphate .. and Muriate of Potash .. .. | 498 | 155 | 107 | 6 | 15 | 80 | 3 | 3 | 77 |
| 5 | No Manure.. .. .. .. | 207 | 113 | 78 | 3 | 11 | 8 | | .. | |
| 6 | Mineral Superphosphate .. and Muriate of Potash .. .. and Nitrate of Soda .. .. .. | 441 | 162 | 95 | 6 | 4 | 72 | 2 | 12 | 69 |
| 7 | Peruvian Guano .. .. | 274 | 129 | 108 | 4 | 11 | 28 | 0 | 19 | 25 |
| 8 | Mineral Superphosphate .. and Common Salt .. .. .. | 326 | 116 | 103 | 4 | 17 | 36 | 1 | 5 | 33 |
| 9 | Good Rotten Dung .. .. | 547 | 154 | 153 | 7 | 12 | 56 | 4 | 0 | 53 |
| 10 | No Manure .. .. .. | 225 | 105 | 101 | 3 | 16 | 108 | | .. | |

Average weight of total produce per acre of the three unmanured plots, 3 tons 12 cwts. 3 lbs.

The preceding calculated results exhibit several points of interest, on which a few observations may be offered:—

1. The natural produce of plot No. 1 was somewhat smaller than that of plot No. 5, and this was again smaller than the produce of the third unmanured plot, No. 10, showing, as already indicated, that the field was rather better at one end than at the other. The differences in the produce of the three unmanured plots are not very great, and it may therefore be assumed that the field was tolerably uniform and well adapted for experimental purposes.

2. By far the heaviest crop was obtained by the use of rotten dung, which appears to be specially beneficial to potatoes, and indeed to all root-crops, in a dry season.

3. Next to the dung in order of efficiency follows the mixture of superphosphate, muriate of potash, and sulphate of ammonia. This mixture gave an increase over the average yield of the unmanured plots of 3 tons 8 cwts. 97 lbs., and in a more favourable season the increase would probably have been more conspicuous.

4. A somewhat less favourable result than on Plot 2 was obtained on Plot 6, where, instead of sulphate of ammonia, nitrate of soda was applied in conjunction with superphosphate and muriate of potash. Comparing the produce of Plot 6 with that of Plot 4, on which mineral superphosphate and muriate of potash were used, it will appear that in the dry season of 1869 the addition of nitrate of soda to these fertilizing matters had rather an injurious than a beneficial effect.

5. Muriate of potash, in conjunction with mineral superphosphate, it will be seen by the preceding results, gave a considerable increase, differing only by 5 cwts. from the increase of Plot 2, which, in addition to 4 cwts. of superphosphate and 2 cwts. of muriate of potash, received 1 cwt. of sulphate of ammonia.

Potash-salts and superphosphate thus appear to constitute a valuable manuring mixture for potatoes.

6. The results obtained on Plot 4 and Plot 8 clearly show that muriate of potash cannot be successfully replaced in artificial manures by muriate of soda (common salt), for, whilst 4 cwts. of mineral superphosphate mixed with 2 cwts. of muriate of potash, gave a produce of 7 tons 100 lbs. of potatoes, the same quantity of mineral superphosphate mixed with common salt produced only 4 tons 17 cwts. 36 lbs., or the increase over the average yield of the unmanured plot was 3 tons 3 cwts. 77 lbs. on the plot upon which potash was used, and only 1 ton 5 cwts. 33 lbs. on Plot 8 where common salt was employed.

7. Peruvian guano, it is well known, is a capital manure for potatoes, especially on light soils. In the experiments at Blennerhasset, however, it produced scarcely 1 ton of increase, a result which finds its explanation in the fact that June, July, and August, in 1869, were unusually dry. In such seasons as that of 1869, Peruvian guano and indeed all manures rich in ammonia do not act nearly so well as fertilizers as in seasons in which a good deal of rain falls during the summer months.

Nitrogenous or ammoniacal matters, unless washed into the soil by copious rains, and thereby distributed through a large mass of soil, appear to check the growth of root-crops; and for this reason it would appear desirable to apply such manures quite early in the spring and to sow them broadcast.

### *Experiments on Potatoes made, in* 1870, *by Messrs. Hull and Coleman on Escrick Home Farm, near York.*

In 1868 Messrs. Coleman and Hull made some experiments on potatoes on Lord Wenlock's Menagerie Farm, at Escrick, near York. An account of these experiments will be found in Vol. VI., 2nd Series, Part II., of this Journal.

At my request these gentlemen kindly undertook to repeat the experiments with precisely the same manuring agents as before, and I have now the pleasure of reporting on the results of their trials in 1870.

The field in which the potato experiments were made in 1870 was a sandy loam in a fair agricultural condition.

The kind of potatoes known as Victorias were planted on oat stubble on the 28th of April, and the crop taken up on the 17th of October.

Before the dry weather which characterised last season set in, no great difference, Mr. Coleman reports, was perceptible in the general appearance of the various plots. The potatoes came up well, and looked healthy on all the plots. After the dry weather had continued some time, the appearance of the various plots became much altered.

The dunged plots No. 3 and No. 9 then looked by far the most promising of all the experimental plots.

The plots manured with superphosphate and potash, and with superphosphate, potash, and sulphate of ammonia or nitrate of soda, (plots 2, 4, and 6), appeared to be much stronger and healthier than the remaining plots, except those dressed with rotten dung.

On Plot 7 (manured with Peruvian guano) the potatoes came up at first with very dark-green tops, but when the dry weather began they soon lost their healthy appearance, and showed signs of turning out a very light crop.

On Plot 4, manured with superphosphate and common salt, the tops became weak and remained as small as, and in no wise better than, on the unmanured plots.

The produce of each plot was carefully weighed, and the results exhibited on the next page were obtained.

A critical examination of these results affords evidence that the field gradually improved in condition, and probably in depth, in the direction from Plot 1 towards Plot 12.

A glance at the following Table will show that the produce on the unmanured plot No. 1 was 3 tons 17 cwts. 36 lbs.; on the more central unmanured plot it was 4 tons 9 cwts. 32 lbs.; and on the unmanured plot at the other end of the field it was 5 tons 3 cwt. 104 lbs.

RESULTS of POTATO EXPERIMENTS at ESCRICK HOME FARM in 1870.

| Plots. | Manures used per Acre. | | Produce of each Plot of $\frac{1}{20}$ of an Acre. | | Produce per Acre. | | |
|---|---|---|---|---|---|---|---|
| | | cwts. | stones | lbs. | tons | cwts. | lbs. |
| 1 | No Manure .. .. .. .. .. .. | .. | 30 | 13 | 3 | 17 | 36 |
| 2 | Mineral Superphosphate .. .. and Potash-salts .. .. .. .. .. and Sulphate of Ammonia .. .. | 4 / 2 / 2 | 71 | 13 | 8 | 19 | 92 |
| 3 | Good Rotten Dung .. .. .. | tons 20 | 73 | 0 | 9 | 2 | 56 |
| 4 | Mineral Superphosphate .. .. and Potash-salts .. .. .. .. .. | cwts. 4 / 4 | 68 | 3 | 8 | 10 | 60 |
| 5 | No Manure .. .. .. .. .. .. | .. | 35 | 10 | 4 | 9 | 32 |
| 6 | Mineral Superphosphate .. .. and Potash-salts .. .. .. .. .. and Nitrate of Soda .. .. .. .. | 4 / 2 / 2 | 70 | 2 | 8 | 15 | 40 |
| 7 | Peruvian Guano .. .. .. .. | 4 | 41 | 0 | 5 | 2 | 56 |
| 8 | Mineral Superphosphate .. .. and Common Salts .. .. .. .. | 4 / 4 | 35 | 4 | 4 | 8 | 24 |
| 9 | Good Rotten Dung .. .. .. | tons 20 | 90 | 9 | 11 | 6 | 68 |
| 10 | No Manure .. .. .. .. .. .. | .. | 41 | 8 | 5 | 3 | 104 |

Again, of the two plots which were dunged, the produce of plot No. 9 was larger than on the second dunged plot, placed nearer to plot No. 1.

At the end near plot No. 10 the field evidently was naturally more productive than near Plot 1.

In calculating the increase per acre due to the application of the various fertilizing agents employed, I have taken the mean produce of the two unmanured plots, No. 1 and No. 5. The average weight of potatoes on these two plots amounts to 4 tons 3 cwts. 34 lbs. per acre, and the increase on each manured plot over the average produce of clean potatoes from plots Nos. 1 and 5 is shown in the Table on the following page.

These results confirm in a striking manner Messrs. Coleman and Hull's experience with the same manures in 1868, and they agree likewise with Mr. Charles Hunter's experiments at Blennerhasset Farm made in 1869.

The tabulated statements of results lead me to make the following remarks :—

1. In a dry season rotten dung produced the most luxuriant crop. In such a season, however, very nearly the same increase

## Escrick Potato Experiments in 1870.

Table showing the Increase per Acre on each Experimental Plot over the average produce of the Unmanured Plots, Nos. 1 and 5.

| Plots. | Manure used. | Increase per Acre. tons | cwts. | lbs. |
|---|---|---|---|---|
| 2 | Mineral Superphosphate .. .. .. .. .. and Potash-salts .. .. .. .. .. .. .. .. and Sulphate of Ammonia .. .. .. .. .. | 4 | 16 | 58 |
| 3 | Rotten Dung .. .. .. .. .. .. .. .. | 4 | 19 | 22 |
| 4 | Mineral Superphosphate .. .. .. .. .. and Potash-salts .. .. .. .. .. .. .. .. | 4 | 7 | 26 |
| 6 | Mineral Superphosphate .. .. .. .. .. and Potash-salts .. .. .. .. .. .. .. .. and Nitrate of Soda .. .. .. .. .. .. .. | 4 | 12 | 6 |
| 7 | Peruvian Guano .. .. .. .. .. .. .. | 0 | 19 | 22 |
| 8 | Mineral Superphosphate .. .. .. .. .. and Common Salt .. .. .. .. .. .. .. .. | 0 | 4 | 102 |
| 9 | Rotten Dung .. .. .. .. .. .. .. .. | 5 | 3 | 34 |

may be obtained if, instead of dung, a mixture of 4 cwts. of mineral superphosphate, 2 cwts. of potash salts, and 2 cwts. of sulphate of ammonia or nitrate of soda, be used per acre as a potato-manure.

Relying on the experience of the past three seasons, I can confidently recommend this mixture as an excellent and well-paying potato-manure for light soils, when dung cannot be employed in sufficient quantity for that crop.

2. In a dry season Peruvian guano produces but an inconsiderable increase in potatoes on light land. In more propitious seasons than that which characterised the past three years in many localities in England, the effect of guano, no doubt, is very different, and in good seasons guano will probably prove one of the best artificial manures for potatoes on light land.

In 1868, 4 cwts. of Peruvian guano gave at Escrick an increase of only 1 ton 4 cwts. 1 qr. 17 lbs.; and, in 1870, on similar soil to that upon which the guano was applied in 1868, only an increase of 19 cwts. 22 lbs.

3. It will have been seen that neither sulphate of ammonia nor nitrate of soda materially increased the crop of potatoes in 1870, thus confirming the general experience that in dry seasons ammoniacal or nitrogenous matters added to superphosphate and salts of potash are comparatively ineffective.

4. Common salt, in quantities of 4 cwts. per acre or more, added to superphosphate, apparently does more harm than good to potatoes in a dry season. Practically speaking, the yield of potatoes on plot No. 6, upon which 4 cwts. of common salt were used, together with 4 cwts. of superphosphate, gave no more potatoes than the average produce of the two unmanured plots, No. 1 and No. 5, and somewhat less than the third unmanured plot, No. 10. Superphosphate alone, I do not doubt, would have given a better crop than the mixture of 4 cwts. of superphosphate and 4 cwts. of common salt.

5. A striking difference will be noticed in the effects of common salt and of potash-salts, when each is used in combination with mineral superphosphate.

On plot No. 4, where 4 cwts. of superphosphate and 4 cwts. of potash-salts were used, the produce per acre was 8 tons 10 cwts. 60 lbs., or an increase, by that mixture, was obtained over the unmanured plots, amounting to 4 tons 7 cwts. 26 lbs.; whereas 4 cwts. of superphosphate, mixed with 4 cwts. of common salt on plot No. 8, gave only 4 tons 8 cwts. 24 lbs., or, practically speaking, no increase at all over the unmanured portions of the field.

6. It follows clearly from the results of the experiments on potatoes here recorded, and of those previously published by me, that potash-salts materially increase the produce of potatoes; that they are very useful constituents in a potato-manure, at all events upon light land; and that they cannot be replaced with advantage by soda-salts in such a manure.

*Experiments on Mangolds made, in* 1870, *at Escrick Home Farm, York, by Messrs. Coleman and Hull.*

The field on which the following experiments were tried was of a light sandy character. It was divided into 12 equal plots of $\frac{1}{20}$th of an acre each, which were treated as regards manures, as on the following page.

The dry summer greatly influenced the produce, which was but small on the unmanured plots, and not nearly so large on the manured portions of the field as it might reasonably have been expected on at least some of the plots in a more propitious season. The mangolds, topped and cleaned, were carefully weighed; and in the Table given on p. 384, the results of these weighings are given, together with the produce of each plot, calculated per acre, and the increase over the average produce per acre of the three unmanured plots.

The average produce of the three unmanured plots per acre, was 15 tons 10 cwts.

Although the dry weather spoiled to some extent the experi-

| Plots. | Kind of Manure used. | Quantity of Manure per Plot. | Quantity of Manure per Acre. |
|---|---|---|---|
| | | lbs. | cwts. |
| 1 | No Manure .. .. .. .. .. .. .. .. .. | .. | .. |
| 2 | Mineral Superphosphate .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| 3 | Mineral Superphosphate .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Muriate of Potash .. .. .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| 4 | Mineral Superphosphate .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Peruvian Guano .. .. .. .. .. .. .. | $5\frac{1}{2}$ | 1 |
| 5 | Peruvian Guano .. .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| 6 | No Manure .. .. .. .. .. .. .. .. .. | .. | .. |
| 7 | Mineral Superphosphate .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Muriate of Potash .. .. .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| | and | | |
| | Sulphate of Ammonia .. .. .. .. .. .. | $5\frac{1}{2}$ | 1 |
| | | ton. | tons |
| 8 | Rotten Dung .. .. .. .. .. .. .. .. | 1 | 20 |
| | | lbs. | cwts. |
| 9 | Mineral Superphosphate .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Muriate of Potash .. .. .. .. .. .. .. | $11\frac{1}{4}$ | 2 |
| | and | | |
| | Nitrate of Soda .. .. .. .. .. .. .. .. | $5\frac{1}{2}$ | 1 |
| | | cwts. | tons. |
| 10 | Rotten Dung .. .. .. .. .. .. .. .. | 10 | 10 |
| | and | lbs. | cwt. |
| | Mineral Superphosphate .. .. .. .. .. .. | $8\frac{1}{4}$ | $1\frac{1}{2}$ |
| 11 | Bone Dust .. .. .. .. .. .. .. .. .. | $16\frac{1}{2}$ | 3 |
| | and | | |
| | Mineral Superphosphate .. .. .. .. .. .. | $8\frac{1}{4}$ | $1\frac{1}{2}$ |
| 12 | No Manure .. .. .. .. .. .. .. .. | .. | .. |

ments, they are not altogether void of interest. It will be noticed that, as in previous years, the addition of potash-salts to superphosphate had a decidedly beneficial effect upon the crop. Thus, whilst 3 cwts. of superphosphate produced 17 tons of mangolds, the same quantity of superphosphate, used with 2 cwts. of muriate of potash, yielded 19 tons 15 cwts., or 2 tons 15 cwts. more than superphosphate alone. It will likewise be noticed that the artificial manures which were applied to plot No. 3 (superphosphate and potash-salts), and to plot No. 7 (superphosphate, muriate of potash, and sulphate of ammonia), had quite as good an effect as a heavy dressing of good rotten dung; and, lastly, it will be seen that in these experiments the addition of sulphate of ammonia to superphosphate and muriate of potash had a better effect than the addition of nitrate of soda to the same fertilizers.

RESULTS of MANGOLD EXPERIMENTS at ESCRICK, near YORK, in 1870.

| Plots. | Manure used. | Produce per Plot of $\frac{1}{20}$ Acre. | | Produce per Acre. | | Increase per Acre over average produce of Unmanured Plots. | |
|---|---|---|---|---|---|---|---|
| | | cwts. | lbs. | tons | cwts. | tons | cwts. |
| 1 | No Manure .. .. .. .. .. .. | 14 | 28 | 14 | 5 | .. | |
| 2 | Mineral Superphosphate .. .. .. | 17 | 0 | 17 | 0 | 1 | 10 |
| 3 | Mineral Superphosphate .. .. .. and Muriate of Potash .. .. .. .. | 19 | 84 | 19 | 15 | 4 | 5 |
| 4 | Mineral Superphosphate .. .. .. and Peruvian Guano .. .. .. .. | 18 | 0 | 18 | 0 | 2 | 10 |
| 5 | Peruvian Guano .. .. .. .. .. | 18 | 0 | 18 | 0 | 2 | 10 |
| 6 | No Manure .. .. .. .. .. .. | 16 | 28 | 16 | 5 | .. | |
| 7 | Mineral Superphosphate .. .. .. and Muriate of Potash .. .. .. .. and Sulphate of Ammonia .. .. .. | 20 | 28 | 20 | 5 | 4 | 15 |
| 8 | Rotten Dung .. .. .. .. .. .. | 19 | 56 | 19 | 10 | 4 | 0 |
| 9 | Mineral Superphosphate .. .. .. and Muriate of Potash .. .. .. .. and Nitrate of Soda .. .. .. .. .. | 18 | 28 | 18 | 5 | 2 | 15 |
| 10 | Rotten Dung .. .. .. .. .. and Mineral Superphosphate .. .. .. | 18 | 28 | 18 | 5 | 2 | 15 |
| 11 | Bone Dust .. .. .. .. .. .. and Mineral Superphosphate .. .. .. | 15 | 84 | 15 | 15 | 0 | 5 |
| 12 | No Manure .. .. .. .. .. .. | 16 | 0 | 16 | 0 | .. | |

## *Experiments on Mangolds made by Mr. Thomas Brown, Grimston, King's Lynn, in* 1870.

The last series of experiments on which I have to report were carried out in accordance with my instructions by Mr. Thomas Brown, of Grimston, King's Lynn, who informs me that the soil of the experimental plots was in a good agricultural condition. The surface-soil has a depth of about 2 feet, and rests upon chalk. It yielded a good crop of wheat in 1869, and was cropped in the preceding year with turnips, which crop, however, owing to the exceptional drought in 1868, was a failure.

The turnips received 12 tons of farmyard-manure and 4 cwts. of home-made superphosphate per acre. The wheat-crop had no farmyard-manure, but was top-dressed with 2 cwts. of guano and 2 cwts. of salt per acre.

Mangolds, it is well known, are sometimes manured with very large quantities of farmyard-manure, as well as guano and other artificials. Although very heavy dressings of manure may do no harm to so greedy a feeder as the mangold-crop, it is very questionable whether it is good policy in average seasons to put as much as half a ton of superphosphate, or guano, or more, on mangolds. It appeared to me desirable, moreover, to ascertain, by actual experiments, whether or not the application of very large quantities of various kinds of artificial manures may not injure the crop. I therefore suggested to Mr. Brown to apply as much as 16½ lbs. of superphosphate or guano, kainite, &c., to a plot of $\frac{1}{100}$th of an acre, which amounts to about 15 cwts. of each kind of manure per acre.

The plots, ten in number, each $\frac{1}{100}$th of an acre, were treated as follows as regards manure:—

No. 1. Left unmanured.
2. Received 16½ lbs. dissolved Coprolites.
3. " 16½ " dissolved Coprolites and 16½ lbs. of Kainite.
4. " 16½ " Kainite.
5. Was left unmanured.
6. Was dressed with 16½ lbs. Peruvian Guano.
7. " " with 16½ " dissolved Coprolites, 16½ Kainite. and 16½ " Peruvian Guano.
8. " " with 1 load of fresh Horse-dung.
9. " " with ½ load of fresh Horse-dung and 16½ lbs. dissolved Coprolites.
10. Was left unmanured.

The crop on plots Nos. 1 and 2 showed no difference in appearance. On plot No. 3 the mangold looked more healthy and luxuriant, during the whole of the summer, than on plots Nos. 1 and 2.

Plot No. 4 appeared about equal with plot No. 3.

On plot No. 6 (manured with guano) the mangolds were larger than on plots Nos. 4 and 5.

Plot No. 7, as far as could be judged by its appearance, was the best of the lot.

The plants on plots Nos. 8 and 9 were very slow in starting, which was probably due to the manure being taken fresh from a horse-yard.

The produce of each plot was carefully weighed, and the results given in the next Table were obtained.

The average weight of mangolds from the unmanured plots was 18 tons 15 cwts. 7 stones 2 lbs.

The preceding experiments show—

1. That dissolved coprolites, applied alone, had no great effect upon the produce.

2. That kainite alone increased the crop considerably.

3. That, in combination with dissolved coprolites, kainite produced a more favourable result than kainite applied by itself.

4. That the largest increase in the crop was obtained by the mixture of dissolved coprolites, kainite, and guano.

RESULTS of MANGOLD EXPERIMENTS at GRIMSTON, KING'S LYNN, in 1870.

| Plot. | Manure used. | Produce per Plot. | | | Produce calculated per Acre. | | | | Increase over average Unmanured Produce. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | cwts. | stones | lbs. | tons | cwts. | stones | lbs. | tons | cwts. | stones | lbs. |
| 1 | No Manure .. .. | 3 | 6 | 3 | 18 | 17 | 5 | 6 | .. | | | |
| 2 | Dissolved Coprolites | 3 | 8 | 2 | 20 | 1 | 6 | 4 | 1 | 5 | 7 | 2 |
| 3 | Dissolved Coprolites .. and Kainite .. .. .. | 5 | 2 | 10 | 26 | 13 | 7 | 6 | 7 | 18 | 0 | 4 |
| 4 | Kainite (Potash-salts) | 5 | 0 | 9 | 25 | 7 | 5 | 6 | 6 | 11 | 6 | 4 |
| 5 | No Manure .. .. .. | 3 | 6 | 4 | 18 | 18 | 4 | 8 | .. | | | |
| 6 | Peruvian Guano .. | 5 | 5 | 5 | 28 | 6 | 7 | 10 | 9 | 11 | 0 | 8 |
| 7 | Dissolved Coprolites .. and Kainite .. .. .. and Guano .. .. .. | 6 | 1 | 0 | 30 | 8 | 4 | 0 | 11 | 12 | 4 | 12 |
| 8 | Farmyard Manure .. | 4 | 4 | 1 | 22 | 10 | 7 | 2 | 3 | 15 | 0 | 0 |
| 9 | Farmyard Manure .. and Dissolved Coprolites .. | 4 | 3 | 7 | 22 | 4 | 2 | 0 | 3 | 8 | 2 | 12 |
| 10 | No Manure .. .. | 3 | 5 | 10 | 18 | 11 | 3 | 6 | .. | | | |

5. That the large doses of kainite, dissolved coprolites, and guano, which were used in these experiments, did not injure the mangold crop.

On reviewing this Report, it will be found that in every trial in which potash-salts were applied to root-crops, either alone or in conjunction with other fertilizing matters, they materially increased the crops. Considering the number of trustworthy experiments now on record, all affording distinct evidence of the utility of potash-salts as manuring constituents of a turnip, potato, or mangold manure, intended to be used upon light land, there can be little doubt of the more abundant use which these salts will find in British agriculture. During the past season large quantities of raw and calcined kainite, and similar impure potash-salts, have found their way into the hands of the farmer; and in many cases the experience gained with potash-salts on a large scale has corroborated the opinion which I expressed some years ago that these salts will often be found very useful when added to superphosphate, or to mixtures of superphosphate with ammoniacal salts, especially on sandy soils, and ere long will find an extensive application in England.

Potash-salts are offered for sale under various names, and in various forms. All are obtained from the salt-mines of Stassfurt and the adjoining mines of Anhalt, and imported into England by several rival merchants, who, naturally enough, praise their own wares, and occasionally disparage those of their competitors. As many trade circulars which reach the farmer have a tendency to bewilder rather than to enlighten him, I would mention, for the guidance of intending purchasers of potash-salts, that the main point for their consideration is to make sure of obtaining in these salts as much potash as possible for a given price. During the past season I have made a good many analyses of native and calcined kainite, and of various kinds of Stassfurt potash-salts, and have found the percentage of potash in the several salts to vary considerably. I would, therefore, advise the buyer of German potash-salts to obtain in writing, from the dealer or importer, a guarantee, stipulating the percentage of potash which the native or calcined kainite, or any other species of crude or impure potash-salts, is to contain. When the bulk is delivered, the purchaser should take a fair average sample and have it tested for potash; and, if the analysis shows less potash than the guaranteed percentage, to make a deduction from the price corresponding with the value of the deficient potash.

*Laboratory*, 11, *Salisbury Square, Fleet Street, E.C.*,
*July*, 1871.

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## XV.—*On the Composition and Nutritive Value of the Prickly Comfrey* (*Symphytum asperrimum*). By Dr. AUGUSTUS VOELCKER, F.R.S.

THE prickly comfrey (*Symphytum asperrimum*) is a native of the Caucasus, whence it was introduced into England, in 1811, as an ornamental plant, by Messrs. Loddige, of Hackney. It is perfectly hardy in Great Britain, a rapid grower, and in moderately good soils reaches a great size; and even in poor soils grows over 2 feet high. It is a perennial plant, with fine reddish-blue flowers, and as it may be cut down three or four times in one season, it produces an abundance of succulent green food, which is said to be particularly useful for dairy-cows.

It is conveniently propagated by divisions of the root; the root may be cut into small pieces, as the smallest bit will produce a plant. The best time for planting the root-cuttings is February or the beginning of March; on good soils it should be planted in rows 2 to $2\frac{1}{2}$ feet apart, and 15 to 18 inches apart in the rows. If the plantation is made early in the year and the cuttings strike root and get well established before genial spring weather sets in, it will yield two good cuttings the first season; and in the succeeding years, if it is kept fairly clean and occasionally manured, it will give three or four cuttings furnishing an abundance of green food from April to October.

The prickly comfrey, although first introduced into England, has not much engaged the attention of English agriculturists, but it appears to be extensively cultivated in several parts of Ireland. It was extensively cultivated by the late Bishop of Kildare in a field at Glasnevin, where the plant is still found, growing up as a persistent weed, in spite of every attempt to eradicate it. Many gentlemen, after the example of the Bishop of Kildare, who was a first-rate dairy-farmer, are reported to cultivate it in their villa or suburban farms around Dublin, and find it a very useful food for their dairy stock.

At first cattle do not like it much, on account of the prickly character of its leaves; but they soon get accustomed to it, and are said to do well upon the food.

Its ordinary produce has been estimated by practical farmers at 30 tons per acre; but in experiments made in Ireland, on Carnew Castle Farm, on a considerable scale, the produce is reported to have amounted to 82 tons per Irish acre in three separate cuttings—of $28\frac{1}{2}$ tons in the middle of April, 31 tons in the middle of July, and $22\frac{1}{2}$ tons in the middle of September.

The prickly comfrey, as far as I am aware, has not been made the subject of careful analysis; at any rate I do not find a record of any such analysis in any accessible agricultural publication or scientific treatise, in which the chemical composition of agricultural productions is given in detail.

Having had occasion to make a full analysis of the prickly comfrey, grown in 1869, in Oxfordshire, I here give the analysis in the hope that it may perhaps be of some use or interest to some one or other of the readers of this Journal.

The general composition of the comfrey in the state in which it was received, and perfectly dried at 212° Fahr., may be stated as follows:—

*General Composition of Prickly Comfrey.*

| | In Natural State. | Calculated Dry. |
|---|---|---|
| Water | 90·66 | .. |
| *Nitrogenous organic compounds (flesh-forming matters) | 2·72 | 29·12 |
| Non-nitrogenous compounds (heat and fat-producing substances) | 4·78 | 51·28 |
| Mineral matter (ash) | 1·84 | 19·60 |
| | 100·00 | 100·00 |
| * Containing nitrogen | ·434 | 4·66 |

In its natural state comfrey, it will be seen, contains a high percentage of water, and in that respect resembles green mustard, mangold and turnip-tops, varying with the soil and season, the treatment as regards manure, and the rapidity with which such green food is grown. The percentage of water varies to some extent, but it is seldom less than from 90 to 91 per cent.

The following figures express the detailed composition of prickly comfrey in its natural state, and dried at 212° Fahr. :—

| | In Natural State. | | Calculated Dry. |
|---|---|---|---|
| Water .. .. .. .. .. .. .. .. .. .. | 90·66 | .... | .. |
| Oil and chlorophyll .. .. .. .. .. .. .. | ·20 | .... | 2·20 |
| *Soluble albuminous compounds .. .. .. | 1·10 | .... | 11·81 |
| †Insoluble albuminous or nitrogenous compounds | 1·62 | .... | 17·31 |
| Gum, mucilage, and a little sugar .. .. .. | 1·28 | .... | 13·65 |
| Woody fibre (cellulose) .. .. .. .. .. .. | 3·30 | .... | 35·43 |
| Mineral saline matters, soluble in water .. .. | 1·25 | .... | 13·32 |
| Mineral matters, insoluble in water .. .. .. | ·59 | .... | 6·28 |
| | 100·00 | .... | 100·00 |
| * Containing nitrogen .. .. .. .. .. | ·175 | .... | 1·88 |
| † Containing nitrogen .. .. .. .. .. | ·259 | .... | 2·78 |

The juice of this plant is very mucilaginous, though it contains but little sugar.

The preceding figures show that, notwithstanding the large amount of water, the proportion of albuminous compounds (flesh-forming matters) in comfrey is considerable, and that the percentage of cellular fibre is not larger than in similar green food.

In comparison with other similar food, I may state that comfrey has about the same feeding value as green mustard, or mangold, or turnip-tops, or Italian rye-grass grown on irrigated land.

All such watery food is very useful to dairy-farmers, especially if they sell their milk, and do not make it into butter or cheese, for succulent green food, as is well known, gives abundant though rather poor milk.

The cultivation of prickly comfrey requires but little care. The plant is quick growing and perfectly hardy, and it may, therefore, be worth the trouble of dairymen to grow it and to give it to their cows as a change of food.

*Laboratory*, 11, *Salisbury Square, Fleet Street, E.C.*,
*July*, 1871.

## XVI.—*Sewage-Farming.* By Herbert J. Little, of Thorpelands, Northampton.

It is scarcely thirty years since an eminent pioneer of agricultural progress — whose name has, during all the interval which has elapsed, been kept before the public in connection with the subject of this paper—incurred the taunt of being "a very nasty fellow" for insisting upon the importance of utilising our sewage, instead of allowing it to pollute our rivers, and endanger the public health, while we wasted our resources in the endeavour, at any cost to ourselves and risk to others, to throw it away. The sanitary engineer of that day—

"Utilium tardus provisor, prodigus æris,"

thought he had amply fulfilled his duty when the ordure and filth of our large towns, dispatched by the appliances of modern civilization down sink and sewer, were, by the friendly aid of summer storms and winter wet, swept into the neighbouring stream, to be lost indeed to sight, and therefore, according to the proverb, to be also dismissed from mind.

Within the last few years, however, a great change has taken place in the public appreciation of this subject; and the sewage question has attained such prominence that its discussion in these pages will certainly not need the apology with which I have small doubt that Mr. Mechi, and the early workers with him in so unfashionable a movement, were wont to preface their observations.

Important as is the proper disposal of this filth and waste in a sanitary point of view, it is of scarcely less moment as an economic subject; and I need hardly say that in these pages it should receive discussion mainly from the latter position. If much has been learned of late years with regard to it, there is still very much to be taught; and it must be acknowledged that, whatever benefits are in store for agriculture from an observance of the scientific laws which ought to govern the utilization of sewage, farmers, as a class, have hitherto hardly appreciated the significance of the subject, or devoted enough attention to its varied aspects. Forced upon towns, as it has been, by the exigencies of modern society, it is no wonder that urban authorities should be the first to attempt to obtain pecuniary return from the circumstances which compelled them to become, in many instances, the unwilling owners or occupiers of considerable tracts of land; but it will reflect no credit upon the professional tillers of the soil if the experience and knowledge which costly trials of public bodies have afforded should bear no fruit for them, and if new systems of the utmost importance in modern agriculture should be developed without their aid.

Sewage has been defined by Professor Way as "water holding in solution or suspension ingredients which do not belong to it as water, and which render it objectionable to the senses of sight and smell, injurious to health, and unfit for drinking and domestic purposes." In this paper I would rather regard it in the less comprehensive light adopted by the Sewage Committee of the British Association, as "any refuse from human habitations which may affect the public health." It is plain that the latter definition succinctly describes the matters with which we have to deal in considering it from a sanitary or an agricultural point of view.

He would be a bold man indeed who maintained that by any management we could at present obtain the full value of the substances to which I refer; but though it may be useless to indulge in hopes of the realization of such an amount, it is plain that, with our growing population and stationary acreage, it is our duty to let no means slip of increasing the productions of our fields. The most trustworthy estimates place upon the excreta of the people of these islands a value of not less than twelve millions sterling annually; but as this part of the subject has received full discussion in the pages of this Journal at the hands of able scientific writers in previous years, I will only add that this sum is based upon the figures of Messrs. Lawes and Gilbert, who have placed upon the manurial ingredients of a mixed population an average value of 8*s.* 4*d.* per head per annum.

A little consideration will show why the whole of this value can hardly be expected to be secured. In the first place, the collection of excrement can only be made profitable where large quantities of it exist; and in the second, the necessary processes for carrying it away add enormously to its bulk without in any corresponding degree increasing its value.

The conditions under which the elements contained in manures can be successfully applied to the soil are the subject of the most careful consideration to the farmer; and although it is perfectly true that 8*s.* 4*d.* per head represents the intrinsic value of certain ingredients in sewage, the manner of its application may reduce such a sum to one-half or one-fourth in its result to the agriculturist. In the same way, the mode of application of certain manures may double their real value to the farmer. They come to him in a convenient, handy, and portable form; they fill up a deficiency which practice tells him to exist; he is able to apply as much or as little as he chooses; and, in fact, he only finds them beneficial to certain crops and at certain stages of their growth. He does not forget, moreover, that the same value put upon the ingredients of well-made farmyard-dung would place it at a price which (notwithstanding all the esteem in which that valuable fertilizer is held) no one has yet consented to pay for it.

In a certain sense "the value of a thing is just as much as it will bring," and the worth of sewage under all the varying circumstances of its application can be determined by experience alone. Proof has yet to be afforded that under any conditions its intrinsic value, *plus* the cost of laying on, can be recovered from its use. It is certain, however, that more has been done during the last few years towards the solution of this problem than had been before attempted. Sewage-farming has become an established fact in every quarter of the kingdom, and, thanks to the intelligence and zeal of some of its promoters, every day is adding to our knowledge of the principles on which it should be conducted.

## Modes of Utilizing Sewage.

I shall briefly refer to some of the various modes which have hitherto been adopted on a large scale for the utilization of those substances which are included in the definition of sewage which I have adopted. The more important of these may be classified as:—1, the Earth System; 2, the Precipitation System; and 3, the Water System.

The first of these has received considerable attention of late years. It is probable that no other mode approaches it in its power of retaining the value of the solid parts of the excreta of a population. Why then has it met with so little favour? Because it is impracticable in any but small villages or isolated dwellings, and because the application of it in towns (if practicable) would still leave undisposed of a vast quantity of offensive matter which must be got rid of by means of water. It is not only the excreta of the population which find their way into town sewers, but a thousand sources of pollution, many of them at least as offensive as those with which the earth-closet would alone deal. It is a fact that the sewage of towns where the "midden system" is adopted is nearly equal in value to those where the water-closet system is in use. The middens are cleaned out periodically by scavengers appointed for the purpose, and on notice being given to the proper authority, the contents being carted away and sold for manure. This course would seem to prevent the possibility of the contamination of the sewage with any large proportion of fœcal matter; yet the experiments instituted by the Rivers Pollution Commissioners have placed it beyond a doubt that the sewage from these towns is to the full as offensive as, and nearly equal as a manure to, that of the others. The reason seems to be that much of the soakage from the middens finds its way into the sewers, and that more people generally contribute to the sewage in midden than in water-closet towns. It is evident that the earth-closet system can no more deal with, what I may call, the waif-and-stray elements of sewage than the midden, and for this reason it is found impracticable in towns.

I have stated thus much of the dry-earth system, because its value in an agricultural point of view is considerable under some circumstances, and not because it is applicable in any way to the disposal of town sewage. With proper management it may no doubt be so adapted to the wants of private dwellings and small communities as to be a fertile source of increased production and of health. If the whole of our means are to be made the most of, Mr. Moule's system should find its way to general application in our hamlets, and the water system in our more populous villages and towns.

The question of midden and water-closet sewage in towns has been thoroughly discussed by the Rivers Pollution Commissioners. They give the result of 37 analyses of the former, and of 54 of the latter, with the following result:—midden sewage contained on the average 5·435 parts in 100,000 of ammonia, against 6·703 in water-closet sewage. It also contained 6·451 of combined nitrogen against 7·728 in closet sewage, but of chlorine the proportions were reversed, and midden sewage was found to yield 11·54 to 10·66 parts in water-closet sewage. "It is, therefore, a fallacy," say they, "to suppose that by merely keeping solid excrement out of our rivers the sewage pollution of the latter is prevented. There exists a remarkable similarity of composition in the sewage of each description of town. The proportion of putrescible organic matter in solution in the sewage of midden towns is but slightly less than in water-closet towns, whilst the organic matter in suspension is somewhat greater in the former than the latter. For agricultural purposes 10 tons of water-closet sewage may be taken to be equal to about 12 of midden sewage. The retention of the solid excrements in the midden is not, therefore, attended with any considerable diminution in the strength of the sewage, although its volume is somewhat reduced. *Neither is the case substantially different where earth-closets are substituted for middens;* for the sewage from Broadmoor Lunatic Asylum, in which these closets are partially used, exhibits no degree of exceptional weakness. It seems hopeless, therefore, to expect any substantial reduction of sewage pollution by dealing with solid excrementitious matters only."

I pass on now to some notice of the various precipitation systems. Some of these have been announced with much parade, and we have been again and again assured that the *desideratum* we were anxiously looking for had indeed at last been attained; that the discovery how to retain the valuable substances and discharge the worthless was made; and that the nitrogenous constituents of sewage were available to the farmer in a convenient and handy form. The fact still remains that nearly all the ammonia escapes with the water, which looks so clear and is so foul, and that the dregs are hardly worth the trouble taken with them. No doubt if the promises held out by the advocates of this system could be fulfilled, a discovery of immense importance would be made to agriculture; but there is as little doubt that at present we can scarcely be said to be on the way to such a desirable achievement of science by any of the various schemes to which I allude. The A B C system, as it is called, is the most prominent of these. It professes, by a mixture of alum, blood, clay, and other ingredients, to precipitate the solid matters in suspension and solution in sewage; by the addition of sulphuric acid to the sediment to fix the ammonia contained therein; and by such means to manufacture a valuable manure. The analyses by Dr. Voelcker, however, which have been published in this Journal,* and the researches of the Rivers Pollution Commissioners, sufficiently prove that the manure produced by this process, is practically worthless. A more modest form of the precipitation system is practised at some places, Northampton among others. The solid matters are here precipitated into tanks by similar chemical agents; the water is discharged apparently clear; and the residue is mixed with the sweepings and other scavenger's refuse of the town, which have previously been passed through a riddle, and the larger matters calcined. This manure is sold at 3*s.* per ton; yet, having myself used considerable quantities of it, for which I paid this moderate price, and having carefully compared its effects with those of other ammoniacal and phosphatic manures, my own appreciation of its worth may be estimated by my declaration that I would not *accept* a further quantity of it if I had to cart it three or four miles at my leisure. The pollution of the river Nene has moreover become so serious that injunctions have been obtained by dwellers on the stream, and this case, with others similar to it, fully bears out the Commissioners' words—"We have never taken a sample of effluent sewage which had been subjected upon a working scale to any of these cleansing processes, which was not still so highly charged with putrescible animal matters as to be utterly unfit for admission into running water." Good service has been done to the public health, and also to the agricultural interest by the examination of this and kindred schemes, and the A B C system (at least so far as its value to the farmer is concerned) may be said to have received its death-blow. Practical sewage farmers are well aware that the least valuable of the matters which reach them are the solid, the ammonia having passed into the water, which has a remarkable natural affinity for it.

I must not omit some mention of a process lately patented by Mr. D. Forbes, F.R.S., and Dr. Price, in which phosphate of

* 2nd Series, Vol. VI. Part II., p. 415.

† Second Report, 1870.

alumina is the agent employed for the clarification and utilization of sewage. It would be premature, at present, to pronounce any decided opinion upon this scheme, but there seems no doubt that a valuable manure can be manufactured by it, since Dr. Voelcker has estimated the worth of various samples of such manure at from 2*l.* 15*s.* to 7*l.* 7*s.* per ton. As, however, we are not told what proportion of phosphate was added in each instance, and at what cost, we have no means of judging how much of such sums was due to the sewage itself, and how much to the added phosphate, but the value of the deposit depends entirely upon the quality of the sewage and the quantity of phosphate added. The clarified sewage, it is announced, loses none of its mineral fertilizing matters, and becomes slightly richer in saline ammonia. As, therefore, most of the ammonia it appears escapes with the water, the invention would hardly seem to be one of much practical utility, because the trouble and expense of treating the deposit would, probably as in other cases of the kind, annul the benefit derived from the use of *clarified* sewage. I do not learn from the prospectus of the Company that it professes to be able to do more than make clear the effluent sewage, and at present the extraction of the ammonia seems the one thing needful to render any process of this kind hopeful and satisfactory.

I now come to the water-closet and sewage-irrigation system, the only one of the three which (as has been seen) is at present applicable to towns with any prospect of success; which combines perfect cleanliness with considerable economy, and which meets in any degree the needs of agriculture. When we remember the necessity of water-supply—the fact that it forms a cheap and expeditious carrier, and that the earth is one gigantic filter, ever ready not only to *absorb* but to *utilise* the impurities of sewage—we can no longer wonder at the growing popularity of a system, the manifest advantages of which may lead to its adoption in all large collections of human beings.

"Sewage traversing the soil undergoes a process to some extent analogous to that experienced by blood passing through the lungs in the act of breathing. A field of porous soil, irrigated intermittently, virtually performs an act of respiration, copying on an enormous scale the lung-action of a breathing animal; for it is alternately receiving and expiring air, and thus dealing as an oxydizing agent with the filthy fluid which is trickling through it. And a whole acre of soil, 3 or 4 feet deep, presenting within it such an enormous lung surface, must be far superior as an oxydizer for dealing with the drainage of 100 people to any filter that could be practically worked for this purpose. . . . Moreover the appetite of the soil is constantly kept alive and fresh (except

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in winter) by the action of plant-growth, in constantly removing the deposited impurities and rebuilding them into wholesome organic structures." *

No one can view the sewage farm at Aldershot and compare it with the sterile waste which lies around it without a feeling of more than surprise and admiration. Here land of absolutely no agricultural value by nature may be found producing its crops of rye-grass up to 50 tons per acre per annum, and letting for 20*l.* or 25*l.* Here may be seen land, which in its pristine state would not support a sheep, employing the energies of a numerous band of labourers, the effect of whose toil is seen in the remarkable crops which adorn the fields; here, in short, may be studied the successful solution of the problem of sewage utilization.

Thousands of acres of such barren soil lie within an hour's journey of the metropolis, yet with this fact in view, the strange and wilful waste of nearly all the sewage of London continues; whilst the millions who throng the Lancashire towns, and pollute its rivers, make but the miserable return of $5\frac{1}{2}d.$ per head per annum to our agricultural resources.

But though I believe increasing knowledge and practice will in time enable us to obtain from diluted sewage far larger returns than we have yet acquired, I must not pass lightly over the difficulties which that dilution brings with it to the cultivator of the soil. It is a fact that, though the intrinsic value of ordinary town sewage (where 30 gallons are supplied per head of population daily) is 2*d.* per ton, no one has been found eager enough to pay anything like that sum for it. At the Barking farm the *return* for it is about $\frac{1}{4}d.$, at Romford Mr. Hope pays about $\frac{1}{2}d.$, and I believe that the latter figure is as much as at present can be obtained for any quantity. Of course the value will vary with the dilution and other circumstances. The unit of value will be fixed by the population contributing; but that once obtained, the farmer will easily ascertain the actual price he ought to pay for his manure, since every grain of ammonia in a gallon of the latter represents a theoretical value of $\frac{1}{4}d.$ per ton. Thus the value of man as a producer of manure is at present reduced to about 2*s.* per head per annum, which is, it must be confessed a scarcely satisfactory result when a comparison is drawn between him and other animals. The remarks by the Rivers Pollution Commissioners upon this point are so much to the purpose that I may perhaps be allowed to quote them here:—

"It is an established maxim in agriculture that, apart from the use of imported and manufactured fertilizers, the maintenance of fertility depends very much upon the live stock which the farmer

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* 'First Report of Rivers Pollution Commissioners,' p. 71.

keeps upon the land, and the quantity of manure which he can thus apply to it. The fertility of the 23,370,502 acres in the hands of English farmers is thus dependent on the 19,821,863 sheep, 3,706,641 cattle, and 1,629,550 pigs, which, according to the statistical returns just issued by the Board of Trade, are kept on English farms (1869); a number which, calculated wholly as sheep,* amounts in food-consuming and therefore manuring-producing power to as nearly as possible two sheep per acre over the whole area of the enclosed land in England. Taking 1,141,996 agricultural horses into account, we may say that the whole farm stock of this country is less than five sheep to every two acres in the hands of English farmers.

"We have, however, omitted all reference to another resident animal of the greatest food-consuming power, for whose maintenance indeed all these acres and all this live stock are owned and cultivated. Nearly one-third of the live stock of this country is mankind! In 1809 there were in England 20,658,599 of 'man,' and he consumes not only the produce of all these acres, and of all these cattle, sheep, and pigs which are maintained upon them, but imported food as well, to the extent of two-fifths of the estimated quantity of our home-grown meat. A creature of such great powers of consumption ought, according to all the analogies, to be of corresponding agricultural value as a fertilizer. If, leaving out of consideration the products of respiration, excrement be just the food of an animal minus its growth, then on the ground of both these elements of the calculation man ought to be the very best farm stock we have. He is not only a much better fed animal than a sheep, but he takes much less out of his food. Bread and beef are better food than grass and turnips, and the growth taken out of these several rations is much less in the former case than in the latter. The population fed on bread and beef does not increase in number, and that is, virtually, in total weight, more than 2 per cent. per annum, whereas the 'population' fed on grass and turnips increases in weight at least 30 to 50 per cent. within the year. A sheep builds its whole weight of body out of the food of eighteen months. The average age of man in England is rather more than forty years, and the weight of his body at death is all that he has saved out of all the food he has consumed during the whole period of his life. On any ground, therefore, we ought to anticipate the superiority of man to sheep as a manure-producing animal for farm use.

"And it is worth while to compare the two species further. So far as England is concerned, although the sheep 'population'

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* That is putting cattle of all ages as equal to six, pigs as equal to two, and horses equal to eight sheep a-piece.

varies considerably from year to year, they are upon the whole as nearly as possible alike in number; and in the month of June, when the agricultural returns are made up and when lambs are not above half grown, they are also probably very nearly alike in weight. The average carcase weight of the sheep sold at Smithfield is barely 80 lbs., which would correspond to a live weight of 140 lbs., and that may be considered also the average weight of the adult man. Comparing, then, their respective rations, their relative wastefulness of food, their weight and number, we might reasonably expect that Englishmen ought at the very least to be as efficient as English sheep in the maintenance of English fertility. But what is the fact? The sheep is the very best live stock known to English agriculture, and man is virtually good for nothing. What would the English farmer do without his flock? Over all the oolitic, chalk, and gravel soils—the light-land districts of the country—to be deprived of the assistance of the sheep would be ruin to the agriculturist. Man is, on the other hand, we repeat it, as live stock, virtually useless to him. The excrement of a sheep is worth at least 5*s.* a year to the farmer. In South Lancashire the excrement of man does not realize 5*d.* per head individually. . . . . The agricultural worthlessness of the immense stock of man here 'folded on the land' thus becomes a perfect scandal." *

What, then, is the reason why the sewage cultivator can only with safety reckon upon the realisation of one fourth (or some such proportion) of the value of the substances which he knows to exist in the fertilizer to be applied to his soil? Without doubt, the application of such abnormal quantities of liquid to his land. The sewage farmer, with corresponding advantages, has difficulties to deal with unknown to his older-fashioned rival. The season, the temperature, the rainfall, must all have his careful attention. Who can deny that if the summers of 1868 or 1870, with their tropical temperature and protracted drought, offered to him special advantages and rare opportunities of profit, a wet and cold season, or a frosty spring, would peculiarly try his system. As his success will often depend upon a lucky hit or a successful pack for market, so will his failure sometime date from a little lack of energy, or an unwise or unskilful application of the sewage which must be disposed of.

## Land adapted for Sewage-Farming.

The best authorities are now agreed that the land selected for a sewage-farm should be either nearly flat, or upon a gentle slope,

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* 'First Report of Rivers Pollution Commissioners,' p. 72.

or should possess the capacity of being laid in some such form. There are not wanting, indeed, advocates for rather steep hill-sides, so that the sewage can be used two or three times over, after the fashion of catchwater meadows; but this mode of irrigation with sewage is found both expensive and troublesome, the cultivation of the land being rendered far more difficult. With proper management, there should be no difficulty in extracting from the sewage, on its first application, nearly the whole of its manurial properties, and if this result is unaccomplished it must be from some fault in the cultivator or some deficiency in the filtering powers of the soil. To secure this most necessary object, the farmer should see that his land is laid out in the manner which modern experience has proved the best. The *quality* of the land selected is a point of somewhat less importance, provided that it be not too stony or gravelly for perfect filtration, and not too stiff for easy cultivation. This latter description of land has, indeed, received the sanction of a high authority, Mr. Bailey Denton; but notwithstanding the great weight of his opinion, I may be allowed to doubt whether the theoretical advantages which clays unquestionably possess, for the retention of certain valuable elements in sewage, would not be far outweighed by the impediments to their tillage which would be offered by their other qualities. A heartbreaking and profitless task would seem to be laid upon the man who should undertake the cultivation of stiff clay under sewage. A poor sand, or not too porous gravel, would probably in the long run answer the purpose of the sewage-farmer better than a naturally richer soil at a greatly enhanced price. There already exists sufficient evidence that the poorest sand will afford an ample return for his outlay. At Aldershot he will find almost pure silica, with a mixture of actually poisonous peroxide of iron, successfully irrigated and cropped. At Barking and Romford, plots of the most sterile gravel have yielded unexpected returns; but the farmer will avoid such extremes as these by choice. He should, moreover, take care that the land he selects possesses qualities for the purification of sewage, and also for the utilization of its fertilizing ingredients. As a matter of fact, some soils possess one of these qualifications without the other. It should be the province of the town authorities to select soil suitable for the former purpose, whilst the latter must not be lost sight of by the sewage-farmer in his estimate of its value for his end. The Rivers Pollution Commissioners found that certain soils possessed in far greater degree than others the property of nitrification, *i. e.*, the conversion of ammonia and organic animal matter into nitrates; indeed this process hardly goes on at all in some soils. When 3·8 gallons were filtered per diem through a cubic yard of Barking soil, the ammonia in the effluent water continuously increased, until at the end of three months it rapidly approached in quality unchanged and unpurified sewage. Beddington soil, on the other hand, submitted to a similar test (and in this case taken from a field which had been continuously irrigated with sewage for five years), proved such an admirable natural filter, that at the end of the same period, the organic impurity in the effluent water had not increased. The various experiments of the Commissioners upon different soils are deserving of serious attention. They will be found in their first Report, pp. 65 to 69. They seem to show that almost any variety of porous and finely divided soil will efficiently purify sewage to a much greater extent than any farmer could possibly require, and that its cleansing capacity depends upon porosity and comminution far more than upon its chemical composition; also that soils possessing extreme nitrifying properties are far less valuable for cultivation than those in which that process is carried out with difficulty, or not at all. Experience, however, has now proved that almost any light or medium soils will repay for the application of sewage, though not all to the same extent. These points should not therefore be overlooked by the practical man. As a rule, common-sense and the application of principles which govern the judgment in the choice of land for ordinary purposes, will suffice for that intended for sewage-irrigation; though, if the Commissioners' experiments are to be considered final, science should aid in the selection of land intended for this object.

## Preparation of Land for Sewage-Irrigation.

The preparation of the land for sewage-irrigation next demands attention, and here will be found considerable diversity of opinion and of practice. The width of the beds, for instance—a matter of no small importance—has been the subject of sharp skirmishing between the advocates of the several plans. I take it, however, that among those best qualified to give an opinion on laying out land for this purpose, certain principles may now be considered definitely settled. That the irrigation should be by surface application, by overflow from grips or carriers, and not by the old fashioned and expensive method of hose and jet; that open carriers (as being the least expensive and the handiest) should conduct the sewage to convenient points for distribution, whence smaller courses should convey it along the centre of raised-up beds or ridges (resembling the high-backed lands so well known in certain districts); that the drainage should be deep and thorough, and the subsoiling perfectly accomplished;

## PLAN OF

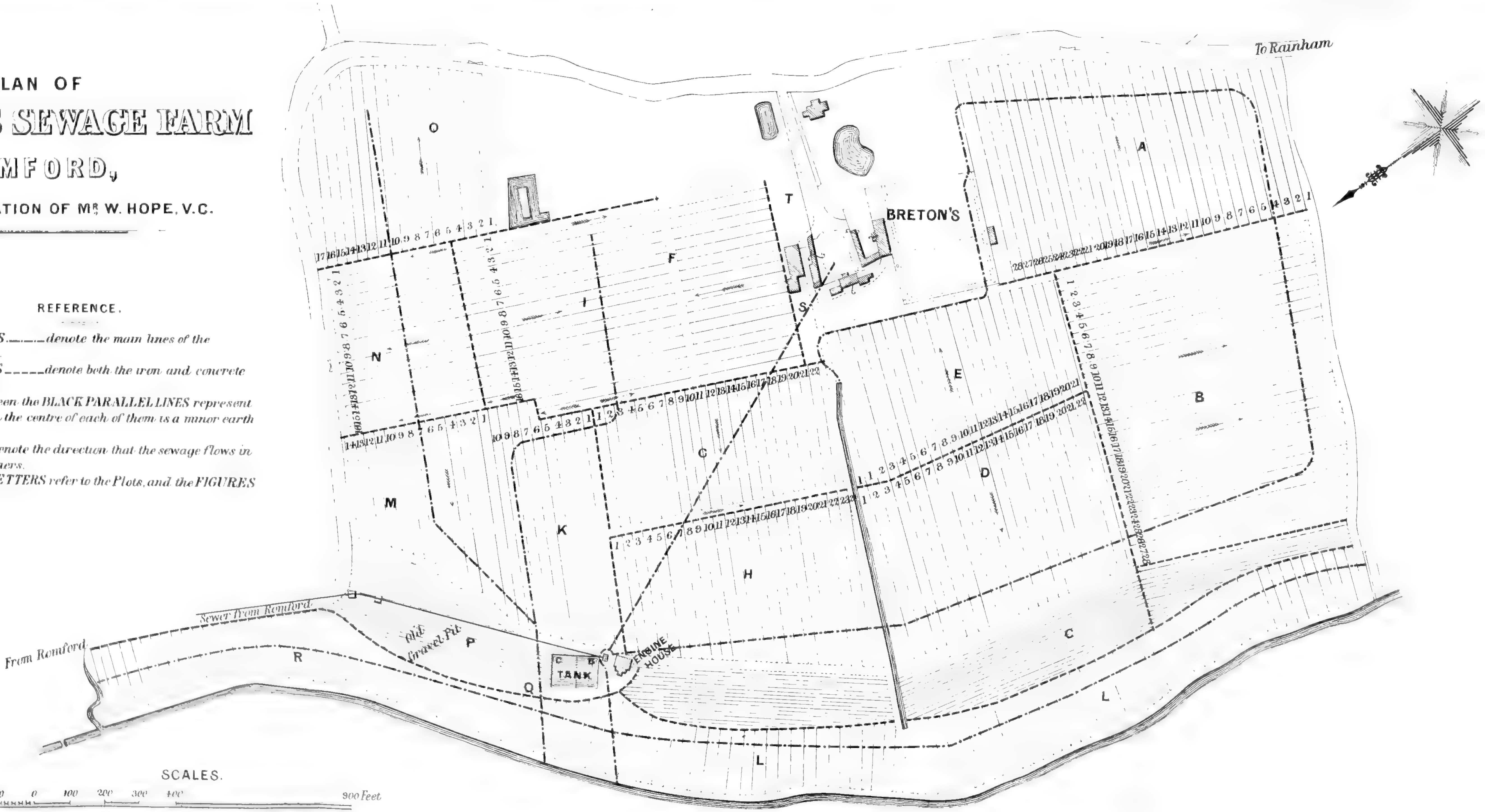
# BRETON'S SEWAGE FARM

## ROMFORD,

### IN THE OCCUPATION OF M^R. W. HOPE, V.C.

REFERENCE.

*The LINES THUS ——— denote the main lines of the under Drainage.*
*The LINES THUS – – – – denote both the iron and concrete main carriers.*
*The spaces between the BLACK PARALLEL LINES represent the Beds, and in the centre of each of them is a minor earth carrier.*
*The ARROWS denote the direction that the sewage flows in each set of carriers.*
*The CAPITAL LETTERS refer to the Plots, and the FIGURES to the Beds.*




SCALES.

100 0 100 200 300 400 900 Feet

1 0 1 2 3 4 5 6 7 8 9 14 19 Chains

F Dangerfield lith 22 Bedford S^t Covent Garden that the slope of the beds should vary with the character of the land, a sharper fall being obviously needed on loose soils than on more retentive ones;—these are principles upon which competent authorities may now be considered agreed. But there are still many subjects which, nevertheless, are warmly disputed by the ablest and most experienced men. Taking *results*, however, as his measure of success, the tyro in sewage-farming will do well to devote himself to the consideration of the systems practised upon the most noteworthy farms; and keeping in mind his own special case will consider the economy, the scientific practice, and the results of these systems in all their details.

Perhaps no sewage-farm in England offers a better example for the study of this subject than Mr. Hope's, near Romford. That gentleman may indeed be considered one of the first who, recognising the vast importance of the question, set himself to work out its practical solution with an earnestness and intelligence which have greatly advanced our previous knowledge of the subject. For ten years Mr. Hope has thrown all the energy of an active life into the working out of the problem we are considering, and for the same period he has never hesitated to do battle on behalf of a cause which he has espoused with such hearty zeal, with all comers who, in his opinion, violate the principles—engineering, scientific, or economic—upon which sewage-farming should be conducted. In Breton's farm the student may not only see one of the most successful examples of sewage-agriculture, but may acquire more exact knowledge of the quantity, quality, and details of application of sewage, than he is likely to obtain from those who have not made such a special study of its varied and peculiar details.

By Mr. Hope's kindness, I am enabled to give a plan of this farm; and, as the system upon which it is laid out embodies the experience and observation of several years, those interested in the subject cannot fail to derive from its consideration the knowledge of many practical points which deserve attention.

Mr. Hope is an advocate of narrow beds or lands, and the whole of Breton's farm is laid out upon this system; the beds being 15 feet wide on each side of the central carrier, or 30 feet over all. The advantages which are offered by the adoption of this plan are various and considerable; but I will allow Mr. Hope to tell in his own words his reasons for, and his mode of carrying out, his own principles.

"I took," says Mr. Hope, "a lease of the sewage of the town of Romford, together with a farm of 121 acres. The town had already purchased the farm, constructed the outfall sewer to it, and erected pumps and engines. I entered on the farm in

September, 1869, and at once set to work to make a clean sweep of existing divisions and obstacles, that is, hedges, ditches, banks, trees, &c., in order to be able to remodel the entire surface. The boundary of the farm was more or less irregular, as are the boundaries of all farms. One of my principal objects was therefore so to arrange the distribution of the sewage as to be incommoded to the minimum possible extent by these irregular boundaries. Of course all farming, if it is to pay, has to be conducted by the aid of horses or steam. But neither horses nor steam can cultivate the land unless in parallel lines, which must also be more or less straight.

"As regards the system of sewage distribution by means of the ridge and furrow, this necessity of horse or steam cultivation offers no difficulty, as nothing is more simple than to form a low ridge by means either of the horse or of the steam-plough; but clearly it would not do to have divisions, whether consisting of roadways or main distributing-channels, running in such a manner as to interfere with those lines of cultivation. Of course the easiest and simplest way of distributing a liquid over a given area of surface would be by a series of diverging main channels, with minor radiating branches. But such a system would render cultivation by horse or steam power absolutely impossible. The main distributing-channels must clearly be either parallel with the lines of cultivation, or they must intersect them as nearly at right angles as possible.

"A reference to the accompanying map will show how I have carried out these principles on my Romford farm. The highest land on the farm is at Plots A and U, from which it slopes gradually down to a contour line a little above the engine-house. From there it falls much more rapidly down to the little valley by the side of the river, forming, in fact, a steep hill-side. The comparatively flat land above and below this hill-side is all laid out or is now being laid out, as indicated by the small black lines, in beds, on the ridge-and-furrow system, each bed being 30 feet wide. The hill-side itself is ploughed horizontally with a turn-wrest plough, and then with a double-mouldboard plough thrown into little ridges, as if for potatoes, also horizontal. The sewage is applied to this hill-side from a carrier running along the top, the horizontal grooves of the double-mouldboard plough effectually preventing the liquid scouring away the earth from the plants. On this system, Italian rye-grass cannot, of course, be grown, nor can cereals; but the slope of the hill-side is far too rapid to permit of the application of any liquid by irrigation if the surface were left smooth; this is therefore no drawback.

"It will be observed that a roadway leads to every plot and to each bed in every plot; also that the land is so laid out that the beds abut, as far as possible, on the irregular boundaries of the farm, so that they may not interfere with the parallel lines of cultivation. I fixed the width of the beds at 30 feet, after a number of very careful experiments to ascertain what was, all things considered, the best and most convenient width of bed for the economical distribution of sewage; and this bed combines other great advantages not connected with irrigation; for the area of a bed is at once obtained in square yards with absolute precision by measuring the length and multiplying by 10. This, for selling market-garden crops, is a very great convenience. The half-bed of 15 feet from ridge to furrow is also a convenient width for harrowing, rolling, drilling, mowing, or raking 'in twice,' as the farmers say.

"The sewage is delivered on to the farm by gravitation some 20 feet below the higher portions of the farm. In order to reach these, I put up a sheet-iron trough on wooden legs, which reaches from the engine-house to various parts of the farm, where the level of the ground admits of the sewage being carried on in ditches, or carriers formed in low earth banks and lined with concrete. The concrete carrier is the best, but of course after a certain height it becomes too expensive and wastes much land by its spreading base; hence the substitution of iron. Both are so constructed as to distribute the sewage to the minor gutters in the beds passed on the way, if desired, as well as to *convey* it to more distant parts. This the infinitely more expensive pipe used in some places would not do."*

The map annexed, and Mr. Hope's description, will give a very clear idea of the *mode* which has commended itself most highly to modern authorities, but about the smaller details of which there is yet some dispute. The catchwater system, I have before said, yet finds its defenders, but it seems far better adapted for simple irrigation than for the utilization of sewage. This mode is so generally understood that it is unnecessary to explain its operation; but it seems a self-evident proposition that sewage delivered over successive areas or beds cannot equally and satisfactorily irrigate them alike. This latter, however, should be the object, if any adequate money return is looked for. Every ton of sewage should be carefully husbanded, expended where it is required, and by no means allowed to run to waste, as some of it inevitably must, in the beds which it at first reaches, under the catchwater plan.

The cost of the preparation of land will of course vary with circumstances and localities. At Aldershot, where much of it was levelled at great expense, it probably was not less

* 'Sewage Irrigation.' A lecture by W. Hope, V.C., p. 11. Stanford, 1871.

than 40*l.* or 50*l.* an acre, an outlay, however, in that case amply repaid. At Bedford (a successful example of sewage-farming), it did not exceed 10*l.* per acre, including covered earthenware carriers. It will probably be found, where suitable land is selected, to range from 10*l.* to 20*l.*, and to average 15*l.* per acre. This sum will not include the conveyance of sewage to the farm, nor the erection of pumping machinery for its elevation to the height requisite for its distribution.

## Extent of Land required.

The quantity of land required for the disposal of all the sewage of a town should be a serious consideration; and the farmer will be wise to provide land according to the estimated increase of the population. He will, however, have very considerable difficulty in deciding at the present time upon the acreage of land which ought to be put under sewage. For the *purification* of the sewage has been hitherto far more studied than its *utilization.* This fertilizer, of which we are beginning at last to understand the true value, has hitherto been treated as waste, and much land has been occupied simply for the purposes of filtration. The capacity of the soil in this respect is well-nigh unlimited. The Rivers Pollution Commissioners give it as their opinion, that 5 acres of land, drained 6 feet deep and thoroughly well, will suffice for the purification of the sewage of 10,000 persons, if it be only divided into equal plots, each of which shall receive the sewage of six houses. The object of the sewage-farmer will be, of course, to spread it over the largest area compatible with remuneration; the prevention of waste and the extraction of nitrogen will be his chief cares. Hopeless, indeed, may he be of the realization of any pecuniary result should he select such a farm as Barking for his model. At that place, if Mr. Morgan's method of calculation be reliable, the sewage of no less than 335 persons was poured over every acre in 1870. The opinions of practical men now point, however, to 50 or 60 as the number of persons who can beneficially contribute to each acre. As a matter of fact, at least double that number yield ammonia to most of our sewage-farms. At Croydon 100, at Bedford 140, at Banbury 80, and at Aldershot 80 individuals thus contribute; but Mr. Hope, with the light of recent experience, descending from 50 to 40, from 40 to 30, and from 30 to 20, is now strongly of opinion that the latter number represents something like the normal proportion of human beings whose sewage should be disposed of per acre; and for this simple reason, that he is sanguine enough to believe that by proper management the whole of the nitrogen derived from such a number of persons can be restored through the soil, that only our present ignorance prevents our securing crops which will pay for such an application, but that vegetation is unable beneficially to appropriate a greater amount. With such differences of opinion, enough land should at any rate be secured; and, for reasons which I shall presently enter into, I think the farmer should not estimate more than 40 or 50 persons to the acre, and possibly less than either of those numbers.

The quantity of water supplied to the population will determine approximately the strength and amount of sewage on which he has to depend, assuming that the storm-water is excluded from the sewers, and that they do not receive land-drainage to any extent. It is almost impossible for the farmer to deal satisfactorily with sewage which will be infinitely increased in quantity (at the same time that it is diluted in strength) when he least requires an addition in such a shape. Nevertheless, so little attention has been paid to this important point, that at Bedford, where the supply of water to the inhabitants reaches but 150,000 gallons daily, the average quantity of sewage which reaches the pumping-station is no less than 600,000 gallons. At Warwick the sewage amounts to double the quantity of water supplied to the population; and at Dover, with 1,000,000 gallons of water-supply, the discharge from the sewers amounts to 3,500,000 daily. Where each inhabitant is supplied with 30 gallons of water per diem, a total of 50 tons per head per annum will be available for sewerage purposes; and, as this is a fair and liberal but at the same time not excessive supply, we may take it as a basis for our calculations on the subject. This quantity, where 50 persons contribute to each acre, will give a supply of 2500 tons of sewage per acre per annum, equivalent to a vertical depth of 25 inches, which, in dry districts, will fully equal that of the rainfall; while taking 100 persons as contributors, no less than 5000 tons of sewage, containing ammonia of the value of upwards of 40*l.* per acre, will have to be disposed of, and, I need hardly add, in a great degree wasted.

But unsatisfactory as is this prodigality, far greater quantities than even the latter are lavished at present upon some sewage-cultivated land. When Mr. J. C. Morton published his 'Agricultural Experience of 300,000 tons of North London Sewage' in 1867, he estimated that at Barking 100 tons of sewage would be required to produce one ton of rye-grass over and above the natural and unassisted growth of the land. What have been the facts? In 1870, a year of exceptional drought and heat, no less than 314 tons of sewage were used for every ton of grass cut; while in one instance the prodigious quantity of 450 tons was applied for each ton of grass produced! That is to say, 11,500 tons of sewage were used *per acre* for the production of 23⅖ tons of grass (the actual yield where this extraordinary irrigation was carried out). As, however, it is almost impossible to believe that this represents anything but a very exceptional state of things, I prefer to draw attention to the amount of sewage applied over the whole farm upon rye-grass. This, in the year alluded to, was 8688 tons per acre, which resulted in 27½ tons of rye-grass for cutting; in other words, 314 tons of sewage to 1 ton of grass.

Now, the average rainfall of this district of Essex scarcely exceeds 21 inches annually, and may be taken at 17 inches for the growing period from February to November. In 1870, a deficiency existed in those months of not more than 6 inches; and taking an inch of rainfall to amount to 100 tons per acre, as it does approximately,* we have the fact that a deficiency of rainfall of 600 tons, replaced by 8688 tons of sewage (or in other words 14 times the amount of the deficiency), was only equal to the growth of a crop of grass representing two-thirds of an average of that grown upon sewage-cultivated land! These facts, taken from Mr. Morgan's Report for 1870, are very discouraging. Assuming that much of the land upon which the grass was grown would have produced no crop at all under the burning sun of last summer, in its natural state, it yet seems incredible that upwards of 7 feet in vertical depth of fertilizing liquid, yielding nitrogen of the value of 70*l.* and upwards per acre, should bring forth such a miserable return. I have before said that there are quicksands which the sewage-farmer must avoid, as well as beacons which should guide him; and I think these figures (assuming their correctness) conclusively prove that the greatest waste may be accompanied by insignificant results, and that the selection of land should be a matter of much forethought and caution.

## Crops.

The crops which have already been cultivated under sewage, with more or less success, are legion. Indeed, it may be doubted whether any plant would not to some extent pay for its application. I need not spend time, therefore, in the enumeration of such plants, herbs, roots, and fruits as may be seen by any visitor to

* The following Table may be useful to those who wish to estimate the weight or bulk of rainfall or sewage per acre. It is extracted from Mr. G. J. Symon's 'British Rainfall,' 1865:—

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Inches .. .. | 0·1 | 0·2 | 0·3 | 0·4 | 0·5 | 0·6 | 0·7 | 0·8 | 0·9 | 1 in. |
| Tons per acre | 10 | 20 | 30 | 40 | 50 | 61 | 71 | 81 | 91 | 101 |
| Gallons ,, | 2262 | 4525 | 6787 | 9049 | 11312 | 13574 | 15836 | 18098 | 20361 | 22620 |
| Cubic feet ,, | 363 | 726 | 1089 | 1452 | 1815 | 2178 | 2541 | 2904 | 3267 | 3630 |
| A cube of ,, | 7·1 ft. | 9·0 ft. | 10·3 ft. | 11·3 ft. | 12·2 ft. | 13·0 ft. | 13·6 ft. | 14·3 ft. | 14·8 ft. | 15·4 ft. |

a sewage-farm. Suffice it to say that any ordinary farm-crop can with certainty be grown, and that garden products will revel in the congenial richness and moisture of the land. This latter description of produce will undoubtedly yield far larger returns than any farm-crop, provided a satisfactory market can be found; but except in the neighbourhood of the metropolis, or any very large towns, it may be questioned whether the market-garden branch of the farmer's business will not be the most hazardous, and whether it will in all cases prove so remunerative as some sanguine persons have led us to believe. It is plain that the easy access to some rather populous place, which he will in most cases enjoy, the considerable rent and other charges upon his land, and the superiority of his produce in this department, will all tend to induce him to cultivate some considerable portion of his farm with crops of this description; but it is also evident that the cultivation of 400 or 500 acres as market-garden would be completely out of the question, if dependence must be placed upon such consumption as a town of 20,000 or 25,000 inhabitants would afford. The addition of such an area to the land already tilled for this purpose would swamp the market. When sewage-farming is better understood market-gardeners may be eager each to occupy his plot upon the farm, but in the mean time, with a large area of land under sewage, and a limited demand for such produce, other crops which are in greater request must continue to be grown. The growth of cereals and of roots, &c., must not therefore be discouraged, for in these the sewage-farmer will find his most certain market, though not his most remunerative return. I shall proceed to discuss the claims of a few of these crops to his consideration.

*Italian Rye-grass.*—This plant has hitherto deservedly enjoyed a foremost place on all sewage-farms. There is none better adapted for the cleansing of sewage, and this, with its easy cultivation and immense yield, makes it one of the most reliable and valuable of any crop upon the list. From 40 to 50 tons per acre can with certainty be produced in 14 months from a well laid down and well managed plot of this grass. It should be drilled in August or September, receive a light sewaging, and be cut once during the autumn, and, under favourable circumstances, it will bear five, six, or seven cuttings during the next season; after which, in most cases, it will be better to break it up. Until recently, it was almost invariably allowed to remain down two years, under the impression that, as a perennial, it should stand at least that time without exhaustion. I believe that nearly all sewage-farmers have now agreed that one year is all that it is safe to reckon upon for a full crop. On a number of farms which I visited during the spring of the present year, I have found in nearly every case the second year's crop patchy and variable, and evidently much affected by the winter. Mr. Hope informs me that if cut at the proper time, and never allowed to seed, it will make a total growth of 150 to 200 inches in the time I have named. For every one of these inches a weight of half a ton per acre will be produced, so that 75 to 100 tons per acre are within the limits of its capabilities of production. Although the latter figure has perhaps never been attained, authentic instances of the former are not wanting. It is plain that a plant possessing such manifest advantages to the sewage-farmer will be likely to hold its place in his rotation, since under proper management there can be no fear of the successful disposal of his crop. I put entirely on one side the cases where it has been grown and found unsaleable, as such a state of things could only arise from bad management. The grazier who should neglect to provide a sufficiency of live stock for the consumption of his grass, would not hold a very high place in the estimation of his fellows; neither would I take as an example the sewage-farmer who neglected to find mouth or market for his produce. It is much to be desired that some really satisfactory and efficient artificial means could be devised for the turning of large crops of this kind into hay. An invention of this description would add immensely to the value of the sewage-farmer's produce; and there should be little doubt that such difficulties as now exist will speedily be removed whenever a serious demand arises for such a machine.

*Mangold.*—This is another of the mainstay crops of the irrigator, well repaying considerable applications of manure. Easily stored, readily saleable, and wholesome in use through the whole of the spring months, it is no wonder that large breadths of it should be found in cultivation on most sewage-farms. The irrigator possesses such facilities for its successful *planting* that it may be questioned whether this mode of cultivation has yet received all the attention it deserves. It is generally drilled in May and sewaged freely as soon as above ground, and by this means crops of 40 or 50 tons are easily secured. The advantage of planting would be the clear gain of nearly two months to the land, which might have already borne a crop of early potatoes or other produce before its occupation by the mangold plant. I would not place the limit in the yield of this crop at the tonnage I have named. I believe 60 or even 70 tons per acre are quite within the cultivator's reach; indeed such amounts have been produced under ordinary tillage; and when it is remembered that roots at two feet apart, and of an average weight of one stone (14 lbs.) each, give a crop of 68 tons per acre, I think that with the advantage he possesses of absolute certainty of plant, and with his command of liquid manure, the skilful cultivator need not despair of obtaining at least such a result. But it may be questioned whether in all cases it is advisable to rely wholly upon sewage for the mangold crop; a dressing of phosphatic manure, followed by irrigation later in the season, might yield results superior to those obtained by the operation of the latter manure alone. The irrigation of the plant early in the season may do quite as much harm as good. It is possible to *starve* a plant as well as to feed it by the use of large quantities of liquid in cold weather. On rich and heavily manured land, the agriculturist well knows that hardly any amount of drought and heat affects the mangold crop, provided the plant is fully established and the land deeply subsoiled: the magnificent crops obtained in 1868 and 1870 attest this. Could the cultivator of this description of land rely upon some of the advantages possessed by the sewage irrigator, it is probable that he would more than vie with him in the abundance of his produce; but no *light-land* cultivator can hope to approach without sewage the production of him who has it at command.

*Sugar-beet* has lately received some attention in this department of agriculture; but it is to be feared, from the experimental crops at present tested, that a deficiency of saccharine matter exists in roots grown under sewage. If, however, further experience should suggest the means of overcoming this difficulty, the importance of this crop could hardly be exaggerated, as large yields could with certainty be secured; and the success of beetroot-sugar manufacture in this country is no longer a matter of conjecture.

*Cabbage.*—The well-known greediness of the *Brassica* tribe for rich ammoniacal manures and deep cultivation sufficiently explains the great success of this crop under sewage. Immense prices have been obtained during the past few years for such varieties as meet the wants of the market; and in 1870,—a season when few ordinary gardeners could show a plant of this valuable vegetable—sewage-farmers realized in some cases not less than 70*l.* per acre for their produce. At Barking a crop of Collards, which had occupied the ground but three months, fetched 73*l.* per acre, and similar instances are not wanting. Moreover, the succulence and tenderness of sewage-grown cabbage is well known. "Joost lik' a bit o' marrow," was the character given of his cabbage by the bailiff of a well-known sewage-farm. Mr. Hope, at the Farmers' Club in 1870, mentioned a case which sufficiently illustrates the superiority of cabbage grown by this method to that produced in the ordinary manner: 600 dozen of this vegetable were sent to Covent Garden in one day, half of which were cultivated without and half with sewage. The 300 dozen of sewage-grown cabbage were bought at once for 14*d.* per dozen; the remainder went off very slowly, first at 8*d.*, then at 6*d.*, per dozen, and were with much delay disposed of. There should be no difficulty in growing 40 or 50 tons of the large cattle-cabbage to the acre, and such a yield would afford an ample return to the grower.

It is almost needless to say that *Carrots* and *Parsnips* are easily cultivated, and that very large crops of them have been obtained.

*Potatoes.*—The cultivation of this plant has much increased of late years upon sewage-farms. Its ready sale and facility of storing will account for this, and though; on the one hand, we have no evidence of the production of superior crops under irrigation to those obtained by other means, it does not seem, on the other hand, that this mode of cultivation renders the plant more subject to disease. Perhaps we have hardly experience enough, at present, upon the latter point; but, on two well-known sewage-farms at least, I have been assured that a diseased tuber has not been seen, though its cultivation has proceeded for some years. The short time that the early varieties occupy the land should render them objects of special attention to the sewage-farmer, and he will probably find it to his advantage in many cases to substitute a certain breadth of potatoes for some of the above-mentioned crops. I shall have occasion to allude to this subject further on, and as the cultivation of this plant under sewage in no way differs from its ordinary culture, I need only thus briefly call attention to its utility to the sewage-irrigator.

*Cereals.*—I now turn to the cultivation of *Cereals*, and the consideration of the question whether they can take their place in the routine of an irrigated farm. The attention of those interested has for some time past been given to this problem, for upon it hangs another connected closely therewith, and one which some day or other must force itself into prominence. Unless grain crops can be cultivated successfully, I confess I do not look upon the establishment of sewage-farms on an extensive scale with any very sanguine expectations of immediate success. The keeping of large numbers of stock must, I am persuaded, eventually become a chief part of the business of the sewage-farmer upon all extensive occupations; but without straw this would be impossible. Moreover, I firmly believe that the use of sewage as an *auxiliary* to other manures will extend, and that farmyard-dung will be hardly less valued by the sewage-farmer than by the ordinary agriculturist. There are certain crops (onions, for instance) which have already proved their partiality for such a mixture; and it is plain that on many descriptions of soil (though perhaps not on all) the benefit to the *condition* of the land from the use of straw-manure must be considerable when the constant wetting is taken into account. Further, by the use of dung the area of land under sewage may be increased, since the former manure can in some cases be reserved for crops to which (at least in certain stages of them) irrigation is undesirable. Great stress must be laid upon this point. The market for milk, meat, and corn is unlimited; the sale of the other produce of the farm is restricted by a variety of circumstances. The favourite theory of some authorities, that sewage and sewage alone is needed for the production of every kind of crop, will hardly bear examination. Granted that such is the case, the question may be asked, what is the actual *waste* of nitrogen in the production of certain crops? and how is that waste to be accounted for, except by the excessive application of liquid? Heretical as the opinion may be, I am persuaded that no theory as to the sufficiency of any one kind of manure will be allowed long to stand in the way of the practical farmer, but that if the union of these manures should prove as beneficial upon sewage-farms as that of others has already done to ordinary agricultural land, a great advance will have been made in the application of the system upon an extensive scale.

The natural tendency of excessive applications of liquid to a soil containing an appreciable amount of aluminous matter is to render it sticky, and, as it dries, lumpy and hard of cultivation. On the other hand, the tendency of farmyard-dung is to open it and render it friable, pervious to rainfall, and generally easy of tillage. The term "velvety," well known to gardeners, sufficiently expresses this most desirable condition—a state in which every fibre and rootlet gets free play, and the perfect development of the plant is thereby assured. It must be distinctly understood that nothing has yet been done with sewage which has not been also accomplished without it. Great crops and fabulous proceeds have, indeed, been realized by its aid, but returns fully as large have also been reaped by the use of London or other dung. Its value as an *aid* can hardly be estimated, for it may often be the means of saving crops which no reasonable expenditure of time or money could otherwise preserve; but many market-gardeners, in the environs of London especially, where their business is conducted with prodigious skill, could probably show greater average returns than any sewage-farmer has yet been able to demonstrate. I do not speak of the expenditure, nor do I allude to the exceptional crops with which exceptional seasons will sometimes reward the one kind of cultivation and sometimes the other. I only assert that sewage applied in unlimited quantities has not yet been proved superior to other manures also administered without stint. It is in the manner of its provision to the soil that the chief benefit lies. "*L'eau doit être la charrette de l'engrais*" was the expression of the celebrated French chemist Dumas, when he saw the result of the Barking irrigation; and although we may not feel disposed to admit this in its fullest sense, we must allow that, for facility of application and readiness of command, sewage is incomparably superior to other manures. In such sense water is undoubtedly the best dung-cart.

Mr. Morgan's experience, at Barking, last year, distinctly goes to prove that a good dressing of dung, followed by irrigation, is, at any rate, advisable in the case of onions. "Even up to the last, the influence of the dung made itself apparent," says that gentleman, in describing the cultivation of a field of onions, the crop on which was sold on the land at 43*l.* per acre.

The comparative smallness of the returns from corn compared with those from many other crops must not, therefore, be allowed too much to influence the sewage-farmer. If its cultivation can be made successful—if cereal crops can alternate with green produce on some lands, and can be taken in succession on others—the moderate amount of labour required for their production, and the other advantages I have named, may well be set against the exceptional returns from some other sources. It has been much doubted whether cereals can be made to stand up under large applications of ammoniacal manure in such a form. I fail to see, however, any greater difficulty to the sewage-farmer than to his brother agriculturist in this particular. Undoubtedly land may be so enriched that the prospect of a good crop of corn in an ordinary season is hopeless. But successive crops or skilful alternations should correct such a state of things, and large crops of straw would represent an unusual value under his special circumstances. Moreover, what evidence we have at present goes to prove that, even on unfavourable soils, good crops of wheat or other cereals may be reaped even in successive years. There is now growing at Barking, on poor stony gravel, a crop of wheat, the fifth in succession. The soil is hot, poor, and naturally unfavourable to corn; nevertheless, last year, the produce was 5 quarters 6 bushels of wheat per acre, and the total return (with straw) 19*l.* 5*s.* 8*d.* The present appearance (July) of the growing crop is also very satisfactory. In the same year a piece of wheat on the same farm, to which sewage had not been applied, but on far superior land, yielded but 3½ quarters per acre. At Romford, Mr. Hope has grown large crops of oats experimentally, and barley has also been so successfully cultivated as to demand further trial. If, then, under cereal cultivation sewage can be applied to a far larger area of land than has hitherto been deemed practicable —if a considerable amount of the produce finds its own market in the mouths of cattle upon the farm, and if dung can be made available for such crops as especially need it—these, I take it, are substantial advantages, and such as are likely to advance this mode of sewage utilization. It will not do to put the 15*l.* an acre, which the corn-crop may be expected to pay, in gross, against the far larger returns from occasional speculations in market-garden or other produce, unless at the same time the farmer reckons the benefits to those other crops and the other advantages which are likely to accrue from the adoption of this method.

I must not be understood as advocating, under all circumstances, the growth of corn. In cases where straw is cheap, or where stable manure is procurable at a low price, it may be advisable to concentrate the liquid manure upon a smaller acreage; in such cases nearly all the advantages I have described might be reaped without the drawbacks.

## Modes of Cropping.

Taking the hypothetical case of a farm of 500 acres receiving the sewage of a population of 20,000 persons, or at the rate of 40 persons per acre, I will now endeavour to estimate what return may reasonably be looked for, were such a system as I have been describing carried out. The amount of water-supply before mentioned, viz. 50 tons per head per annum, would afford a total of 1,000,000 tons annually for the irrigation of this farm; or, in other words, 2000 tons per acre would be at the disposal of the farmer over the entire area of his land. But if 150 or 200 acres of this could be cropped with corn, a much larger supply would be available for the remainder, since moderate application would only be required for the cereals grown in succession, whilst those after cabbage, mangold, and similar produce, should require no irrigation at all. On the following page I have endeavoured to show that, at the present *market* value of sewage, a reasonable remuneration might be expected from the adoption of this course. I shall assume that, in the case in point, 200 acres are annually cropped with cereals, 100 acres with rye-grass, 50 with mangold, 50 with cabbage, and that 100 acres are devoted to market-garden crops. The following table and diagram will plainly show the course of cropping upon the 400 acres of *farm* land. I will suppose the land divided into plots of 50 acres, each of which is represented by a column in the diagram:—

*Course of Cropping upon 400 Acres of Sewage-Farm.*

| | | | |
|---|---|---|---|
| | 100 | acres | cereals after mangold and cabbage. |
| | 100 | ,, | cereals after cereals. |
| | 100 | ,, | Italian rye-grass after cereals. |
| | 50 | ,, | mangold after rye-grass. |
| | 50 | ,, | cabbage after rye-grass. |
| | 400 | ,, | |
| | 100 | ,, | market-garden section. |
| Total .. | 500 | ,, | |

DIAGRAM exhibiting succession of Crops upon the above 400 acres.
(Shift of four years.)

| | 50 Acres. | 50 Acres. | 50 Acres. | 50 Acres. | 50 Acres. | 50 Acres. | 50 Acres. | 50 Acres. | Acres. |
|---|---|---|---|---|---|---|---|---|---|
| First year . | Corn | Corn | Corn | Corn | Mangold | Cabbage | Rye-grass | Rye-grass | = 400 |
| Second year | Rye-grass | Rye-grass | Corn | Corn | Corn | Corn | Mangold | Cabbage | = 400 |
| Third year . | Mangold | Cabbage | Rye-grass | Rye-grass | Corn | Corn | Corn | Corn | = 400 |
| Fourth year | Corn | Corn | Mangold | Cabbage | Rye-grass | Rye-grass | Corn | Corn | = 400 |

It is plain that the above plan would offer many advantages; for, whereas cereal crops would never be taken more than two years in succession, a large proportion of them, and a convenient and moderate proportion of such crops as would be required for consumption upon the farm, would obviously reduce the difficulties of the disposal of the farmer's produce to a minimum.

I believe that a stock of 150 cows could well be maintained on such a farm, and I shall proceed upon the supposition that such is the case. I will first, however, remark upon the cropping of the land. I have taken, for the sake of simplicity, such well-known farm-crops as mangold, cabbage, and rye-grass, though there are others scarcely less entitled to the sewage-farmer's favourable regard. For instance, upon a portion of the mangold land he would most likely grow carrots or parsnips, and potatoes might take the place of cabbage on such proportion as he chose of the land set down for the latter. I am only endeavouring to show, that with a town of 20,000 inhabitants, and with 100 acres given up to market-garden produce, he should on the remainder cultivate such crops as he can either dispose of himself, or find a market for without much trouble. The rye-grass should be sown as early as possible after the harvesting of the corn crops, the mode of cultivation being followed which has been before described. The land should be broken up in the November of the following year, and irrigated during the winter in readiness for the mangold and cabbage crops which are to follow. The cereal crops should of course take the place of these as soon as practicable.

## RECEIPTS FROM SEWAGE FARM—500 ACRES.

*Stock: 150 Cows in full profit; 30 Horses.*

| | £. | s. | d. |
|---|---|---|---|
| *Cereals.*—200 acres wheat (or corresponding value in other cereals), 4½ qrs. per acre, at 50*s.* .. .. .. .. | 2,250 | 0 | 0 |
| *Rye-grass.**—100 acres, at an average crop of 40 tons. Total crop 4000 tons, less 153 days' consumption of 150 cows, at 1½ cwt. per head per diem, from May 1 to October 1. 2279 tons for sale, at 10*s.* .. .. | 1,139 | 10 | 0 |
| *Cabbage.*—50 acres. Average crop 40 tons per acre. Total crop 2000 tons, less consumption of cows, 1 cwt. each per diem for 92 days, from October 1 to January 1. 1310 tons for sale, at 15*s.* .. .. | 907 | 10 | 0 |
| *Mangold.*—50 acres. Average crop 40 tons per acre. Total crop 2000 tons, less consumption of cows, from January 1 to May 1, 120 days, at 1 cwt. each per diem. Crop for sale, 1100 tons, at 15*s.* .. | 825 | 0 | 0 |
| *Milk.*—From 150 cows in full profit, averaging each 12 quarts per diem, at 2*d.* per quart .. .. .. .. .. .. | 5,475 | 0 | 0 |
| *Cows.*—Sold off after being milked 6 months, 150 × 2 = 300, at 15*l.* per head .. .. .. .. .. .. .. .. | 4,500 | 0 | 0 |
| *Market-Garden.*—Portion of farm, 100 acres, at 30*l.* .. .. | 3,000 | 0 | 0 |
| Total receipts .. .. .. | 18,097 | 0 | 0 |

## EXPENDITURE ON SEWAGE FARM—500 ACRES.

*Cropping 200 acres Cereals, 100 acres Rye-grass, 50 acres Cabbage, 50 acres Mangold, 100 acres Market Garden.*

| | £. | s. | d. |
|---|---|---|---|
| Rent, rates and taxes on land, at 4*l.* per acre .. .. .. .. .. | 2,000 | 0 | 0 |
| Labour on corn land, 200 acres, at 4*l.* per acre .. .. .. | 800 | 0 | 0 |
| Ditto on mangold and cabbage land, at 6*l.* per acre .. .. | 600 | 0 | 0 |
| Ditto on rye-grass land, at 6*l.* per acre .. .. .. .. .. .. | 600 | 0 | 0 |
| Ditto on market-garden, 100 acres, at 15*l.* .. .. .. .. .. | 1,500 | 0 | 0 |
| Seed corn: 2 bushels of wheat (or its equivalent), at 7*s.* .. | 140 | 0 | 0 |
| Seed: cabbage and mangold, at 10*s.* per acre .. .. .. .. .. | 50 | 0 | 0 |
| Rye-grass seed: 3 bushels per acre, at 7*s.* .. .. .. .. .. | 105 | 0 | 0 |
| Seed on market-garden portion, at 2*l.* per acre .. .. .. | 200 | 0 | 0 |
| Implements, repairs, and tradesmen's bills .. .. .. .. .. | 500 | 0 | 0 |
| Horse-keeping: 30 horses, at 30*l.* .. .. .. .. .. .. .. | 900 | 0 | 0 |
| Cake or corn for 150 cows, averaging 3 lbs. per head per diem = 73 tons, at 10*l.* per ton .. .. .. .. .. .. .. | 730 | 0 | 0 |
| Superphosphate, or other artificial manure, 15 tons, at 5*l.* .. | 75 | 0 | 0 |
| Hay for cows, 100 tons, at 5*l.* .. .. .. .. .. .. .. .. | 500 | 0 | 0 |
| Coals for engine .. .. .. .. .. .. .. .. .. .. .. | 150 | 0 | 0 |
| Cows in full profit bought in, 300, at 20*l.* .. .. .. .. .. | 6,000 | 0 | 0 |
| Loss on cow stock, average 5 per cent. .. .. .. .. .. .. | 150 | 0 | 0 |
| Waste lands, roads, buildings, &c.: allowance for 40 acres, at 4*l.* | 160 | 0 | 0 |
| Total gross expenditure .. .. .. .. .. .. | 15,160 | 0 | 0 |
| Interest on 10,000*l.* capital, at 10 per cent. .. | 1,000 | 0 | 0 |
| Balance for sewage, being at the rate of a fraction less than ½*d.* per ton (·46488*d.*) .. | 1,937 | 0 | 0 |
| | 18,097 | 0 | 0 |

* If this crop should not find customers, the farmer must substitute on 40 acres some other crop of ready sale, such as potatoes. It must be remembered that the consumption of 30 horses has to be deducted from the portion set down as saleable.

A necessity would exist for the use of 600,000 gallons, or about 265 tons, of sewage per diem, during the *winter* as well as the summer months; and 100 acres of land broken up and divided into portions which should receive alternate floodings, would readily accommodate that amount of liquid, even supposing none were required in other quarters of the farm during that period. The question then arises whether this would suffice for the summer and hot-weather supply of 400 acres of land, for I assume at once that the 100 acres of cereals after green crops will require none. It will be observed that in my figures, on page 415, I have allowed for the purchase of 15 tons of superphosphate or non-ammoniacal manure, and by the application of this to the mangold, at the rate of 5 or 6 cwts. per acre, a vigorous start would be ensured to that plant, and the dangers which beset early irrigation would be obviated, at the same time that the supply of sewage would be economized. Cultivated in this manner, it can scarcely be doubted that an occasional application of 100 or 200 tons per acre during the summer and hot weather would be ample to maintain the strength of the plant, and bring to maturity a satisfactory crop.

The cabbage might be planted in May or June, on land also prepared by copious irrigation, and this crop and the rye-grass would require a considerable proportion of the available sewage to ensure a heavy return. If 100 tons of sewage should be equal to the production of one ton of grass (and I see no reason to doubt its power in this respect under good cultivation), 400,000 tons would be the quantity required for irrigating 100 acres of rye-grass for the production of 40 tons per acre, and I will endeavour to estimate the quantity required for the different crops, and compare it with the amount at disposal.

*Tons of Sewage available for application to Crops on Farm.*

| | Sewage in Tons. |
|---|---|
| Rye-grass, 100 acres, at 4000 tons per acre .. .. .. | 400,000 |
| Cabbage, 50 acres, at 2000 tons per acre .. .. .. .. | 100,000 |
| Mangold, 50 acres, at 1000 tons per acre .. .. .. .. | 50,000 |
| Market-garden, 100 acres, at 2000 tons per acre .. .. | 200,000 |
| Wheat, 100 acres, at 2000 tons per acre .. .. .. .. | 200,000 |
| Balance .. .. .. .. .. .. .. | 50,000 |
| Total .. .. .. .. .. .. .. .. | 1,000,000 |

If it be objected that in these figures I have made no allowance for the inevitable winter waste in sewage, and that for the eight months of growth a total of about 666,000 tons only would be forthcoming, I answer that I recognise no necessity for such waste, and that the land which receives the winter sewage should be laying up stores of ammonia which should be yielded up when required. With the system of flooding grass land in winter I have no sympathy. I would scarcely deny that in some cases it may be unavoidable, but the destruction of all the fine clover and grasses, and the creation of a rank growth of coarse herbage, neither valuable for hay nor for pasture, is scarcely the way to ensure success in sewage-farming.

One of the chief sources of profit to the sewage-farmer is the growth of *second crops*, for which he possesses such special advantages. The 100 acres of garden-ground allowed for in the above case will afford him ample scope for the exercise of his skill in this direction; in case, however, he should be very eager of distinction in this line, there is no reason why potatoes or other early produce should not be taken before the planting of some portion of the cabbage and mangold, and the figures I offer would be proportionally swelled by such additions to his crops.

In concluding this part of the subject, I will remind the reader that 2000 tons of sewage per acre, which are allowed for the market-garden, wheat, and cabbage, severally on the above farm, are of the intrinsic value of 16*l.* 13. 4*d.*, and that I have not taken into calculation the very large quantity of first-rate manure which the farmer will have at hand for certain of his crops. I will also direct attention to the great benefit which the intermission of irrigation for the period of one year, allowed by the above plan, must yield to most descriptions of land.

There are certain times of the year when an extra supply of liquid is very desirable, and when the dilution of the sewage beyond the point usually reached is a matter of considerable importance, independent of the fact that the effluent water is seldom free from all traces of ammonia. The interception of the purified sewage can in most cases be managed with little difficulty, and times may come when irrigation, with such a fluid even, may be beneficial. At Romford, Mr. Hope has found such dilution absolutely necessary; and at Aldershot pumping-machinery is in course of erection with a similar object. It will plainly, therefore, pay the sewage-farmer to conduct the drainage of his land to such a point that he can possess himself of this advantage at his option.

## Stock.

With regard to the kind of stock most desirable upon a sewage-farm, I have little difficulty in pronouncing in favour of cows. No one possesses the facilities for the production of milk that distinguishes the sewage-farmer. With an abundance of food of the most succulent and suitable character at command all the year round, he should be able, in this item at least, to beat all his rivals out of the field. At the price at which I have reckoned milk, viz. 8*d.* per gallon, no doubt can exist of a market for every quart which he can produce, and I would therefore urge its especial advantages over the production of meat. There can be no question that the supply of really pure and wholesome milk is by no means equal to the requirements of the population. It is seldom that the children of the poor in large towns can procure even a small quantity of this most nutritious food, to satisfy the requirements of their growth, whilst it is difficult to overrate its value in the increase of health and stamina to the labouring man himself. On public grounds, therefore, the production of this necessary in greater quantities is most desirable, and the sewage-farmer will find himself able to supply a much felt want with advantage to himself.

I by no means presume to offer the above or any other plan as a model one; but, bearing in mind the necessity for the extensive cultivation of such crops as will best repay the application of sewage, I venture to offer this solution of a difficulty which at once besets the sewage-farmer (viz. the disposal of his produce) as not unworthy of attention. Tentative, indeed, as every attempt at a system must be with our present knowledge, I believe the above will be found to afford as satisfactory results as any method which has been already tried.

## Market-Garden.

I shall not attempt an enumeration of the garden crops which experience has proved to pay so well on sewage-farms. I have said that almost any produce can be cultivated without difficulty. With good management, and a good market, the return of 30*l.* per acre which I have modestly stopped at, will probably be very much exceeded; but I have already pointed to the speculative character of some of these transactions. Nevertheless the more enterprising man will undoubtedly succeed better than his more easily satisfied neighbour. I am assured on good authority that double the amount named might easily be made, and is, in fact, realized not unfrequently by London market-gardeners. There is certainly no reason why, in the neighbourhood of the metropolis at least, the profits of the latter should not be equalled or even excelled. But as the minute and exact practice required for such results will hardly be attained upon so large a scale by the direction, however energetic and skilful, of one man, I would by all means recommend the adoption of the plan followed at Aldershot, and suggest the sub-letting of plots upon this quarter of the farm to local gardeners, providing land and sewage alone. The fact that barren sand there fetches 25*l.* per acre for this purpose, proves the very large return which must be made from the land after the settlement of the labour bill. When once the benefits of sewage are fully recognized, and the quick growth, early maturity, and superior quality of vegetables cultivated by its aid established, there should be no difficulty in the disposal of a portion of the farm in this manner, and, perhaps, no more satisfactory course could be followed.

Onions (of which the consumption—judging from the Essex fields — seems unlimited), lettuces of prodigious weight and splendid quality, asparagus of great size, celery of the finest growth, watercresses, spinach, cucumbers, vegetable-marrows, French beans, brocoli, and cauliflower—these are but a few of the ordinary sewage-grown vegetables; whilst, among fruits, strawberries, gooseberries, and currants, all seem coming into favour. Strawberries at Barking have realized 75*l.* per acre. There seems no reason, moreover, why beauty and usefulness should not go hand in hand, and why the florist, as well as the gardener, should not seek for aid from sewage. Roses especially should repay cultivation remarkably well, considering their love of ammoniacal dressings; and abundant luxuriance and bloom would almost certainly reward the florist's efforts in this direction.

Farmers have been accused, without sufficient reason, of being indolently regardless of the "question of the day." The persons hitherto concerned principally have been the ratepayer and the engineer; but now that sewage-farming is taking its place among the money-making expedients of the times, there is little fear of this taunt being any longer levelled against the agriculturist. It is quite true that few farmers are possessed of the requisite engineering knowledge for the successful application of sewage to their land: it is quite true, also, that few engineers have entered fully into the practical difficulties which may embarrass the agriculturist by the adoption of their theories. It is the union of these disqualifications which has hitherto operated as a hindrance to success. The removal of these difficulties, united to the practical skill which distinguishes the English farmer, and the perseverance which the difficulties of his calling encourages, will reward him in sewage irrigation with gains which, if not equal to those of the mercantile man, can at least be looked at with as much satisfaction, whilst they do not partake of their speculative character.

Such I believe to be, upon the whole, a fair exposition of the present state and prospects of sewage-agriculture. If it does not bear out all the high hopes with which it has been heralded into being, it at least invites the attention of the sanitary reformer, the political economist, and, not least, of the agriculturist. To this latter it is a subject of paramount interest. Science can, and does, tell us what we put into the land: it remains to us to prove how, by the exercise of our craft, we can turn into food the valuable elements, too many of which seem at present to elude us in our efforts to recover them.

I must, in conclusion, express my great obligation to Mr. Hope, V. C.; Mr. Morgan; Mr. Bailey Denton, C.E.; and other gentlemen who have most kindly given me information, or permitted me to inspect their farms.

*Thorpelands, Northampton,*
*July 3rd*, 1871.

## XVII.—*Market-Gardening.* By H. Evershed.

The quantity of vegetables eaten by all classes of society largely increased during the last century, and a much greater and more general advance in this direction has been made by the present and the last generations. The actual increase of population has also enlarged the demand for vegetables, and hence a new branch of agricultural industry has been created. Fuller shows us the beginnings of market-gardening two hundred years ago; he wrote in 1662, "Since gardening hath crept out of Holland to Sandwich in Kent, and thence into this county (Surrey) where, though they have given six pounds an acre and upwards, they have made their rent, lived comfortably, and set many people on work." In the same Thames-side district, lying between Battersea and Kew, this Flemish industry still flourishes on the light soil that suits it, and the Flemish implement of tillage or its substitute, the American fork, is used in cultivating the gardens. But it is only articles of limited consumption, such as cauliflowers, radishes, asparagus, forced vegetables, &c., that are produced on this original site. The more common and necessary vegetables are consumed in such enormous quantities that more space, as well as implements of more power, are needed for their production. London, too, has encroached on the former scene of spade-labour, and the old market-gardens in Surrey have been devoted to a large extent to other purposes.

East and west of London the soil is of very similar character, consisting of light land on gravel, equally suitable for vegetables; but in the east the subsoil is without veins of clay, and the district, therefore, is without fruit-trees. The extension of garden farming in Essex, with horse-tillage and steam-cultivation, in one instance, has been rapid. A wealthy grower of vegetables is only lately deceased who was among the first to emigrate from the older site in Bedfordshire. He arrived in the new colony without capital, and without the skill to read or write a market-tally, and lived to occupy a farm where more than 500 acres of vegetables were grown every year.

## The Essex District.

The Essex district extends from Stratford, bricks and mortar permitting, to West Ham, and thence through East Ham, to Barking, Rainham, Dagenham, Hornchurch, and Romford. The parishes of Aveley and Purfleet are at present, but may not long be, beyond the boundary of vegetable growing. They are now famous for early peas, and on June 19th this year large gangs of women were picking the first crop. At Rainham strawberries were begun on the same day, and potato-digging had commenced a few days earlier. The crops are all seven or eight days earlier than they would be under ordinary farming, without the warm coat of manure. The subsoil of the Thames Valley is a drift of sharp small flint, or gravel; it is generally covered with good light loam, which is in many cases several feet in depth, and is continually enriched by heavy dressings of dung. This light soil being peculiarly absorbent of air, heat, and moisture, and admitting of the rapid decomposition of organic matter, is naturally suitable for vegetables, and produces good crops of corn when, after a heavy green crop, it is not in too high condition. Elms are the native timber-trees of the district, growing in rows to a great height with leafy trunks, trimmed to resemble monstrous specimens of Jersey cabbage-stems or Brussels sprouts, with a cabbage on the top. Near Rainham, however, there are several noble avenues of unmutilated trees, which ornament as well as shelter the country. The water-level is generally at from four feet to ten feet from the surface.

This district takes most of the manure produced in the eastern part of London, and it supplies a large portion of the fresh, bulky vegetables consumed in the metropolis between spring and autumn. The whole of the produce is sent by road, and, except near a river wharf, or close to a station, the manure is brought by the waggons on their return from market. The outlay on the farms, as will presently be shown, generally exceeds 20*l.* an acre, and requires such a return as is yielded only by garden-crops and garden-farming. The growth of corn has been almost abandoned.

In this district of large garden-farms the fields are seldom less than ten acres in extent, and are generally from twenty to forty acres.

In garden-farming there are no strict rules with regard to the succession of crops; the land is kept constantly under crop by sowing, or by replanting from seed-beds as fast as the fields are cleared. Cabbages may follow cabbages; and the loading of the market-waggon proceeds in one part of the field while the plough-teams and planters are busily employed close by. On ordinary farms the necessity for a regular distribution of the labour of the farm throughout each period of the year, and for alternating the crops which produce manure with those which expend it, renders a tolerably regular rotation of crops desirable; but, as garden-farms employ five or six times as much labour in proportion to their acreage, their reserve force is larger. Moreover, they are generally situated in the neighbourhood of large floating populations, and extra hands and extra horses, at certain seasons of the year, can easily be obtained. The rest is accomplished by the purchase of dung.

An approach to a systematic rotation arises from the necessity of keeping delicate subjects—such as onions and potatoes—at a distance of several years apart. Having already given examples of such successions, a few remarks on double crops, and the periods of planting and removing them, will suffice to show what can be done in reference to economy of time and ground.

In the London district potatoes are followed by a second crop. The earliest may be followed by cabbages, the later by savoys, and the latest by "collards," for bunching during the winter months, when cabbages are out of season. Cabbages should not be planted much later than the third week in June; they will then be sent to market in November. Savoys are next pricked out from the seed-bed; and collards, which are planted almost at any time when there is a piece of ground to spare, follow up to the end of August.

On the 29th June and 6th July I was in fields where digging potatoes, manuring the land, ploughing, and planting cabbages, collards, and mangold, were proceeding without any delay. It was a little late for cabbages, but the frequent showers would, it was believed, enable the plants to start at once and rapidly. The land was dunged well and ploughed once with two horses, and the furrow was tender and crumbling.

In dry seasons the transplanted crops require watering; and although irrigation generally is neglected, it is sometimes very beneficial to garden crops. A 50-acre gardener, who grows celery, cauliflowers, and other crops, showed me a little rivulet running through his ground. It costs him 60*l.* a year; but, "when other grounds are scorched," he said, "my garden is as green as a leek!" This year I am afraid he had to "eat the leek," in consequence of the general abundance. It will give some idea of speed in gardens if I mention that cabbages planted in the second week in April afforded a first cutting this year on the 28th June. Another example of double crops is in the case of early cabbages, which are sent to market in April and May. A month before cutting them, the land being in good tilth, holes are made in the rows with a spade, one hole between each cabbage; a boy follows and plants potatoes, which are covered with the earth taken from the next row. This plan obviates the treading which occurs when the sets are planted between the rows.

On the 19th June a large farm was shown to me where all the cabbages had been marketed, and a considerable breadth was in potatoes, planted in the manner described, and looking well. The cabbages had been planted 2 feet apart, and the potatoes were of course at the same distance. They were regents, to be followed by some spring-sown crop. Other examples of two and even three crops in a year occur in the gardens near London, where certain vegetables of limited consumption are produced under spade cultivation, when there is no room for a plough.

Peculiar virtues have been attributed to the spade as an instrument of cultivation, but the secret of the great fertility which follows the spade lies in the heavy dressings usually applied to the gardens. As an example of this kind of cultivation, I visited a large garden of 40 or 50 acres, in the parish of Bermondsey, flourishing in the midst of smoke and vile smells. The larger part of the garden is planted with radishes, cauliflowers, and celery, taken from the same ground every year; and the rotation is repeated every year, with the precaution of moving the site of the rows of celery. These are planted 5 feet apart, with two rows of cauliflowers between them. The ground is dug in the ordinary way, once a year, in winter, as soon as the celery is removed. One hundred tons of dung per acre are sometimes applied, at a cost of between 30*l.* and 40*l.* The radishes are sown in March; the cauliflowers, having been sown in October in frames, and protected from frost during the winter, are pricked out among the radishes; and the celery follows.

Eight acres of rhubarb are cultivated with the five-tine steel fork. I was told, "the more manure the more rhubarb." Asparagus is forced by frames and hot dung. Plants of three years' growth afford three weeks' cutting, and are then destroyed; and a less price than 7*s.* 6*d.* for a bundle of 105 does not pay the grower.

On the 11th July a large bed was planted with collards and Walcheren brocoli in alternate rows, at 18 inches from row to row. The brocoli will be sent to market in November. There is a large fenced plot for cucumbers and vegetable-marrows.

The very deep cultivation which is frequently heard of, and occasionally practised in agriculture with more or less profit, has not been found desirable in market-gardens. The cabbages, greens, cauliflowers, brocoli, onions, potatoes, cucumbers, &c., which fill the markets of London, are generally grown on a 7 or 8 inch furrow; and as a rule, only one furrow is turned for each crop. In the case of subsoiling for late carrots and for parsnips, the object appears to be to give mechanical assistance to the root, to enable it to run down long and tapering. One of the most eminent growers of parsnips in the metropolitan district cultivates 9 or 10 inches deep by means of a common plough, followed by a subsoil plough. A 6 or 7 inch furrow is enough for two horses, and 3 or 4 inches are as far as the subsoiler reaches in a gravel loam with three horses. Trenching, double-digging, bringing the bottom spit uppermost, and all those tricks of tillage described in gardening books, are repudiated by market-gardeners, who do not pay much attention to the "mine of wealth" which does *not* exist in gravel subsoils; they seem to think that the sources of wealth lie in the dung-cart and in the judicious management of the upper spit.

Mr. W. W. Glenny has been good enough to permit me to give an account of his garden-farm at Barking. It consists of 150 acres of gravel loam, made rich and friable with manure, and kept in the highest state of cultivation. The farm is entirely in vegetables, with the exception of 18 acres of permanent pasture, and 16 of wheat, on the stiffest land, which is furthest from the railway station.

At the time of my visit the acreage of the farm was thus appropriated:—Potatoes, 34; permanent pasture, 18; spring-sown and Lisbon onions, 15; cabbage, 12; red ditto, 2; seed-beds, 2; carrots, 7; parsnips, $9\frac{1}{2}$; French beans, 6; scarlet runners, 3; vetches and green food for horses, 4; parsley, $1\frac{1}{2}$; willow and osier beds, $1\frac{1}{2}$; wheat, 13; mangold, $1\frac{1}{2}$; peas, 8; asparagus, 1; men's allotments, 1; cucumbers and marrow, 2; seeds, 1; buildings, roads, brook, and small crops, such as sage, &c., 11.

Twelve horses are kept to cultivate the farm, convey the produce a distance of eight miles to London, and to cart manure. The sums paid for dung, exclusive of cartage, during the past three years have been—211*l.* 9*s.* 3*d.*, 271*l.* 16*s.* 7*d.*, and 278*l.* 15*s.* 2*d.* From 400 to 700 bushels of soot were also used in each year. About one-half of the dung is purchased at 3*s.* or 3*s.* 6*d.* a ton, and is drawn from London in the empty waggons; the remainder is bought at 5*s.* per ton, at the railway station or the quay. Some other manures, including the spent hops from an adjoining brewery, are also brought on this farm.

The live stock consists of a couple of milch cows, and 40 or 50 pigs during the winter.

The labour bill, including beer, is 1500*l.*, or 10*l.* an acre. At the time of my first visit—June 17th—the number of labourers employed, including ten women, a wheelwright, and a salesman, was 35, and their wages amounted to 30*l.* a week. During the winter five women are employed preparing goods for market, bunching leeks, pulling and bunching greens, putting up onions, &c.

The implements of the farm, besides carts and market waggons, consist of common ploughs, a double-breasted or ridging-plough for moulding potatoes, beans, and peas, and some hand-drills. A small patent tool, which resembles a Dutch hoe put on wheels, must be mentioned, because its use shows the mechanical effects of dung and good farming in making the surface friable. It is not uncommon for a man to push this little implement over two acres in a day, cutting up all the weeds between the wide rows of the garden crops.

A willow-bed supplies bunching rods for tying the bunches of onions, greens, &c. The plants are set at 2 feet by 18 inches, and the bed lasts twelve years. Osiers of coarser habit are grown to make baskets for vegetables and fruit. I may note that the cost of the baskets (with a few sacks) used on the farm exceeds 50*l.* a year.

Parsnips are one of the main crops which are successfully grown on this farm. The chief points to observe in their cultivation are—1st. To sow on land that is least liable to wire-worms and the small creatures—probably slugs—which are said to be invisible to the eye, and which soon make the parsnips so, by eating the young plants as fast as they appear; the remedy for slugs is soot, and the prevention is, sowing on land that is not liable to be infested. 2nd. To take precautions against having forked parsnips, and to grow them of a fine, tapering, marketable shape by breaking the land well up and applying the manure to the previous crop. It is not perfect management to sow after corn, because the land is not then in sufficient heart and tillage; or after clover and grasses, on account of the danger of wire-worms and canker; or after potatoes, because potato-ground ought to yield a crop of greens after the potatoes are off, instead of lying idle till parsnips are sown. They generally follow late cabbages or savoys, which are cleared respectively in November and from

Christmas till 1st March. In either case, the field is not touched until immediately before sowing the parsnips, and Mr. Glenny would prefer to plough, scarify, and sow on the same day, so that the seeds of the crop might start fairly with those of the small nettle, chickweed, grass, and the shepherd's-purse, which are favourite weeds in market-gardens, frequently escaping the continual hoeing, and almost serving to establish in some quarters the theory of spontaneous generation. Supposing the clearings of the savoys to have been bunched by 1st March, as in 1867 (14th March in 1868, 20th February in 1869), the land is ploughed with two horses and subsoiled with three horses, and is thus moved and stirred to a depth of about 9 inches. It is then drilled with a hand-drill as early in March as the state of the weather permits. Mr. Glenny objects to preparing the land in autumn, because it solidifies too much by the time the crop is sown. In garden-farming a stale furrow and a frosted surface are not entirely appreciated, since the made soil of a garden-farm is effectually pulverised by manure and surface tillage. Parsnips are sown 15 inches apart in the rows, and the plant is singled at 10 or 12 inches. The crop is hoed, singled, and kept clean for 45*s.* an acre. The hoeing this year had cost, up to 21st June—First hoeing, 5*s.*; singling, 16*s.* 8*d.*; second hoeing, 6*s.* Frost does not injure parsnips. The roots are raised and sent to market from the field, and are in season from November till the end of Lent, occupying the ground longer than any other crop.

French beans often follow early cabbages, without dung. The last of the three successive sowings is made about 21st June. This delicate plant is impatient of fresh manure, and requires the preparation of a perfect garden-tilth. Mr. Glenny always ploughs twice, and for this and similar crops the land should be lightly rolled, to level it and to retain moisture. Drills are formed at 2½ feet apart by means of a small hand-plough, or marker, drawn by a man and a boy; women follow, and drop a seed at every 9 inches, and the drill is then covered by a man with a hoe. The plants are carefully hoed. French beans grow rapidly, and soon become what salesmen call "old beans." In hot weather they should be gathered every other day, and they are cleared in about four pickings. The latest-sown beans are cut down by the slightest frost.

Scarlet-runners are generally sown in the last week of April, after greens. The land is ploughed twice, with an interval of two or three weeks. The rows should be 3 feet apart, and a seed is planted in every foot of the drill. Runners continue to bear until they are cut down by severe frost. When manured, they are liable to become too luxuriant in damp summers; they should, therefore, be planted on good land, without manure. It does not pay to support them on sticks, except when they are grown as a shelter for cucumbers; and instead of giving them artificial support, an upstanding habit is induced by continually topping the vine from the period of its beginning to "run," about the middle of June.

Unless beans and runners are gathered when very young, they should be sorted before sending them to market, in order that the broad ones may be pricked out.

*Cabbages.*—A second crop in succession was planted this year, on June 21st, after ploughing in a second and heavy coat of dung with a 7-inch furrow. After rolling the land a line is used in setting the plants, which are put in with a short dibble, at a distance of 22 inches by 20 inches. In the case of "collards," which are planted 12 or 14 inches each way, a light roll after the plough is followed by the "fiddle"—resembling a rake with four or five long teeth—dragged by a boy, to mark drills for the plants.

Red cabbages for pickling are planted in October, a yard apart in each direction, and occasionally collards are set previously between the rows in which the cabbages will afterwards be planted. The catch crop is sent to market early in spring, before the ground is required by the main crop.

The courtesy of Messrs. T. and J. Mathews of East Ham, Essex, and Wandsworth, Surrey, enables me to describe the management of an extensive garden-farm, lying within seven miles of the General Post Office, and occupying a site remarkable for historical memorials, and still more so for certain modern works. The Danes crossed it when they rowed up the Roding to Ilford, the Romans had a burial-place on it, and a few years ago the main sewer of North London was carried through it. These and other intrusions have cut up the farm to some extent, and perhaps it may some day be overwhelmed by works of trade and commerce.

Acreage: 620 acres in the parishes of East Ham, Barking, and Little Ilford. There are about 420 acres of gravel loam and 200 acres of alluvial land drained by "sewers," that is, open ditches which are under management and capable of being drained into the Thames at low tide. Situated in the valley of the Thames, within one mile of the river, and immediately opposite Woolwich, this farm, like the rest of the garden district, lies on a flat. The nearest rising ground is at Epping, to the north, and Shooter's Hill across the river. Technically, however, the farm is divided into the light land called "upland," which is from 10 to 20 feet above the water-level, and rests on a bed of gravel, and the marsh land in Plaistow and East Ham Levels, which is below the water-level at high tide. Eighteen inches of dry mud forms here a desirable *locus statio* for many kinds of vegetables, though not for corn. Magnificent crops of common and red cabbage, parsnips, and long red mangold, are growing on a surface that is only just out of the water at any period of the year. Water oozes into the furrows, where deep ones are drawn here and there; it fills the intersecting ditches and the main sewers. Water, almost stagnant, and covered at this warm season with a thick green scum of vegetation, bounds and protects the fields; and during the whole period of the growth of the crops it fills the subsoil at less than 24 inches from the surface. But the upper layer of this mud-bed is almost always dry, crumbling after a few hours of sun or wind into a soft, black earth, which may be lifted in handfuls that leave no stain of dirt.

The marsh land was converted from pasture by ploughing 15 years ago, and, after a succession of such crops as I have named, with onions and potatoes, it is still so strong as to require but little manure, which in the case of parsnips might induce canker at the crown, and in the case of onions might possibly bring on an affection called "booting," a term expressing the situation of young onions when they slink away, or, so to speak, "sink down into their boots." Onions are liable to be overcome in this way when sown too frequently in the same field, or on a cold, stiff, unsuitable soil, or in an ungenial situation. The more artificial the treatment the nearer the disease, and the cultivation of onions is certainly artificial when they receive 50 tons of manure per acre; young onions, however, in the condition described, seem to suffer from want of vitality rather than from any specific disease. The size of the fields on the farm, generally large, varies from 60 acres to 4 acres. The elm is the native tree. The situation of the farm is anything but rural; and its surroundings, especially on the river side, are incongruous with agricultural operations, if not forbidding in their aspect. There are in the immediate neighbourhood enormous gasworks, jute-factories, docks, an arsenal, a forest of ships' masts, and acres covered with tall chimneys, and, besides the noise of great industries and a large population all around, there is the roar of constant artillery practice at Plumstead Marsh.

The average of rent, tithe rent-charge, rates, and taxes is, together, 5*l.* 15*s.* an acre, rates being about 18*s.* to 21*s.* an acre in the several parishes, and tithes 14*s.* an acre.

The number of farm horses averages about 50, varying from 47 to 52.

The yearly expenditure in manual labour is nearly 5000*l.*, or about 9*l.* an acre.

The quantity of manure purchased yearly is about 10,000 tons, besides bones to the value of 300*l.* The live stock at the present time consists of 25 bullocks, and 220 sheep to eat the aftermath. A large portion of the manure is brought from London by the waggons returning after carrying goods to market.

The farm is divided into 540 acres of arable and 80 acres of grass land. About 160 acres produce two marketable crops yearly, or, if it can be so expressed, 700 acres of crops are grown in each year on the 540 acres. The principal crops, and the customary breadths of each, are the following:—potatoes, 200; onions, carrots, and parsnips, 130; cabbages, 90; corn, principally wheat, and turnip, cabbage, and other seeds, 50; rhubarb, 20; mangold, 20; a variety of small crops and seed-beds, 30.

The second crops are collards, following potatoes, cabbages, or onions; potatoes following spring cabbages; mangold transplanted after cabbages up to about 10th July; and savoys and cabbages after any other crop removed in spring.

The rules observed in cropping are to apply heavy dressings to the gross-feeding crops; to place some others, such as onions, at wide intervals in the rotation; to select the best land for crops like cabbages and savoys, which require strong land; to keep the breadth of potatoes within 200 acres; to use corn, which is not a paying crop, as a rest or change for the land, and mangold as a cleansing crop, *i. e.*, one which induces a healthy growth in the next crop.

No regular rotation is adhered to, but the following examples may be taken as an approximation of the system of cropping: 1, potatoes and greens; 2, parsnips or carrots; 3, mangold; 4, onions and cabbages. Or, 1 cabbage and savoys; 2, parsnips or carrots; 3, onions; 4, potatoes.

In order to give the reader a general idea of the distribution of the 9*l.* per acre per annum expended on labour, I shall notice the main items connected with each crop.

(1.) *Potatoes and Greens.*—The land is left unploughed till March; it is, however, cultivated deeply in spring for this crop and for most others. As the next year's crop ought not to be manured, the potatoes get an unusually heavy dressing, such as 30 tons of short manure per acre, ploughed in with three horses and a 10-inch furrow in March. The sets are planted in every other furrow, at 18 inches by 15 inches in the row. They are hoed and moulded in the usual way, and marketed in June, July, and August. The potato-gang were lifting a large crop of early potatoes, exceeding 4 tons per acre, on July 7th, at 6*s.* 8*d.* per ton, weighed in the field, and the haulm raked neatly into wide rows. In a few days the price would be reduced, and the cost of lifting a heavy crop of 10 tons of late potatoes would be about 4*s.* per ton.

The ground is harrowed at the time of lifting the potatoes, and is immediately ploughed deeply, with three horses, for the collards, which are dunged heavily if they are to be followed by carrots, and are not manured if parsnips are to be the next crop. The plants are set one foot apart, at a cost of 20*s.* per acre for labour and 40*s.* an acre for the plants, supposing one acre of seed-bed to plant 14 acres of collards. This crop is hoed several times. Bunching for market costs 4*s.* 6*d.* per 20 dozen bunches.

The collards having been removed during the winter, the land is cultivated deeply early in spring and ploughed 14 inches deep with four horses for

(2.) *Carrots or Parsnips.*—As the cultivation of the latter is described elsewhere and that of the former does not require minute description, it will be sufficient to add that the Early Horn or James's carrot for bunching is sowed broadcast immediately after the plough. The hoeing and cleaning of this crop costs Messrs. Mathews 4*l.* an acre. Taking up and bunching, which was in full progress this early season in the third week in June, costs 8*s.* per 20 dozen bunches, which is thus divided—the men taking up the roots, 2*s.* 6*d.*; the women washing them, 1*s.* 8*d.*; men bunching, 3*s.* 4*d.*; cost of rods, 6*d.*

(3.) *Mangold.*—The land remains untouched till spring, and is then cultivated deeply and ploughed with three horses, turning in a large dressing of dung. On this farm it is an axiom, with regard to the application of dung both to cabbages and to mangold, followed by onions, "the more dung the greater profit:" 40 tons are sometimes put on for mangold. The seed is drilled in rows 2 feet apart, and the plants are singled at 15 inches in the row. Hoeing, setting out, and cleaning costs 25*s.* an acre; raising and clamping a crop of 40 tons 25*s.** an acre. Owing to the expense of hauling the roots to London, mangold at 18*s.* a ton is a less profitable crop on this site than it might be on a farm twenty miles from London, near a railway station. One reason for growing a few has been suggested; another is a commercial one, in connection with the obtaining of manure from cow-keepers.

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* This price is at least double what I have been accustomed to pay for securing 40 tons of roots of greater size. I venture to refer to the cultivation of mangold by Mr. Drewitt, of Guildford, which is noticed in my Report of the "Farming of Kent, Sussex, and Surrey," in vol. iii., 1871, of the 'Journal of the Bath and West of England and Southern Counties Agricultural Association.' Mr. Drewitt is famous for growing heavy crops at wide intervals; last year he paid only 8*s.* 6*d.* an acre for pulling, carting, heaping, and covering with straw a crop of 35 tons per acre, finding two boys to drive. Day wages at Guildford were 12*s.*, at East Ham 15*s.* a week.

(4.) *Onions.*—The land having been heavily manured for the previous crop, is ploughed deeply with three horses, sown with 5 cwts. per acre of bone-dust mixed with guano, and scarified: 10 or 14 lbs. of seed per acre is sown broadcast at the end of February, or early in March. The cost of hoeing and cleaning the crop is 5*l.* per acre, and bunching a great crop costs 40*s.*

The spring crop of cabbages, sent to market in April, May, and June, is sown in the last week in July or first week in August, and planted at the end of September or early in October. The summer crop of cabbages is sown in succession, commencing in open weather in spring. The seed must not be sown too early, as the young plants become blind when frost-bitten.

Mangold for transplanting is sown thickly in a seed-bed in the middle of April, or more usually it is drilled in rows one foot apart, with about 14 lbs. of seed per acre, and the alternate rows are afterwards pulled for transplanting, which may be ventured on until the 10th of July, and costs 12*s.* 6*d.* per acre at the distance of 24 inches by 12 inches.

Three acres of Italian rye-grass, on the alluvial soil, with its roots reaching the water, yielded a second cutting 2 feet high on the 29th June this year—a result equal to what might be expected under irrigation.

## The Bedfordshire District.

The Bedfordshire district lies in Biggleswade, Sandy, and adjoining parishes. The soil is a sandy or gravelly loam, of excellent quality when not too light or thin, resting on sharp gravel, sand, or sandstone rock. The river Ivel, formerly navigable, runs through the district, joining the Ouse at Tempsford. Water is generally found at a depth of 16 feet. In order to shelter a level tract, rows of lofty elms, trimmed into excessive ugliness, are allowed to disfigure the country in every direction. The same object might perhaps be attained, with agreement among proprietors, by the planting of fast-growing timber at salient points, to break the currents of wind, and the neighbourhood might be ornamented as well as protected by such means, without injury to the crops.

The district is not now particularly well situated for market-gardening; certain industries, however, cling to particular localities. Bedfordshire has long been famous, and a favourable soil, the railway, artificial manures, and skill together, have preserved its prestige, so that the labourers who come into the metropolitan district from all quarters in the hoeing season prefer to be called Bedfordshire hoers, and to enjoy the credit of having come from a noted district.

There are many garden-farmers occupying less than 10 acres, others occupy from 10 to 50 acres, and a few even more, and some are owners as well as occupiers.

Spade-labour is not resorted to, and the small farmers are accustomed to hire teams of horses when they require them. The crops are kept remarkably clean, and every kind of work is well done; for the employer, instead of sending his men to their labour, is in the habit of taking them to it and keeping them at it, his occupation being so small.

Garden-farming is entirely dependent, here as elsewhere, on a supply of manure from outside the farm, consequently, at a distance of more than two miles from the railway-station, gardening merges rapidly into farming; and it may be added, that when farmers have been tempted by the large gross returns to combine the cultivation of vegetables with their ordinary business, they have not usually been successful. The business of market-gardening is one in which both the master and his man should have served an apprenticeship.

The crops grown include a considerable breadth of corn, turnip, kohl-rabi, and onion-seeds, and a few carrots and parsnips. Scarcely any peas are grown, and none of the "fancy crops," such as flowers and culinary herbs. The main crops are potatoes and onions, both for pickling and for "lofting," *i.e.* storing in airy lofts constructed for the purpose, with louvre boards for ventilation. A large portion of the produce is sent to the manufacturing districts. It is common to sell largely to the dealers or agents who visit Bedfordshire after the middle of June, for the purpose of buying the growing crops of potatoes, which are lifted and marketed under their direction, during the following three months, before the Scotch supply has commenced. This intervention of middle-men seems to be practically necessary, in order to regulate and distribute the daily supply of vegetables at the various distant markets.

The succession of crops is not regular. It is observed that turnip-seed is a good, and potatoes a bad preparation for wheat, and that onions ought not to be taken from the same ground oftener than once in five years. A common rotation is: 1, onions; 2, turnip-seed, or potatoes; 3, wheat; followed by such crops as onion-seed (after potatoes), cucumbers, carrots, or parsnips. The most important crop is onions, which receive enormous dressings of manure, and sometimes yield a handsome return. The method of cultivation is the same as at Barking—one ploughing, six inches in depth, and the manure harrowed in with the seed—50 tons of dung per acre are sometimes applied, costing 8*s.* per ton at the railway, and 10*s.* when spread in the field. Small dressings of guano are occasionally used, but in the case of onions intended for "lofting," forcing manures must be applied cautiously, as they induce a luxuriant growth; and as bulbs which have been grown too rapidly do not keep satisfactorily, the grower loses the chance of selling his crop at 11*l.* per ton in March! The cost of hoeing is 5*l.* for the season.

Turnip-seed or potatoes follow onions, with a dressing of guano for the former and of soot for the latter. Turnip-seed is grown for seedsmen who supply the farmer with stock seed, which is drilled at 24 inches apart, or the plants are transplanted from a seed-bed in November. One ploughing suffices for this crop. The land is ploughed in autumn for potatoes and again in spring, and the sets are planted with a dibble at the second ploughing. In the case of early potatoes a wide furrow of 9 inches or 10 inches is given, and the sets are placed in alternate furrows. Late potatoes are planted in every third furrow of 8 inches or 9 inches.

A few other particulars may be briefly noticed. Early potatoes (which are not earthed), and scarlet runners are planted in alternate rows, the latter occupying the whole space between the rows (3 feet or $3\frac{1}{2}$ feet) after the removal of the potatoes. A large breadth of cucumbers is grown. They are manured with perhaps 40 tons of dung per acre, planted thickly in rows, sheltered at 6 feet intervals by rows of rye or onion seed. Some growers sow many acres with this crop. Onion seed is also grown at 2-ft. intervals, and is sometimes supported by stakes and string, but more generally by earthing up.

The lowest day-wages of the district are 12*s.* a week; gardeners, however, require skilled labour, and pay higher rates. A great deal of work is done by task.

My note-taking in Bedfordshire was very much aided by the kind assistance of Mr. W. Pope of Biggleswade.

## General Remarks.

The preparation of the land for onions indicates that they prefer a solid surface. In the Essex district a ploughing is given before Christmas, a large quantity of short dung is spread on the land during frost, and is well knocked with a fork; it is afterwards harrowed in with the seed. If dung be ploughed in, and especially if it be covered deeply, it is observed that the plant does not get hold of it until late in the season, and a rampant habit is induced at the end of June, when the onion ought to be bulbing. The consequences of ploughing in dung would perhaps be less injurious on old garden ground, which is full of manure. Lisbon onions for salads are sown in August or early in September.

Pickling-onions require the same cultivation and excessive manuring. They are sown very thickly, and are bleached by casting mould over them a short time before the crop is secured. The process of brining and skinning the crop for one large grower, employs about 400 women working in sheds. Dung, which is usually placed in large heaps 5 feet high and frequently 10 yards wide, is turned twice for onions.

Peas are not profitable in the field-garden district. An occasional piece of early peas is sown in November, to be followed by some such crop as brocoli, which may be planted as soon as the peas are off. After hoeing, the peas are moulded up and the haulm is laid to check over-luxuriance.

Brocoli and cauliflowers are largely grown on the strong, deep fruit-bearing soil of Enfield, a spot which is famous for the tribe, and has given a name to one of the varieties of cabbage. The cultivation of cauliflowers and of Walcheren brocoli has been noticed in connection with a garden in Bermondsey. The latter are usually planted after potatoes or cabbages at the end of June or early in July, and are cut from September to December. Market-gardeners also provide a crop of brocoli to cut early in spring, sowing the sprouted and winter-white and other kinds to plant early in September after potatoes, &c. A heavy coat of dung is turned in with a deep furrow, on deep soil, by three horses, or dug in when the occupation is small. The earliest are sold in time to sow carrots or onions. Other varieties follow during the spring and summer.

*Lettuce.*—Without plenty of manure and garden cultivation lettuces run to seed quickly. Hammersmith has given a name to one variety, and they are confined in great measure to neighbourhoods where the gardens are small. The Brown Cos is sown in November for early use; this and the white and better, but less hardy varieties, are sown in succession from February till June. The chief demand in London is at the end of May, and during June and July. Early sowings are made in seed-beds, later sowings may be made in drills without transplanting.

With respect to the weight of crops, which is the chief point of agricultural interest, garden crops are generally removed before they are mature, and they are planted thickly with that object. It is not the weight, but the number of bunches, that yields a large return. Prices vary so much that no precise estimates on the subject can be given, although one of my informants lent me his books containing exact accounts of monthly sales for several years. I can report a sale of early potatoes (3 tons per acre) at 11*l.* per ton, on a Saturday in the third week in June; on the Monday the price was 9*l.* per ton, and it soon fell one half. Cabbages when very plentiful are sometimes sold at 4*d.* a dozen, they ought to fetch 9*d*., and it is very satisfactory to the grower when they sell at 1*s*. a dozen. 300 dozen bunches of carrots per acre, including "chumps" or rough carrots, sold to stable keepers, are a very large crop; 2*s*. 6*d*. per dozen is a satisfactory price. This year carrots are considered to sell well at 3*s*. A bunch contains from 50 carrots, early in the season, to 25 when they are larger, 20 tons of Belgian carrots, is considered a good crop; 40*s*. a ton is a common price at the stables in London. A crop of parsnips generally weighs considerably more; the price of the finest roots varies from 1*s*. to 1*s*. 6*d*. per score of 22.

A good crop of collards is 200 dozen bunches. It varies between 50 and 350 dozen, and the smaller crop may pay best, reducing the land but little, and selling perhaps at a high price, with comparatively small deductions for the cost of labour and marketing. 150 bushels of peas is a large crop, and 15*l*. on the ground is a very great price, which is sometimes paid by dealers for a crop that would yield 8 qrs. of threshed peas; 2*s*. 6*d*. or 3*s*. per bushel are common prices in Covent Garden, up to 8*s*. for the first early peas, or for "blues" when they come first to market, "whites" being then worth but little. A crop of onions, I believe, weighs about half as much as a crop of swedes in the Eastern Counties, where 20 tons of swedes are a great crop, and from 10 to 15 tons are common crops; price from 5*s*. to 9*s*. per cwt. Prices are affected by a variety of circumstances which cannot be foreseen. A blight in the early potatoes would raise the price of carrots and other competitive vegetables. Cabbages were selling this year at 1*s*. a dozen on June 14th, because there were few peas or potatoes at market. Each gardening district has its innings, which terminates suddenly; for example, any district which is earlier than another has possession of the market so long as the advantage lasts. During a fortnight last spring immense quantities of cabbages were sent from Essex to the great manufacturing towns in the north.

Lisbon sends the earliest potatoes to London, the French coast and the Scilly Islands follow, then Jersey, Guernsey, Cornwall, and Holland; and by the middle of June, these distant but early districts are driven out of the market, by the arrival of supplies from Essex, &c. Red cabbages have been sold at 160*s*. per ton early in the season, and at 25*s*. per ton a fortnight afterwards; or at from 1*s*. to 4*s*. per dozen.

Lesser movements in the trade are governed by the supply of labour and other circumstances. In a parish where a great many French beans were grown, the erection of a factory absorbed the pickers, and beans were given up, as well as brocoli, which had previously been planted between the rows of beans on the solid ground, which suits them.

The garden-farmers send their own men with the waggons to sell their goods in open market, instead of consigning them to salesmen. The cost of carrying goods to market, of baskets, packing, and market dues is estimated at 50*s.* an acre on large garden-farms.

The customary prices of *Task Work* in the Essex district (day wages 15*s.* a week) are :—*Hoeing* per acre—cabbages at 2 feet by 15 inches, 1st and 2nd time, 5*s.* each; 3rd, 4*s.* 6*d.*; potatoes 3*s.* or 4*s.*, and afterwards chopped over by the day previous to earthing; carrots broadcast, 3*l.*; onions, 4*l.* Lifting early potatoes by fork, sorted into *firsts*, *seconds*, and *chats*, placed in sieves of 56 lbs., or baskets of 1 cwt., covered with haulm and weighed in the field, 8*s.* per ton for a crop of 3 tons. Picking peas, from 4*d.* to 6*d.* per bushel. Pulling, bunching, washing, and loading early carrots, 7*s.* per 20 dozen bunches.

A sieve is a basket holding 56 lbs. of potatoes, or 5 pecks of peas when heaped, wholesale measures being liberal. A small sieve, such as is used for French beans and fruit, holds about half a sieve. A prickle is a conical basket, equal to a half sieve. A punnet is a round open basket holding 10 or 12 apricots, made of the same light material as the conical strawberry-pottle.

In collecting materials for this article, I was much aided by introductions kindly given to me by Mr. James Howard, M.P., Mr. J. C. Morton, Mr. H. M. Jenkins, and Mr. W. Hope, and I gratefully acknowledge their assistance.

## XVIII.—*On the Possibility of separating Nitrogen from the Atmosphere by Percussive Compression, and rendering it available for Agricultural Purposes.* By JAMES NASMYTH, C.E. With an Introduction by JAMES CAIRD, C.B.

In a conversation I lately had with my friend Mr. Nasmyth, the eminent mechanical engineer, and inventor of the steam hammer, I mentioned the existence of a floating idea in the brain of more than one man, that it might yet be possible so to decompose the atmosphere as to be able to appropriate its nitrogen for the purposes of agriculture. Mr. McLagan, M.P., I mentioned specially as having turned his attention to the subject. Mr. Nasmyth said the idea was not new. Many years ago he felt convinced that some great discovery was yet to be made in this direction; he had so far thought it out as to have designed an experimental trial, and, when pressed by me to make it public, he very kindly placed in my hands for publication the following paper, developing his ideas, with a plan of the machine by which he thinks they may be carried into effect. I hope some member of our Society, possessing the requisite combination of chemical knowledge with mechanical skill, will be induced to try the experiment.

JAMES CAIRD.

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The important functions in fertilization performed by nitrogen have been thoroughly established by those who have investigated the cause or active element in manures derived from animal substances.

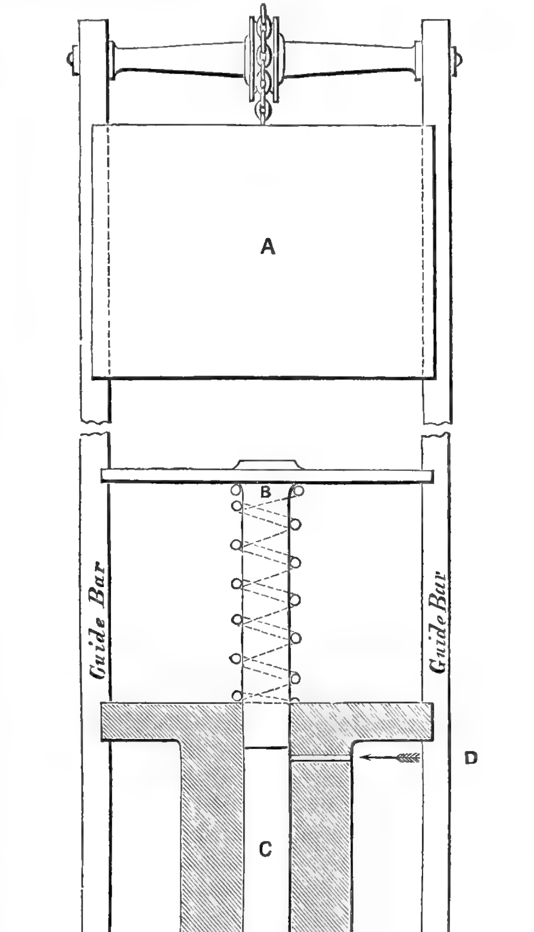
Nitrogen, although a most abundant constituent element in our atmosphere, does not appear to act so readily as a fertilizer as when it is presented to the roots of plants in combination with some other substance, from which combination plants abstract the nitrogen in a manner most effectually conducive to their fertility.

All animal substances, especially when such are in a state of decomposition, are well known to be very effective as manures. This arises from the fact that in that condition they contain *ammonia*, which, being composed of hydrogen and nitrogen, the roots of the plants decompose the ammonia and appropriate the nitrogen greedily, as their most favourite food, and hence its efficacy as a fertilizer.

Reasoning on this subject full forty years ago, and considering the inexhaustibleness of the store of nitrogen we possess in our atmosphere, it occurred to me that, could we but devise some means of laying hold of this nitrogen of the atmosphere, and fixing it in combination with some other element, so as to enable us to present the result directly to the roots of plants, we should, in that way, supply them with their most effective food as manure, derived from an inexhaustible source around us, instead of having to obtain the desired nitrogen, as we do at present, by going all the way to Peru for it in the form of *guano*, which owes its efficacy as a fertilizer chiefly to the presence of ammonia, from which the plants, by means of their roots, abstract their favourite nitrogen. Reasoning on this subject, as I have said, it occurred to me that if by some *mechanico-chemical* process we could manage to knock the nitrogen and oxygen of the atmosphere into chemical combination, and at the same moment combine the so produced nitric acid with some mineral substance which would permanently fix the combination in a portable form, we should thereby get hold of a source of fertilizing power as inexhaustible as it would be effective. In following out this train of reasoning, I called to mind the fact that traces of nitric acid are found in the rain that falls during thunderstorms; and the observed increase of fertility which follows such thunderstorm rain is due, it is supposed, to the nitrogen carried to the roots of plants by the minute admixture of nitric acid in the rain which falls on such occasions.

Also let us bear in mind the wonderful efficacy of a *blow*, or percussive action, in bringing about a true chemical combination between certain elements which otherwise might lie for ever in close juxta-position without ever entering into chemical union. The efficacy of percussive force in this respect is well known in the case of all fulminating compounds. Viewing the thunderstorm effect above referred to as a percussive compressional agency, it occurred to me that we might attain the grand object of chemically combining the nitrogen and oxygen of the atmosphere, for the service of agriculture, by subjecting atmospheric air to exceedingly *violent percussive compression* in the presence of some cheap mineral substance which had a strong affinity for the nascent nitric acid, which I imagine would be the immediate result of such violent percussive compression. Dry slacked lime would appear to be the most suitable substance for effecting this object: the result would be nitrate of lime. Should we thus be so fortunate as to knock into combination the constituent elements of the atmosphere, and so produce a fertilizing agent of the most potent efficacy from an inexhaustible source at home, instead of, as at present, going for it, in the form of guano, all the way to Peru, a great result might ensue. Although this scheme has long afforded me subject for many a bit of quiet cogitation, I have as yet done nothing to bring it to the test of actual trial; but as I have on many former occasions derived high gratification by giving forth such embryo schemes, and seen them come to life by the so planting them into the minds of intelligent men, I venture to promulgate my long-formed notions on this subject, in the hope that peradventure they may take root in favourable soil, and spring up and bear fruit in due season. Even at the risk of being thought a propounder of a visionary scheme in the meanwhile, and even failing the realization of any commercially valuable result, the issue might prove acceptable in a purely scientific point of view.

As some aid to others who might be inclined to practically test my ideas on this subject, I append hereto a rough sketch of an apparatus by which this interesting investigation might be put to the test of actual experiment. Once establish *the fact* that by percussive compression nitric acid can be produced by direct combination of the elements of our atmosphere, the solution of *the commercial part* of the problem would be in a fair way of being solved, as no doubt it would in due time; but *first* let us catch our great fact.




*Sketch of an Experimental Apparatus for determining whether or not the components of atmospheric air can be, by the aid of percussive compression, knocked into combination as Nitric Acid, with a view to its production for Agricultural Purposes.*

A. Weight of $x$ tons, falling $x$ feet on to the top of an air-compressing rod, B, furnished with a spiral spring to return the piston after each blow.

C. Chamber containing the air to be compressed, admitted at each uprise of the piston through the aperture D.

E. Anvil or Foundation Block.

L. Slacked Lime. Means can easily be devised for removing the lime after each compression of the air, and in like manner substituting a fresh charge to fix the nitric acid expected to be produced at each fall of the compressing block. An electric spark sent into the compressed air at the instant of greatest compression might be desirable to aid in affecting a combination of the oxygen and nitrogen.

*Penshurst, Kent, July 25th*, 1871.

# XIX.—*Note on Cattle-Feeding during the Winter of* 1870-71. By W. J. Edmonds, Southrop, Lechlade.

[In a Letter to the Editor.]

My dear Sir,—I think it may not be uninteresting to the readers of the 'Journal' to have a short account of some expedients resorted to during the winter of 1870-71, in order to enable farmers to keep their usual quantity of stock in a healthy condition, and also to fatten cattle without the use of hay. The spring and summer of 1870 were, in this part of the country, unusually dry,—so dry that in the autumn we found ourselves with good wheat but with a very short quantity of straw. Barley, oats, and indeed all Lent corn, as well as winter beans, were lamentably deficient as crops both in corn and straw; seed-hay far from abundant; meadow-hay next to none. Many pieces intended for mowing in the spring were afterwards fed, first, because there was not sufficient grass in them to be worth cutting, and next because the keep in the stocked grounds became so short that those intended for mowing were wanted for the stock. The appearance of the stackyards in September may be imagined; and Nature, which is usually so lavish in compensation, did not even then come to our aid so far as the grass-land was concerned; for, instead of being able to keep the cattle in the pastures until Christmas or nearly so, they continued so bare that in October they were nearly all obliged to be foddered, and many even as early as September. But, if compensation was not given in the grass-land, the same cannot be said of the straw, for the quality of oat and barley straw was almost equal to ordinary hay, whilst that of the wheat-straw was far above the average; and I am the more inclined to name this, lest those who are inexperienced should, another year, adopt the plans successfully pursued this year and find themselves disappointed with the results obtained. It soon became evident, not only that the hay must be most sparingly used, but also that the oat and barley straw would be by no means sufficient for fodder through the winter. These also must be largely supplemented by the use of wheat-straw, and the question arose as to how to make the latter most palatable and most digestible. By some, treacle was given, and with good results: 1 lb. or 1½ lb. per day, besides meal, being allowed to each beast. By others, linseed was used (I was one of those who did so), boiled or steamed, and thrown over the chaff; and as, possibly, it may be more useful to speak of individual experience rather than of generalities, I will state, as nearly as may be, the plan I pursued and its result on the cattle. But I wish it to be understood that

I do so, not because I consider that my plan was better than others, but because I can describe it more minutely. I must plead guilty to great indiscreetness in the previous summer, for, finding some of my intended mowing ground too bad a crop to cut, I bought grazing cattle to stock it, disliking to do so with those I already had, and depending upon rain to give a sufficient supply of grass. The consequence was that the former, later in the season, robbed my others of some hay, and those others were obliged to be brought to the yards early in October, none the better for their summer's keep. Nothing daunted, however, by this piece of bad luck or bad management, I ventured—stock being very low in price—to purchase more cattle, tempted the more to do so by having had built some new cattle-boxes which I wanted to fill. To find Lent corn-straw for them was out of the question. I began to do so, mixing it with a little wheat-straw, but soon found that my sheep would be minus straw if I continued the plan, so determined to feed them upon wheat-straw,—some wholly so, for others, mixing it with oat-straw. We had it cut into chaff, and for the yearlings we added 1 lb. of linseed and 1 lb. of bean and barley meal per beast per day, at a cost of 1*s.* 9*d.* per week, the linseed and meal being steamed and thrown boiling over the chaff and well mixed with it. At one place I steamed the straw-chaff, but I hardly know that we found sufficient difference in the thriving of the animals to warrant the expense. Truly, that was not very much. The smell, especially when mixed with one-tenth hay, was like that of new hay, the knots in the straw were softer, and its *feel* altogether so in the hand, which would lead to the conclusion that it must have been more easily digested; but practically I cannot say that there was enough difference for either me or the feeder to remark it. With this food, assisted by artificials (corn and linseed), I succeeded in grazing oxen which not only paid for what they ate, but realised a handsome profit as well. After selling these fat cattle, just before and just after Christmas, I had left—my yearlings, milking cows, in-calf heifers, and between 50 and 60 young beasts coming two years old. From these last I selected 20 of the best of the heifers and the 6 best steers to keep round, leaving about 30, with regard to which came the question, What must I do with them? I could sell them, but only at a very low price—so low as to lose money upon their cost to the time; I could possibly keep them upon wheat-straw and 2 or 3 lbs. of corn and cake, but then they would probably pay nothing for the winter's keep; or I could try and fatten them for the June market on wheat-straw and boiled linseed and meal. From among these courses capable of being adopted I elected to try the last, and put them into my cattle-pits just after Christmas, having given them before that time mixed straw and a little meal. From that time until the middle of March each animal had 3 lbs. of meal and 2 lbs. of linseed per day, at a cost of about 4*s.* per week; after which, until the 7th May, they had 7 lbs. of meal and $2\frac{1}{2}$ lbs. of linseed, at a cost of about 7*s.* per week. From that time until they were sold their cost was about 9*s.* per week. They consumed daily about 2 bushels of chaff each, part of them having one-tenth hay and nine-tenths wheat-straw, and the others no hay at all. They have paid from the beginning of January, on the average, from about 8*l.* 10*s.* to 9*l.* per head; 14 of them being sold in May and the last three on the 25th July. One went wrong, and made only 3*l.* I had reason, so far, to be satisfied with the result. As to my remaining cattle, fed as before stated (1 lb. linseed and 1 lb. meal), the yearlings I had to spare went out at 9*l.* each, and I never had my two-year-old heifers and steers look better; their allowance of artificials had been a little more liberal, costing about 3*s.* per week; still they had *no* hay, but only mixed straw (wheat and oat) for their chaff. I learnt, too, what I dare say many have long known,—that linseed is an exceedingly good thing for milking-cows. I gave it them until April, when, having some grass, I substituted it and meal for the boiled linseed, and the milk was immediately reduced in quantity and in richness. I cannot conclude without saying that I believe that pits or boxes for feeding cattle are very much better than any other description of stall. They save litter, prevent any waste of valuable manure, and the cattle are quieter and feed quicker.

I am, yours very truly,

W. J. Edmonds.

*Southrop House, near Lechlade, 27th July,* 1871.

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## XX.—*Report on an Outbreak of Splenic Apoplexy at Coldham Hall, near Wisbeach.* By Professor G. T. Brown.

Sir,—In compliance with your request, I proceeded to Coldham Hall on Thursday, June 8th, for the purpose of investigating an outbreak of a fatal disease among cattle and sheep, and I have now the honour to report the results of the inquiry for the information of the Council of the Royal Agricultural Society.

The malady which has destroyed cattle and sheep at Coldham Hall, and on the adjoining farm, is known as "splenic apoplexy," a disease which has much increased of late years in various parts of the country, particularly in those districts where the "forcing system" is pursued, both in reference to the stock and the pastures on which they feed.

Outbreaks of splenic apoplexy among cattle and sheep, and occasionally even among pigs and horses, have occurred on soils which are quite dissimilar in character; as the clays of the lias formation, the red sandstone, the chalk, and also on peats and alluvial deposits of the Fen districts. In all these positions, however, the general conditions under which the disease is developed are remarkably uniform. The pastures are undrained, or drained only by means of open dykes, and the grass is never mown, but always fed off by animals, which are liberally supplied, as a rule, with highly stimulating food. By this arrangement the land is made to carry a much larger number of manure-producing animals than it could otherwise support. Additional manure is also employed in the form of top-dressing from the farmyard. There is ample evidence that a long continuance of this system results in the production of an unwholesome condition of the soil and herbage.

Certain cases of splenic apoplexy have been traced to the use of water contaminated with organic impurities; other instances have apparently been due to the consumption of stimulating food and entire abstinence from water; but the majority of cases may be fairly referred to the influence of "contaminated soils." It is impossible in this report to enter fully into the pathology of the disease, but it may be stated briefly that "splenic apoplexy" is one form of that morbid condition which is generally described as "blood poisoning," in which the blood becomes charged with effete products, and death results from the depressing effects of this impure fluid upon the brain and nervous centres. Congestion of the spleen is a very common lesion, but it is by no means an invariable result of the diseased state of the blood; on the contrary, in some of the most virulent forms of the malady which have been brought under my notice in Ireland and the Isle of Man, and also in this country, the spleen was not implicated. The membranes of the brain and spinal column always show indications of disease, and there is no doubt that the sudden fatality which marks the affection is due to suspension of nervous function. Microscopic examination of the blood has always resulted in the detection of numerous bacteria and vibriones, organisms that are constantly present in fluids which contain organic matter undergoing decomposition.

At Coldham Hall (Mr. John Brown's farm), and on Mr. Little's farm adjoining, the conditions under which "blood diseases" are induced are in existence. The soil is alluvial; the water is stagnant, and contains an excess of organic and mineral matters; the pastures are never mown, are well manured, and constantly fed off by animals in good condition, which are supplied with cake and other nutritive food.

All the sheep on Mr. Little's farm are in high condition; even the ewes are fat, but their lambs are evidently not well nourished. It is worthy of remark that one piece of pasture on Mr. Little's farm became so dangerous after many years' continuance of the "stimulating system" that it was found necessary to break it up.

Splenic apoplexy appeared on this farm (Stag's Holt) some years ago, but was confined to the cattle. About the end of last May a bull and a calf died of the disease, and in the beginning of June the malady attacked the sheep, of which twenty-eight died during the week. The disease manifested itself shortly after the animals were clipped, and it is probable that the prevailing cold wind acted injuriously upon the most susceptible animals, but no amount of exposure to severe weather is, in itself, sufficient to produce the disease.

On Mr. Brown's farm (Coldham Hall), splenic apoplexy appeared last year, in the month of June, among a herd of bullocks. Six of the animals died suddenly, and the remainder were sent to the butcher. This year the same disease reappeared among the cattle only, in the early part of June. One bullock died suddenly, and three others were attacked, but recovered under the treatment which was adopted by the local veterinary surgeon, Mr. R. Knowles, M.R.C.V.S. It has been observed that animals which appear to be in good health are often fatally attacked without any warning; but, that the disease is not so rapid in its course as it seems to be, is proved by the evidence which is obtained by the post-mortem examination of animals in districts where the affection prevails. Two of the best sheep of Mr. Little's flock afforded good examples of the changes which precede the external manifestation of the disease. In both these animals, which were in first-rate condition, there was evidence of congestion in the lungs, liver, and membranes of the brain and spinal cord; and in the blood numerous vibriones with small bacteria were detected.

With the view of arresting the further progress of the disease, the following measures, which have been successfully carried out in other cases, were recommended. All the animals, on both farms, to have daily doses of hyposulphite of soda, two ounces for each bullock, and half an ounce for each sheep, to be given in the food or drinking-water; the quantity and times of administration of the agent to be modified in accordance with the directions of the veterinary surgeon under whose superintend, ence the treatment will be carried out. The quantity of cake to be diminished, and bean mashes to be employed in its stead; the animals to be driven daily from one part of the farm to another, by which course, change of pasture and a sufficient amount of exercise will be insured. In reference to the management of the land, it was advised that the next top-dressing should consist of lime or salt, according to circumstances, instead of farmyard-manure. From the position of the pastures, it would be impossible to drain more effectually than is already done; and it does not appear that under the present circumstances, the extreme measure of breaking up any of the grass land is called for.

*H. M. Jenkins, Esq.* G. T. Brown.

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## XXI.—*Annual Report of the Governors of the Royal Veterinary College.*

The Governors of the Royal Veterinary College acting, as hitherto, in co-operation with the Council of the Royal Agricultural Society, in promoting that branch of veterinary science which regards the diseases of farming stock, have the pleasure of forwarding to the Council of the Society their usual annual Report relative to the diseases prevalent amongst cattle during the past year, and their mode of treatment, as laid before the Governors by the Professors of that College.

The Governors avail themselves of the occasion to mention that lectures, embracing all the leading features of cattle pathology, have been regularly delivered in the College on four days in each week, and that they have been attended by the entire class of pupils, who have shown as earnest a desire to obtain proficiency in this as in any other division of their studies. Their progress has consequently been satisfactory, as shown by the circumstance that those who presented themselves for their final examination before the Royal College of Veterinary Surgeons, after having been in attendance for two full sessions, received as many good marks at the Cattle Pathological Section of the Court, as at any other.

During the year, seventy-six "Freshmen" were enrolled at the College, and entered upon their studies—a number which exceeds that of the preceding year, and has rarely, if ever, been surpassed.

Each "Freshman" was subjected to a Matriculation Examination, which, in the early part of the year, according to custom, was conducted by the Professors, but later on by a Committee of the College of Preceptors, presided over by Dr. Jacob, Dean of that College.

Within the year, that is, at the April and December examinations, 88 students presented themselves before the Court of the Royal College of Veterinary Surgeons. Of these, 56 obtained the diploma, and were admitted Members of the College.

Besides the instruction imparted to the pupils by the professorial lectures, no opportunity has been omitted of giving tutorial explanations of disease, nor of describing the nature of the lesions which had been produced in the several morbid specimens received at the College during the year. The members of the profession practising in different parts of the country have, to as great an extent as heretofore, readily afforded supplementary aid of this description, and the same may be said of many agriculturists and owners of cattle. The value of assistance of this kind is great, and it is aid which the teachers have always done their best to secure. By it they are not only kept informed of special outbreaks of disease, but are often enabled to obtain a clue to the local causes on which they depend. It is a healthy sign of progress to find that many veterinary surgeons of the present day are even more desirous to investigate the causes of disease than to confine their services to the mere routine of medical treatment. Owners of animals are not slow to appreciate the advantages which they thus derive, and it has often been a source of much satisfaction to the Professors of the College to hear them speak of the value of the profession in pointing out how disease is to be prevented, as well as in explaining the principles which should obtain in attempting its cure. The labours of the Professors will continue to be exerted in this direction.

Among the large number of morbid specimens which have reached the College, special mention may be made of some remarkable examples of the disease known as Scrofula, affecting nearly every organ of the body. With a few exceptions only, these cases occurred in cattle used for breeding purposes, and mostly, also, among the improved races.

Attention has previously been directed to the fact of some of the families of the most valued breeds being affected with this hereditary disease, thereby putting persons on their guard against using any animal, which gives the slightest evidence of scrofula, for breeding purposes.

It may be affirmed that these warnings have had a beneficial effect, and hence the necessity of repeating them with such facts as the past year's experience has afforded.

Speaking in general terms of the morbid specimens which have come to hand, it may be stated that proof has been again adduced that the maladies which pass under the general name of blood-diseases are still on the increase among cattle and sheep. Specially to be noticed among such diseases is the one commonly known as Splenic Apoplexy. Many cases of this disease occurred in the winter and spring months, but as the year drew on their number greatly increased, until in the summer scarcely a week elapsed without specimens, consisting of the chiefly-affected parts of animals which had died of the malady, being received at the College. The communications which accompanied these specimens showed that not only cattle, but sheep, pigs, and even horses, had died suddenly, even when believed to be in perfect health, from this remarkable affection. Science has still much to do in investigating the causes of this disease. The facts appertaining to many of the outbreaks are irreconcilable with each other. Animals are struck down with the disease on farms where the malady was never known to have occurred before, and then the disease ceases as suddenly as it had appeared. These things often take place in localities far distant from each other, and where the greatest possible differences exist in the prevailing breed of cattle, character of soil, system of farming, management of animals, &c. Not unfrequently, however, coincidences occur which would almost admit of being regarded as consequences. Thus, the feeding of cattle on fields recently manured with liquid manure or town sewage, or where the water supply is contaminated with the drainage of houses or filthy farm premises, is accompanied with an outbreak of splenic apoplexy. In many of these cases, everything short of removing the animals for a time to another farm, even if merely a contiguous one, fails to arrest the progress of the malady.

An outbreak of splenic apoplexy is also not unfrequently associated with the use of compound feeding-cakes, cotton-cake, and other allied substances, especially when any of these are given in excess. It may be asserted that many feeding-stuffs of this kind are most valuable when used to a limited extent, but positively poisonous if this limit be exceeded, as is often the case in the attempts which are made to push on the condition of animals too rapidly.

Besides the morbid specimens thus specially alluded to, mention may be made of the receipt of others which point to an increase of a peculiar parasitic disease, known commonly as "measles," of the pig. This name of the disease is very inappropriate, as leading to the most erroneous conclusions with regard to the nature of the malady. "Measly pork" has an appearance of the flesh being studded with small watery cysts. These cysts are living entozoa, known ordinarily as hydatids—the *hydatis cellulosæ*. This condition of the flesh would be more properly described as *misty* or *mizzly*, and no doubt "measle," in this instance, is a corruption of the old English word "mizzle." The term "mizzly-pork" expresses the condition of the flesh of a pig, the subject of the malady, better than any other. Hydatids are only immature tape-worms, and when such pork is eaten by man, tape-worms will abound in his intestines.

Several prosecutions of low-class pork-butchers have recently taken place for exposing mizzly-pork for sale. Good cooking, or complete pickling of the infected meat will destroy the vitality of the hydatids; but it is evident that much must depend on the activity of Meat Inspectors in preventing the spread of this loathsome disease. Foreign pigs, especially those known in the trade as Hungarian pigs, and also Irish pigs, are more frequently the subjects of the disease than English. The Inspectors at the ports are aware of this, and although the malady is not easily detected in the living animal, seizures and destruction of infected pigs take place from time to time, an instance of which occurred at Hull during the past summer.

Referring to the importation of foreign cattle and other animals used as food, it may be stated that the prompt means which have been adopted by the Government, and the vigilance observed by the Veterinary Inspectors at the ports, have proved most effective in saving the country from a fresh invasion of the cattle plague, consequent on the Franco-Prussian war. At the commencement of the year, cattle-plague was prevalent in Poland, Galicia, Hungary, Roumania, &c., as well as in countries more immediately contiguous to the steppes of Russia. Early in the year the disease made its way into Siberia: but, in consequence of the precautions adopted by the Austrian and Prussian Governments, it was prevented extending further in a westward direction. The continuance of the disease, however, in the countries referred to, required on the part of Prussia the maintenance of stringent regulations with respect to the importation of cattle and such articles of commerce as were likely to bring in the infection. Just before the breaking out of the war the restrictions amounted to the positive prohibition of cattle into East Prussia, in consequence of the extension of the cattle plague to the Baltic provinces of Russia.

The occurrence of the war had, however, to be followed by the withdrawal of the military cordon on the Russian and Polish frontier; and as the demands of the Commissariat of the Army increased, contractors for the supply of cattle did not hesitate to obtain animals from Poland and other infected countries. The cattle-plague was thus quickly introduced, and within a few weeks it had established itself in Prussia, Mecklenburg, Saxony, and other States of the North German Confederation. Following in the wake of the army, the disease broke out along the whole course of the Etappen Road. Its ravages in the Palatinate were most destructive. Entering France, it quickly spread to the cattle of that country, while it continued to prevail among the animals of the Commissariat, producing immense losses around Metz and other centres of the invading forces. Still following the army, it was soon established in the Valleys of the Sarthe, the Marne, and the Seine, and in the Northern Departments of France near to the

Belgian frontier. Subsequently the disease obtained a footing in Belgium, despite the precautionary measures adopted by the Customs' authorities, assisted by the military.

The English Government lost no time in issuing an Order of Council requiring that all cattle, sheep, or goats imported from France, or any port of the North German Confederation, should be killed at the place of import. This Order was also followed by another to the same effect, as applicable to Belgium, on the extension of the disease to that kingdom. At the close of the year cattle plague was increasing in all the countries referred to, leaving but little hope of its being early exterminated under the circumstances in which Europe is placed.

Another infectious continental disease may be here alluded to, *viz.* sheep-pox.

The information which reached England from time to time was to the effect that this disease was prevalent in Mecklenburg and other States of North Germany.

During the autumn it was ascertained that the malady was increasing, which led to apprehensions of its importation here again taking place. The fear was well grounded, for in the month of October the Veterinary Inspector detected the disease in a cargo of sheep which arrived in London from Hamburg. It fortunately happened that the Order of Council, requiring the slaughter of sheep as well as cattle imported from Germany, was at the time in full force, so that no ill-consequences followed the importation. With this exception no other known case of importation of sheep suffering from variola has occurred during the past year.

With reference to other diseases of a contagious type which may be said to be naturalized, but nevertheless likely to be added to by cattle importations, *viz.* pleuro-pneumonia and mouth-and-foot disease (eczema epizootica), it is not known that more than one cargo of cattle visibly affected with the first-named disease has arrived at any of the ports. There have, however, been very many importations of animals the subjects of mouth-and-foot disease. In each of these cases the animals have been killed at the place of debarkation. Mouth-and-foot disease seems to be one of the most widely spread cattle affections of which the profession has any knowledge. We have information of its existence throughout the whole of Europe, in Asia Minor, India, North and South Africa (being particularly rife at Port Natal and the Cape); in several of the West India Islands; North and South America, including Brazil, Uruguay, Buenos Ayres, &c. Facts of this kind incontestibly prove that the infecting material on which the spread of the disease mainly, if not entirely, depends, is uninfluenced by the climate of the country which the animals inhabit. They also show that food, breed, system of management, and all the ordinary causes on which the disease has by some persons been thought to depend, are altogether inoperative in its production. The year 1870 has witnessed one of the most remarkable outbreaks of the mouth-and-foot disease on record, and at the time we write the disease, although much diminished in many parts of Great Britain and Ireland, is far from being exterminated by the sanitary regulations of 'The Contagious Diseases (Animals) Act, 1869.'

Pleuro-pneumonia has also been rife, but less so than in some preceding years. Many parts of the country have sustained serious losses, particularly those where large numbers of dairy cows are kept. Animals of this kind are highly susceptible to the disease, and for this reason, among others, large towns suffer to a greater extent than extensive tracts of country where but few milking animals are found, although extensive herds exist.

The regulations of 'The Contagious Diseases (Animals) Act' are operating very beneficially in keeping in check the spread of pleuro-pneumonia.

It remains only to make mention of two or three diseases which have been brought prominently to the notice of the Professors during the year.

(*a*.) *Venous Congestion in Lambing Ewes.*—The long-continued stormy and wet weather which prevailed in the spring, and the sudden transitions from cold to heat which occurred, led to very serious losses, in the western parts of England in particular, of in-lamb ewes. Many of the animals died after a few hours illness, either just before or very shortly after parturition. Many lambs were also born dead. Post-mortem examinations revealed the existence of venous congestion chiefly of the uterus or of the brain, less frequently of the lungs, liver, or other organs. These congestions evidently depended on a changed condition of the blood, which would seem to have been deficient both in albuminous and saline materials. A restricted use of green food, especially turnips, and a free allowance of good hay, cake, and corn, with a daily use of salt, alternated with the sulphite of soda, acted most beneficially in the cases which came immediately under the notice of the Professor of Cattle Pathology.

(*b*.) Similar climatic conditions induced a large number of attacks of acute rheumatic fever among lambs. Some very remarkable cases of the disease occurred in the county of Essex, in which the attacks were almost entirely confined to the male lambs, the disease following very closely on castration. The deaths were numerous, depending mostly on organic disease of the heart as shown on a post-mortem examination. Another peculiar feature of the malady was the loss of sight in a large proportion of the lambs which survived, due to the rheumatismal inflammation attacking the fibrous tissues of the eye. Treatment availed but little in any of these cases.

(*c.*) *Ophthalmic Disease of Cattle.*—For several years past a disease of the eyes of cattle has prevailed, particularly calves and young store-stock, and more especially during the summer months. The malady has many of the characteristics of the affection technically called Staphyloma. Its cause has not clearly been ascertained; but there appear to be reasons for believing that it may possibly be due to parasitic agency. The affection was less rife in 1870, but nevertheless sufficiently so to call for special mention in this Report.

With regard to its *local treatment*, it has been found that at the commencement, antiphlogistic remedies, modified according to cirumstances, have sufficed in many instances, especially when combined with a perfect exclusion of light, to effect a cure. In many cases, however, blindness, partial or complete, has resulted despite the adoption of the best directed means of effecting a cure.

(*d.*) *Acorn Poisoning.*—The autumn of 1870, like that of 1868, witnessed the loss of a large number of young cattle at pasture in parks and places where oak-trees were growing. Investigation showed that the disease often destroyed 60 or 70 per cent. of the animals attacked, and that the malady depended entirely on the cattle eating the acorns as they fell from the trees. It has been supposed that the ill effects were principally due to the astringent properties of the fruit, which led to constipation and its attendant ill consequences of occlusion and inflammation of the bowels. On this point, however, opinions do not coincide. At present the veterinary profession is unacquainted with any antidote to the deleterious matter, nor does it yet know on what the poisonous effects of acorns really depend.

It is proposed that a chemical examination of fresh acorns be undertaken by Professor Tuson in the course of this year, with a view to the solution of this question. Animals are now within the College, which are being used for experimental purposes to determine, if possible, the several problems connected with this important subject. One young ox has especially been brought under the influence of the acorn poison. The symptoms which developed themselves were perfectly characteristic, and differed in no respect from those which were observed among the animals which were affected when at pasture. The young ox in question remained in a very precarious condition for two or three weeks, but ultimately recovered. As will be inferred from these general observations on this interesting subject, further investigations will be undertaken for its more complete elucidation. The several officers of the College are co-operating in the matter pathologically and chemically, so that it may be reasonably expected that the causes of acorn poisoning will be fully cleared up.

J. W. Bosanquet,
*Treasurer.*

*April* 15*th*, 1871.

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## XXII.—*Report on Experiments in reference to Pleuro-pneumonia and other Diseases of Cattle, made during the half-year ending March* 31*st*, 1871. By Professor James Beart Simonds.

Sir,—I have the honour to report, for the information of the Veterinary Committee, that in September last I purchased a cow and steer, and subsequently two sheep and a lamb, for experimental purposes, with the funds, 25*l.*, placed at my disposal by the Committee. Shortly after purchase, the cow, being found to be unsuited for the required purpose, was disposed of, and the money expended in procuring two other animals, a young steer and a heifer. With the exception of the lamb, which died shortly after purchase, these animals are now at the Royal Veterinary College, where they have been kept throughout, at the expense of the Institution.

The experiments originally had recourse to had for their main object the further elucidation of the laws which regulate the spread of pleuro-pneumonia; but, in consequence of the difficulties which were found to beset this subject, some of the animals were subsequently used for other purposes. The first pleuro-pneumonia experiment consisted in exposing one of the steers to the inhalation of the vapour of diseased lungs. For this purpose a dairyman's cow, suffering from the disease in its advanced stages, was killed, and the lungs immediately forwarded to the College. Here they were placed with the experimental animal in a closed loose-box, care being taken so to secure the head of the animal, that at each inspiration the vapour should enter the respiratory organs. The steer was kept in this position until the lungs had become cold; but, although then liberated, the lungs were not removed from the box, it having been determined to leave them with the animal until visible decomposition had begun. The animal was carefully watched day by day until the expiration of the tenth week, but not the least deviation from health was observed during any part of the time.

It was now determined to repeat the experiment in a modified form, and for this purpose a sponge was placed in the nostril of a diseased cow and allowed to remain until it had become thoroughly saturated with the breath and also the mucous discharge from the nostril. It was then transferred to the nostril of the experimental animal and retained there for upwards of half an hour. As in the former case, the animal was closely watched for several weeks—during the time, in fact, which pleuro-pneumonia is often known to lie dormant in a herd in which the disease is taking its natural course; but again no ill effects followed. Besides these two experiments with one animal, some mucus obtained from the respiratory organs of diseased cattle was rubbed on several occasions upon the mucous membrane of the nostrils of other of the experimental animals, with a view to effect its absorption. These experiments had also a negative result.

It may likewise be stated that persons intentionally came from attending on sick animals and placed themselves in contact with the experimental cattle. Inoculations with the products of the disease, as obtained either from the lungs or the chest, have not been had recourse to, former experience having shown that such inoculations have invariably failed to transmit pleuro-pneumonia.

Apart from natural cohabitation, it yet remains to be shown how the disease is conveyed from animal to animal in a herd. No safe deductions can, however, be drawn from these failures, for further experience may show that success may follow the repetition of one or more of the experiments. They possess, nevertheless, a certain value as illustrative of some of the reasons why pleuro-pneumonia often progresses so slowly among cattle herded together; and they also point to the propriety of isolating and slaughtering the first animal of a herd which becomes affected. These experiments will in due course be repeated, and others having the same object in view will be also adopted.

*Sheep-pox.*—The importation of a cargo of sheep from Hamburg, among which sheep-pox existed, led to the inoculation of an experimental sheep with the virus of this disease. The chief object being the production of a good pathological specimen, and even the death of the sheep, a very unusual quantity of the virus was employed and several punctures made in different parts of the body. Each of the punctures took, and on the eighth day, as is usual, variolous fever set in. The intensity of the fever increased, and the skin gave evidence of a copious eruption, thus indicating that the object of the experiment would be obtained. For five or six days death was looked for; at the end of this time, however, the severity of the symptoms began to abate and the animal ultimately recovered. Had the animal died, or a free vesication taken place on the skin, the solution of two problems might possibly have been effected: *first*, whether the infecting *materies morbi* contained in the contents of the vesicles could be easily destroyed by exposure to some of the supposed disinfecting agents, recently advocated; and *secondly*, whether placing the carcase or parts thereof with healthy sheep would propagate the disease, thus obtaining an answer to the question, "Can the dead convey infection?"

It may be stated, however, that the belief of the veterinary profession is that dead sheep will convey sheep-pox: and with regard to cattle-plague it may be affirmed that the disease being thus propagated is established beyond all doubt. There are several reasons for believing that the carcases of diseased sheep are a source of real danger to healthy animals; but other experiments are required in this direction.

*Acorn-poisoning.*—It had long been known that acorns, from their indigestibility and consequent retention within the stomach and intestinal canal, often proved injurious to cattle, sheep, and even pigs, when too freely partaken of. It was not, however, until the autumn of 1868 that any suspicion seems to have been entertained that acorns contained, under certain circumstances, deleterious matter which would produce blood-poisoning in cattle, especially in those which were under two years of age. This blood-poisoning does not appear to be due to the tannic, or the gallic acid of acorns, nor to an immoderate quantity of them having accumulated within the stomachs or intestines. Indeed, experience has shown that the worst form of the disease is often developed after the greatest part of the acorns have been expelled from the system, and when diarrhœa and not constipation is one of the leading symptoms. In the year referred to, a large crop of acorns followed upon an unusually hot and dry summer, by which all ordinary pasturage was nearly destroyed, and probably also the acorns themselves brought into a more perfect or ripe condition. As soon as the acorns began to fall it was found that the young cattle grazing in parks and pastures, where oak-trees abounded were attacked, with a serious and most fatal malady. Some of the animals suffered more than others, but none escaped an attack if allowed to remain in the pastures and partake of the acorns. The fatality was very great, often reaching as high as 60 to 70 per cent. So numerous, indeed, were the deaths, and so peculiar the symptoms, that many of the original attacks were thought to depend upon an outbreak of cattle-plague. The similarity of the symptoms in the two affections was very remarkable, so much so indeed that had cattle-plague still existed in the country there cannot be a doubt that the spread of the disease would have been attributed to an outbreak of that malady. As a matter of history, it may be stated that our advice was originally sought in many of the cases in order to determine whether cattle-plague had really reappeared in the country. Numerous visits were made into the Midland and Southern counties particularly, and the same characteristic symptoms of the acorn-disease were everywhere found to prevail. Prevention, by a speedy removal of the animals, did much to arrest the progress of the affection; but when fully established, curative means were of little or no avail. With the ending of the fall of acorns the disease entirely and suddenly disappeared, and nothing was heard of any allied cases until the autumn of 1870.

The drought of that year proved even more disastrous to the grass-crop than that of 1868, and what was not a little singular, it was accompanied by an equally prolific crop of acorns. The fall of the acorns was again accompanied by the same ill consequences; outbreak of disease rapidly succeeding outbreak, and in numerous instances, on the same farms as before. Fresh investigations were made, which confirmed the conclusions previously arrived at; nevertheless it was determined to have recourse to a direct experiment for clearing up some doubtful points in the pathology of the affection. For this purpose a young steer and a sheep were selected for feeding with acorns. The fruit obtained was fully ripe—indeed more so than in many instances where mischief had resulted from its natural fall from the trees. For the first two days a very few acorns were given, so as to induce the animals to eat them. This end being accomplished, the steer, on November 14th, was supplied with a liberal quantity, when he ate about a peck, mixed with a small quantity of hay-chaff. During the two following days he consumed not more than a peck and a half, also mixed with chaff: water was allowed *ad libitum.* On the fourth day, November 18th, the animal's appetite failed, and he could scarcely be induced to partake of food of any kind; beyond this, however, there were no indications of ill health. The acorns were continued, and by the 20th very many of the special symptoms of acorn-poisoning had developed themselves. The semi-conscious condition, weak pulse, pallid membranes, cold surface of body, torpid bowels, slow breathing, twitchings of muscles, and a disposition to maintain a recumbent position, were well marked. The thermometer registered the internal heat as ranging between 100 and 101 degrees, showing the entire absence of inflammatory action.

Day by day the symptoms increased in severity, and by November 25th the characteristic symptom of acorn-poisoning—*viz.* a copious flow of colourless urine—was fully established. A muco-purulent discharge also flowed from the eyes and nostrils, as is sometimes seen in cases of cattle-plague. Some of the colourless urine was collected; its specific gravity was found to be 1·012. Its reaction was alkaline. A microscopic examination was made of the blood, which showed that the red cells had undergone remarkable changes; some were stellate, others oblong or oval, and not a few of a square form. Others presented such a distorted condition as to be almost indescribable. The white cells were more numerous than usual, but their normal globular form was preserved. As the animal refused all food, some crushed acorns were mixed with water and given as a draught thrice a day, with a view to prolong the illness that further investigations might be made.

By December 3rd it was evident, however, that the severity of the symptoms had begun to abate, and as there was a fair probability of the animal's recovery, the acorn-drenches were discontinued; he was also well nursed and every means taken to promote a return to health. He ultimately but slowly recovered, and for weeks remained in a miserable plight. This loss of condition was especially observable when compared with that of a heifer of the same age, which had not been made the subject of any experiment.

The sheep continued to eat the acorns daily, consuming each day from a pint and a half to a quart. With a view to produce some ill effects, if possible, the acorns were used unmixed with any other kind of food. Not only did no impairment of health follow, but the animal may be said to have gained both flesh and condition. The feeding with acorns was continued for a month.

In concluding this Report, I have to state with regard to disease in general as affecting cattle, sheep, and pigs during the past year, that, in accordance with established custom, this matter has been fully reported on to the Governors of the Royal Veterinary College, who, I have every reason to believe, will not depart from their usual system of embodying the chief points of my communication in their annual Report to the Council.

I have the honour to be, Sir,
Your obedient servant,
JAS. B. SIMONDS.

*Royal Veterinary College,*
*March* 31*st*, 1871.

P.S. I have further to inform the Committee that a few days subsequently to this Report being written, the steer which was made the subject of the pleuro-pneumonia experiments was disposed of, and three younger, but equally as suitable animals, purchased with the money, with the small addition of 2*l.* to the price obtained. There are therefore now five young bovine animals at the College, the property of the Society.

*H. M. Jenkins, Esq.,*
*Secretary Royal Agricultural Society.*

## XXIII.—*Correspondence with the Veterinary Department of the Privy Council with reference to the Regulations under which Foreign Cattle are imported into Great Britain.*

At a Monthly Council held on Wednesday, July 5th, Mr. Torr called attention to the relaxation of the restrictions on the foreign cattle trade recently made by the Privy Council, and to the injury which may have been thereby inflicted on English herds, and Professor Symonds explained the existing regulations of the Privy Council. It was thereupon moved by Mr. T. Dyke Acland, M.P., seconded by Mr. H. S. Thompson, and carried unanimously:—

"That the Council, having heard a statement from Professor Symonds as to the present regulations of the Veterinary Department of the Privy Council, and as to the precautions adopted with regard to the importation of foreign stock, are of opinion that it would be desirable to obtain such a statement in an official form, and consequently that the Privy Council be requested to allow Professor Symonds to communicate to the Council of the Royal Agricultural Society, for publication, the exact regulations and restrictions under which the importation of foreign cattle is now carried on."

In consequence of this resolution a correspondence ensued between the Secretary of the Veterinary Department of the Privy Council and the Secretary of the Society. The following letters contain all that is essential to the question.

(Copy.)

"Privy Council Office, Veterinary Department,
"Princes Street, Westminster, S.W.,
"6 July, 1871.

"Sir,—The resolution of the Council of your Society with regard to obtaining the sanction of the Privy Council that Professor Symonds may communicate in an official form, for publication, the exact regulations and restrictions under which the importation of foreign cattle is now carried on, has been submitted to the Lords of the Council.

"In reply, I am directed to state that their Lordships can only be responsible for official communications signed by the Secretary of the Department.

"With regard to the information asked for, it can only be obtained by a reference to the Act and Orders of Council relating thereto, copies of which are enclosed. Any interpretation of these enactments by the Lords of the Council would have no weight in a court of law, but I have been directed to prepare some notes of the principal regulations relating to the importation of foreign animals, with marginal references to the Act and Orders, and an Appendix containing the regulations at present in force at the ports.

"These notes will supply a means by which references to the Act and Orders can readily be made, but it must be distinctly understood that the Act and Orders themselves are alone authoritative.

"A copy of these notes shall be forwarded to you as soon as they have been approved by Mr. Forster.

"I have, &c.,

"ALEXANDER WILLIAMS,

"*Secretary.*

"*The Secretary,*
"*Royal Agricultural Society of England,*
"*Hanover Square, W.*"

(COPY.)

"Royal Agricultural Society of England,
"12, Hanover Square, London, W.,
"July 20th, 1871.

"SIR,—I have the honour to acknowledge the receipt of your letters, No. 32,916, dated respectively the 5th, 6th, and 17th inst., enclosing the Official Orders regulating the importation of foreign cattle, and referring to the resolution of the Council of the Society requesting Professor Simonds to communicate, for publication, the exact regulations and restrictions under which the importation of cattle is now carried on.

"The Lords of the Council having, in consequence of the above-mentioned resolution, ordered the preparation of some notes of the principal provisions with respect to foreign cattle, contained in 'The Contagious Diseases (Animals) Act, 1869,' and Orders issued thereunder (a copy of which notes was enclosed in your letter of the 17th), I am directed to enquire whether there is any objection to the publication of that document in the next number of the Society's 'Journal,' subject to the note signed with your initials stating that the Acts and Orders themselves are alone authoritative, and to any other note or qualification which the Lords of the Council may deem necessary.

"I have, &c.,

"H. M. JENKINS, *Secretary.*

"*Dr. Alexander Williams, &c. &c. &c.,*
"*Privy Council Office, S.W.*"

(Copy.)

"Privy Council Office, Veterinary Department,
"Princes Street, Westminster, S.W.,
"22nd July, 1871.

"Sir,—I have the honour to acknowledge the receipt of your letter of the 20th instant, inquiring whether there is any objection to the publication of the notes of the principal provisions with respect to foreign animals contained in 'The Contagious Diseases (Animals) Act, 1869,' and Orders issued thereunder; which has been submitted to the Lords of the Council.

"In reply, I am directed to state that their Lordships do not object to the publication of the whole of the correspondence on the subject.

"I have, &c.,
"Alexander Williams,
"*Secretary.*

"*The Secretary,*
"*Royal Agricultural Society of England,*
"*Hanover Square, W.*"

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"Veterinary Department, 7th July, 1871.

*Notes of the Principal Provisions with respect to Foreign Animals contained in 'The Contagious Diseases (Animals) Act,* 1869,' *and Orders issued thereunder.*

N.B.—These notes are intended to supply a means of reference to the Acts and Orders; but it must be distinctly understood that the Acts and Orders themselves are alone authoritative.—A. W.

Section I.—*Cattle from Scheduled Countries.*

*O. C.* 258, *Schedule, and O. C.* 325.—Cattle coming from Russia, the Austrian-Hungarian dominions, North Germany, the dominions of the Sultan, Italy, the Papal States, Belgium, and Greece, can only be landed at the following ports:—

| | | |
|---|---|---|
| Bristol. | North Shields. | Portsmouth |
| London. | Shoreham. | Grimsby |
| Dover. | Southampton. | Dartmouth. |
| Hartlepool. | Granton. | Littlehampton. |
| Hull. | Leith. | Sunderland. |
| Newcastle-upon-Tyne. | Glasgow. | Goole. |
| Plymouth. | Middlesbrough. | Liverpool. |

These cattle must be landed at parts of these ports defined by the Privy Council as landing-places for slaughter, and are subject to the regulations contained in the fourth schedule to the Act.

*O. C.* 258, *Art.* 5.—All such cattle must be slaughtered within ten days after being landed, exclusive of the day of landing.

All such cattle must be slaughtered at such landing-places, except for the supply of London and Edinburgh, and at ports where quarantine or re-shipment to another landing-place is allowed.

*O. C.* 274, *and* 275.—For the supply of Edinburgh the defining Orders contain special provisions enabling these cattle, under certain conditions, to be moved by railway from the landing-places at the ports of Granton and Leith to the Edinburgh Public Slaughter-house.

*O. C.* 259, 263, *and* 326.—For the supply of London the Metropolitan Order and the Order defining the port of London, contain special provisions, enabling these cattle, under certain conditions, to be moved by railway from the landing-places in the port of London to the Metropolitan Cattle Market.

*O. C.* 293, 297, *and* 282.—Re-shipment is allowed at Hartlepool, Hull, and Sunderland.

*O. C.* 311.—In the Order for Southampton there are special provisions under which cattle from scheduled countries may undergo quarantine, and so cease to be deemed foreign cattle.

*O. C.* 285.—The Order of the 1st September, 1869, contains special provisions with regard to milch-cows in vessels taken out from, and brought back to, Great Britain, without having left the vessel.

*Act of* 1869, *Sec.* 19.—All animals within a part of a port defined for the landing and slaughter of cattle from scheduled countries are to be deemed cattle from scheduled countries.

*O. C.* 263, *and* 326.—There are three places within the port of London, defined as landing-places for slaughter, namely, Thames Haven, Victoria Docks, and Brown's Wharf.

*O. C.* 259, 263, *and* 326.—The Metropolitan and defining Orders provide for the removal of cattle from these landing-places to the Metropolitan Cattle Market. The cattle are to be taken by railway in special trucks along specified routes to within 1000 yards of the market, and are to be there discharged, and driven immediately to the market, or to lairs licensed by the Privy Council. No such cattle can leave the Metropolis alive.

*Act of* 1869, *Secs.* 28 *and* 29.—There are special provisions in the Act for the establishment of a foreign market for the metropolis.

### SECTION II.—*Foreign Animals generally, and Cattle from Unscheduled Countries.*

*O. C.* 328.—Foreign animals can only be landed at the following ports:—

| | | |
|---|---|---|
| Bristol. | Grimsby. | Newcastle-upon-Tyne. |
| Cardiff. | Hartlepool. | Penzance. |
| Dartmouth. | Harwich. | Plymouth. |
| Dover. | Hull. | Portsmouth. |
| Falmouth. | Kirkwall. | Shields, North. |
| Folkestone. | Leith. | Shields, South. |
| Glasgow. | Littlehampton. | Shoreham. |
| Goole. | Liverpool. | Southampton. |
| Grangemouth. | London. | Sunderland. |
| Granton. | Middlesbrough. | Weymouth. |

*Appendix, O. C.* 258 *Arts.* 7 *and* 9, *and O. C.* 322.—All foreign animals must be detained and inspected on landing. If any one of a cargo is found affected with any contagious or infectious disease, such animal or the whole cargo may be detained and slaughtered, or otherwise dealt with, as the Privy Council or Customs direct.

*Act of* 1869, *Sec.* 71.—Compensation may be withheld in respect of any foreign animal slaughtered on account of its being affected with cattle-plague, or with disease suspected to be cattle-plague, if it appears that the animal was so affected at the time of its landing.

*O. C.* 258., *Art.* 6.—Healthy foreign cattle, if landed at places other than those defined for the landing of cattle from scheduled countries, will cease to be deemed foreign cattle after complying with the following conditions:—

1. The vessel in which they are imported must not within three months have had on board any cattle from a scheduled country.

2. The vessel must not, since taking on board the cattle imported, have entered any port of a scheduled country.

3. The cattle must not, while on board, have been in contact with any cattle from a scheduled country.

But they are not allowed to land until the owner or charterer of the vessel or his agent has entered into a bond not exceeding 1000*l.*, to observe the above conditions, nor until the master of the vessel has made a declaration that none of the cattle exported have come from a scheduled country, and that the foregoing conditions have been observed.

## Section III.

*O. C.* 321.—The provision of the Order issued on the 9th March, 1871, prohibiting the landing of cattle coming from France, and sheep and goats coming with them, is still in force.

(Signed) Alexander Williams.

## APPENDIX.

*Regulations relating to the Landing and Inspection of Foreign Animals arriving at Ports in Great Britain, from and after the 31st day of March,* 1871.

### Marking.

Each kind of foreign animal landed at a landing-place for slaughter (with the exception of sheep and swine landed within a defined part of the port of London) shall be marked in the following manner, namely:—

*Cattle.*—By clipping the hair off the end of the tail, and by clipping a broad arrow, about 5 inches long, on the left quarter.

*Sheep and Goats.*—By clipping a broad arrow, about 4 inches long, on the forehead.

*Swine.*—By printing a broad arrow, about 3 inches long, on the left side, with the following composition, namely:—Resin, five parts; oil of turpentine, two parts; and red ochre, one part; melted, and used warm.

### Detention.

All foreign animals landed in Great Britain shall be detained for at least 12 hours after landing, except as hereinafter provided, in some lair or other proper place adjacent to the landing-place, for the purpose of being inspected by the Veterinary Inspector appointed by the Privy Council for that purpose; and every such Inspector shall have power to detain, for any longer period, any animal or animals which he has reason to suspect is or are affected with any contagious or infectious disease.

No animal, carcase, hide, meat, offal, provender, or manure shall be removed from the lairs, except with the permission of the Inspector.

### Inspection.

All foreign animals shall be inspected by the Veterinary Inspector appointed for that purpose; and such inspection shall commence as soon as possible after landing.

The final inspection of each animal shall not take place until the end of the 12 hours, except as hereinafter provided, nor except during daylight.

*Regulations relating to Contagious or Infectious Diseases amongst Foreign Animals landed at Ports in Great Britain.*

### 1. *Slaughter.*

Should one or more sheep or swine be found to be affected with any contagious or infectious disease (except cattle-plague), such sheep or swine shall be kept separate from those of the same cargo which have been passed as healthy. The slaughter of the healthy sheep or swine of such cargo may be permitted to take place immediately, and such slaughtering may, if desired by the importer or consignee, be continued without intermission.

The carcases of the healthy animals, so slaughtered, may be removed without a post-mortem examination, under the superintendence of the Inspector, or of the police, or of any officer appointed by the local authority in that behalf.

The slaughter of the diseased animals shall take place under the superintendence of the Inspector, who shall make a post-mortem examination of each carcase, and give instructions as to the disposal of it.

### 2. *Cleansing and Disinfection.*

When any animal suffering from any contagious or infectious disease has been landed at any port, or has been slaughtered at the landing-place in consequence of being so affected, the landing-place, lair, or other place where such animal has been, shall not be used for any other animals until such landing-place, lair, or other place has been properly cleansed and disinfected.

### 3. *Cattle-Plague.*

When cattle-plague has been detected in one or more of a cargo of animals, the whole of the animals forming such cargo shall be detained and slaughtered at the place of landing.

### 4. *Pleuro-Pneumonia.*

When pleuro-pneumonia has been detected in one or more of a cargo of animals, the whole of the cattle forming part of such cargo shall be subject to the following regulations, namely:—

When such cattle have been landed at any place other than within the defined part of a port, they shall be slaughtered at the landing-place, or if, at the port at which such cattle are landed, there is a part defined for slaughter, they may, with the permission of the Commissioners of Her Majesty's Customs, be removed into such defined part for the purpose of such slaughter.

When such cattle have been landed within a defined part of a port, or have been moved as above provided into such defined part, they shall not be moved therefrom alive, but shall be slaughtered within such defined part.

### 5. *Foot-and-Mouth Disease.*

When foot-and-mouth disease has been detected in one or more of a cargo of animals, the following regulations shall apply: Provided that such regulations shall be deemed to apply only to the class of animals amongst which the disease has been found to exist.

1. The cattle, if any, so affected shall be slaughtered at the landing-place.

2. The cattle, if any, not so affected shall either be slaughtered at the place of landing, or if, at the port at which they are landed, there is a part defined for slaughter, they may, with the permission of the Commissioners of Her Majesty's Customs, be removed into such defined part.

3. The cattle, when landed within a defined part of a port, or if moved, as above provided, into such defined part, shall be slaughtered within such defined part, subject, however, to any regulation affecting any port, in the defining order of which, special permission is granted to remove cattle out of such defined part.

4. The sheep, if any, so affected shall be slaughtered at the landing-place.

5. The sheep, if any, not so affected, shall either be slaughtered at the place of landing, or if, at the port at which they are landed, there is a part defined for slaughter, they may, with the permission of the Commissioners of Her Majesty's Customs, be removed into such defined part.

6. The sheep, when landed within a defined part of a port, or if moved, as above provided, into such defined part, shall not be removed therefrom alive, but shall be slaughtered within such defined part.

7. The swine, if any, so affected, shall be slaughtered at the landing-place.

8. The swine, if any, not so affected, shall either be slaughtered at the place of landing, or if, at the port at which they are landed, there is a part defined for slaughter, they may, with the permission of the Commissioners of Her Majesty's Customs, be removed into such defined part.

9. The swine, when landed within a defined part of a port, or if moved, as above provided, into such defined part, shall not be removed therefrom alive, but shall be slaughtered within such defined part.

### 6. *Sheep-Pox.*

When sheep-pox has been detected in one or more of a cargo of animals, the whole of the sheep forming any part of such cargo shall (subject to Regulation No. 1) be detained and slaughtered at the place of landing.

### 7. *Sheep-Scab.*

When sheep-scab has been detected in one or more of a cargo of animals, all the sheep forming any part of such cargo shall (subject to Regulation No. 1) be detained and slaughtered at the place of landing, or if, at the port at which they are landed, there is a part defined for slaughter, they may, with the permission of the Commissioners of Her Majesty's Customs, be removed into such defined part for the purpose of such slaughter. .

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## XXIV.—*Report of the Proceedings in Court in the case of Bradburn* v. *Royal Agricultural Society of England.* Before Mr. Baron Bramwell and a Special Jury. June 13th, 1871.

Mr. Morgan Lloyd opened the pleadings.

Mr. Henry James: May it please your Lordship—Gentlemen of the Jury.—This, as you have heard from my friend, is an action of libel, but I am happy to say that in consequence of the course which has been taken (and I venture to say most properly taken) on the part of the defendants, you will be only troubled for a very few minutes by having a short statement from my friend Sir John Karslake and myself.

The defendants on the Record are the Royal Agricultural Society of England, and the plaintiff, Mr. Bradburn, is a gentleman who for some years has carried on a very extensive business as a manufacturer of artificial manure at Wolverhampton. At the commencement of the year 1870 he had an application from a Mr. Whittingham—a person who had been an agent of his, but who had ceased to be his agent—to supply a certain quantity of manure called ground bones, at a somewhat low price, which he named. Mr. Bradburn replied in his letter (which has been published), that he could not supply that manure at that price without mixing with it an article called bone-waste, which is produced from the manufacture of phosphorus with bone-ash. The manure, so prepared, was sold upon the order of Mr. Whittingham, by whom it was resold to his landlord, Mr. Broughton, a gentleman residing near Nantwich, in Cheshire. That gentleman thought it right to have it analysed; and when it was submitted to Dr. Voelcker, the eminent analytical chemist, it was found not to be that which Mr. Whittingham had represented it to be—the highest class of manure. Under those circumstances, a statement was made to the Chemical Committee of the Royal Agricultural Society of England, an explanation took place, and Mr. Bradburn (the plaintiff), by means of a printed document, set forth most clearly and distinctly the circumstances under which he had sold the manure, and that he had invoiced it as bone and bone-waste, and had placed marks upon the bags showing that it was bone and bone-waste, and that therefore it was not the highest quality of manure. He placed the correspondence which had passed between himself and Mr. Broughton—who had purchased the manure from Mr. Whittingham—before the Council of the Royal Agricultural Society. I will say no more than that probably through some inadvertence, or possibly from a little over-zeal on the part of some gentleman connected with the Chemical Committee of the Society, after that full and detailed explanation had been given by Mr. Bradburn, in a journal which was published in the month of August last year, the statement was substantially repeated that a sale had taken place, by the plaintiff, of an inferior article which had been represented as a superior one. Mr. Bradburn having to live upon the good opinion of those who purchase from him, it became, of course, a serious matter to him that such a statement should be in the hands of his opponents in trade. It has injured him considerably in his business up to this time, and if the thing had been allowed by him to pass unnoticed it would probably have injured him still more. Under those circumstances it was absolutely necessary for him to bring this action. When the action was brought, a plea of justification was put upon the Record, alleging that the statements in the article were true. It must be obvious to every one who has had an opportunity of reading this correspondence, and who is aware of the circumstances that were brought to the notice of the Council before this article was published, that the statement contained in it could not be justified, and that, if it were taken to be true, it could only result in almost ruin to Mr. Bradburn. After consideration, my friends who have had an opportunity of consulting their clients, have taken a course which Mr. Bradburn feels he ought at once to acknowledge to be a right and kind course towards him. He has no wish or desire, in dealing with such a Society as the Royal Agricultural Society of England, to which he subscribes largely himself, and which can have no object but to do good to the agricultural interests of this country, to press litigation unduly against them; and the result is, that my friend, Sir John Karslake, will state the circumstances under which the Royal Agricultural Society of England have taken this course; and when you have heard that statement from him, the only thing that will remain for you to do will be to give such a verdict as will give Mr. Bradburn his costs.

Sir John Karslake: May it please your Lordship—Gentlemen of the Jury.—My friend, Mr. James, has truly stated to you that, as far as the Royal Agricultural Society are concerned in making this publication, there was not the slightest malice on their part. The circumstances have been shortly and accurately stated to you by my friend. Mr. Bradburn being a manufacturer of manures, Mr. Whittingham—a person who represented himself to be an agent of his—procured from him some manure, which he bought of him as bone and bone-waste, and which he (Mr. Whittingham) resold to Mr. Broughton as pure bone-dust. Mr. Broughton, as a Member of the Royal Agricultural Society—of which Mr. Bradburn is a Member,—knew that one of the great objects of the Society was to have manures analysed so that the agricultural interests should not suffer by having from time to time spurious instead of genuine manures given out to them, and they should not be disappointed by having crops come up of an inferior character. Mr. Broughton sent a specimen of this manure to Dr. Voelcker, the analytical chemist of the Society, and it was reported by him, that instead of being pure bone-dust it was bone-dust with an admixture of waste, and that under those circumstances a great deal of its value was lost. The report of Dr. Voelcker was laid before the Council of the Society, and at the time when it was originally laid before them and was published, and before any explanation was given by Mr. Bradburn, there was, no doubt, in the minds of the Council of the Royal Agricultural Society, a belief that Mr. Bradburn had through an agent—or, as it was supposed, by himself,—sold as bone-dust that which was really bone-dust and waste. After a considerable correspondence between Mr. Broughton and Mr. Bradburn, and after an explanation by Mr. Bradburn as to the part he had taken in the sale, it turned out that Mr. Whittingham, who had been his agent, and who might for some purposes be still deemed to be an agent for Mr. Bradburn, had been told with reference to this transaction that he was not to sell this as pure bone-dust, but as bone-dust and waste. The correspondence was afterwards laid before the Royal Agricultural Society, and they, taking the view that what was done by an agent was in fact done by the principal, in the month of August (when this work* is sent round to different members of the Society) published the report of Dr. Voelcker, in which it was stated that on analysing a sample of bone-dust that had been sent to him by Mr. Broughton, who bought it from Messrs. Bradburn and Co., through Mr. Whittingham, their agent, he found that it was not pure bone-dust, but bone-dust and waste. But, gentlemen, now that this matter has been sifted, and I have had the honour of seeing some of the Council of the Royal Agricultural Society, I may say that they are satisfied that the statement of which the

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* Holding up a copy of a number of this Journal.—Edit.

plaintiff complains, and which was made without any qualification at all in the August number of the Royal Agricultural Society's Gazette,* is a statement which, when read, might be deemed by many persons to impute to Mr. Bradburn that he had been himself active in the sale of that which, though represented to be bone-dust, was not pure bone-dust, but was an inferior article; and feeling as they do, after Mr. Bradburn's explanation, that he only intended to have it sold as bone-dust and bone-waste, they feel that they ought not still to adhere to the statement that has been made, and which they feel, if interpreted in that way, would be an unfair statement as against Mr. Bradburn.

Under those circumstances, I am quite willing, on behalf of the Council, to say that they feel they have gone too far in making this statement they have made, and therefore, under those circumstances, they feel that they ought to state so publicly, and allow a verdict for nominal damages to pass against them, it being understood that his Lordship shall give a certificate for costs; and so the matter will be ended. The Royal Agricultural Society of England have no interest in this matter, except that of doing good to the agricultural interests of this country. It is perfectly well known that it does sometimes happen that when people are led to believe they are getting valuable manure, an artificial of very inferior quality is palmed off upon them. This statement was published under the circumstances I have mentioned; and inasmuch as it imputes to Mr. Bradburn that which could not be justifiably imputed to him—he personally having had nothing to do with this sale—the Council feel that in justice to Mr. Bradburn the statement ought not to go uncontradicted by them in open Court; and on their behalf, I now admit that they were not justified in stating what they did in August in the 'Agricultural Gazette'† of that date.

Mr. Baron Bramwell: Gentlemen of the Jury.—Of course there can be no notion here that there has been any ill-will or any improper motive on the part of the defendants, who are far too respectable and too distinguished a body to be influenced by any such feelings. I think that the public ought to be very much obliged to them, and to others who do as they do. We have no public prosecutor whose business it is to protect us against frauds and adulterations, and therefore we ought to feel very grateful to the Society for what they do; but, as Sir John

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* Referring to the Society's Journal.—Edit.

† 'The Journal of the Royal Agricultural Society of England.'—Edit.

Karslake has said, let them be as distinguished and as useful as may be, as soon as they find they have done a man a wrong they ought to come forward and say so, and that they have done. You will therefore give a nominal verdict for the plaintiff in this case, and I will give the necessary certificate for costs.

Mr. HENRY JAMES: It is a special jury.

Mr. BARON BRAMWELL: Forty shillings.

Mr. HENRY JAMES: Five guineas, it is a special jury.

Mr. BARON BRAMWELL: Then it will be a verdict for five guineas.

The Jury returned a verdict accordingly.

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## XXV.—*Report on the Trials of Implements at Wolverhampton and Stafford.* By Lieutenant-Colonel FULLER MAITLAND WILSON, Senior Steward.

THE trials of 1871 have been in some respects the most important that the Society has ever undertaken, inasmuch as they have been extended to a greater length of time and over a larger area of land than on any former occasion, and have been marked by the new feature of a most searching trial of Traction-Engines. The additional time did not prove to be more than was necessary to enable the Judges to give in their awards before the commencement of the Show, and the thanks of the Society are due to those gentlemen for the care and patience with which they performed their arduous duties.

Provision having been made by the Council for a full report of the trials being prepared for the 'Journal,' there remains little for the Stewards to add but a few general remarks as to the circumstances under which they were carried out.

In compliance with a resolution passed by the Council, that one of the Stewards should attend at Wolverhampton on the Friday previous to the commencement of the trials, the Steward-Elect attended on that day; and on the following day, in concert with Mr. Anderson, one of the Consulting Engineers, he measured and marked out some of the trial-fields, in order to enable the Judges to commence on Monday. On their arrival, however, they were of opinion that a different arrangement of plots would be more satisfactory to them, so that the labour of the Steward and Engineer was of no service. It appears desirable that on future occasions there should be some previous consultation between the Stewards and Judges as to the system on which the trials shall be carried out, suggestions for which have been entered in the Steward's Book.

We found at Wolverhampton a letter from the Secretary, stating that he had failed in obtaining a third Engineer Judge, though he had applied to all who had been nominated by the Council: and a telegram from Mr. Kay, that his medical adviser would not allow him to attend. The number was thus reduced from three engineers and six other Judges to two engineers and five others. Under these circumstances, we were glad to avail ourselves of the services of Mr. James Easton, one of the Consulting Engineers, who was associated with Mr. Bramwell in the testing and trials of the Traction-Engines, which occupied their entire time from Monday, June 26th, till the evening of Friday, July 7th. In the run of these engines over the course provided for them, two other Judges were attached to the engineers; and from the skill and practical knowledge brought to bear on them, the Report cannot fail to be satisfactory to the public, as showing how far they are, and how far they are not, applicable to the various purposes of farm and road for which their advocates give them credit.

The weather, previous to the commencement of the trials had been very wet, and was of the same character during their whole continuance, making the Show-yard, which was naturally soft, in many places almost impassable. The trial-fields at Barnhurst were light, stony land, and would not have afforded any satisfactory results as to steam cultivation without the additional land which had been provided near Stafford, which, though not so light as that at Barnhurst, could not be called really heavy. The removal of so much tackle to a second trial-ground, 16 miles distant, was attended with some expense and inconvenience; that it was satisfactorily accomplished was owing, in a great measure, to the valuable assistance rendered by Messrs. Fowler and Co., and Messrs. Aveling and Porter, who were ready on this and on all other occasions to place their engines at the disposal of the Society.

The trials at Stafford commenced on Tuesday, July 4th, under very unfavourable weather, and were concluded on the morning of Thursday the 6th, on which day, as it was understood that several members of the Society and of both Houses of Parliament intended to visit the trial fields, the Stewards arranged that the traction-engines should leave Wolverhampton at 5 A.M., bound for the railway station at Stafford, about 15 miles distant, each engine being loaded in the proportion of $1\frac{1}{2}$ ton to its nominal horse power; thus a 10-horse engine drew a load of 15 tons. The train was accompanied by a staff of engineers, under Messrs. Bramwell and Easton, who took their passage on board the "Chenab," which had recently been built by Messrs. Ransome for the Indian Government steam-train service, and was kindly placed at their disposal by Mr. Crompton, of the Rifle Brigade. All the engines arrived safely at their destination, and were paraded in front of the railway station at Stafford before the arrival of the 12 o'clock London train. As a Committee of the House of Lords was then considering the question of legislation with regard to traction-engines, it was hoped that this exhibition of them might furnish some information which might be valuable.

At 2 P.M. on the same afternoon, Messrs. Fowler's double set of 20-horse engines was set to work, and was followed in succession by all the sets of tackle that had been in competition; thus enabling the public to see all the different systems at work, and to form their own opinion as to their various merits. The difficulty of keeping so many engines supplied with water was well provided for by Mr. Elphick, who had each set ready to commence work in its turn without loss of time.

The Stewards felt it their duty to report to the Council that one of the engines used in Class 2 proved to be considerably over the limited weight (10 tons). They regretted that the heads of the firm were not able to attend the trial, and they are willing to believe that this might have been an oversight on the part of their representative, but it is clearly as imperative on exhibitors of implements to take care that their implements conform to the regulations, and agree with the description in the catalogue, as it is on the exhibitors of live stock.

In this Class there was a doubt whether it was the intention of the Council that a detached windlass should be included in the weight of the engine. The wording, however, of No. 1 paragraph in the conditions appeared to give the Stewards no option but to include it.

In Class 3 objection was raised to the entries of Messrs. Hayes and Fisken, on the ground that one required to apply a pulley, and the other a groove fly-wheel to the "ordinary agricultural engine" before they could be worked by it. Though perhaps in strictness they might have been disqualified, they were allotted their trial-plot with the others.

Amongst the Miscellaneous Articles the Judges found nothing that they considered worthy of a Silver Medal; but they awarded one to the principle of the revolving mould-board, as applied to the plough entered for cultivating hop-gardens, though they did not consider the implement itself at present suitable for that purpose.

*Stowlangloft Hall, Bury St. Edmunds,*
*August 1st,* 1871.

## XXVI.—*Report on the Trials of Steam-Cultivating Machinery at Wolverhampton.* By John Algernon Clarke.

In visiting the veritable "Black Country," with its scenery of chimney-shafts, furnaces, and metalliferous works, its innumerable engines, huge mining machinery, and intersecting network of canals and railways, the agriculturist may well have considered how largely the industry and riches of this nation are dependent upon the cheap unfailing energy of steam. He may have reflected that in less than fifty years since the opening of the first passenger railroad, we have now in Great Britain some ten thousand locomotives, running over thirteen thousand miles of iron way; while, probably, two hundred thousand steam-engines are driving the mechanism of our mills, workshops, mines, and factories—to say nothing of the great number of these motive-powers afloat, whether for inland, coasting, or ocean navigation. And from the estimate that about fourteen thousand threshing or barn engines are now at work in this country, barely thirty years since the Tuxfords of Boston constructed the earliest farm "portable" and the Ransomes of Ipswich made the first "traction-engine," he may look forward to a like rapid multiplication of tilling-engines, and of engines for draught upon ordinary roads. Already the sets of steam-cultivating apparatus in use in England number many hundreds. And while the Steam-Plough Works at Leeds, the Britannia Works at Bedford, and other works besides, are continuing to open up a great trade with occupiers who are adopting steam husbandry, such an impetus has been given to the hiring system by the success of double-engine machinery, self-transporting from place to place, that several contract men have now their half-dozen sets apiece, many have their two, three, or four sets; and one company, with a capital of 42,000*l.*, working in Northumberland and in parts of the counties adjacent, finds employment for no less than twenty double-engine sets, with which it accomplishes in one year the heavy and light tillage of about 60,000 acres of land. When it is known also that, in some districts of the kingdom, farmers now give the preference to contract-threshing men, who bring and take away both engine and machine without any demand upon the farm teams, just as they formerly patronized those of the contract men who provided the labour-saving straw-elevator; and when it is known that hauling work, in conveying timber, building materials, coal, agricultural produce, and heavy loads of all kinds, is being done on a considerable scale by engines traversing field-roads and highways, it is clear that the Royal Agricultural Society was fully justified in devoting the main business of one of its annual trials to a competition of farm-locomotives and steam-cultivating machinery. The money prizes offered by the Society amounted to 605*l.*, to which Lord Vernon, the President, added a magnificent cup, value 100*l.* making the total value of the prizes of this section 705*l.* Prizes amounting to 50*l.* were offered in Section II. for hop machinery; and, in addition, ten silver medals were, as usual, placed at the disposal of the Judges for miscellaneous awards to agricultural articles, for new principles of construction and essential improvements therein. The following is the Schedule of Prizes:—

"SECTION I.—*Steam-Cultivation.*

| | | |
|---|---|---|
| "CLASS 1.—For the best combination of Machinery for the cultivation of the soil by Steam-power .. .. | 1st Prize | £100 |
| | 2nd Prize | 50 |
| "CLASS 2.—For the best combination of Machinery for the cultivation of the soil by Steam-power, the weight of the Steam-engine not to exceed 10 tons .. | 1st Prize | 50 |
| | 2nd Prize | 25 |
| "CLASS 3.—For the best combination of Machinery for the cultivation of the soil by an ordinary Agricultural Engine, whether self-propelling or portable .. .. | 1st Prize | 50 |
| | 2nd Prize | 25 |
| "CLASS 4.—For the best Windlass, detached .. .. .. .. .. | | 20 |
| „ 5.—For the best Snatch-block, or substitute thereof .. .. | | 10 |
| „ 6.—For the best Plough, suitable for steam-cultivation .. | | 25 |
| „ 7.—For the best Subsoiler Ditto ditto .. | | 20 |
| „ 8.—For the best Digger Ditto ditto .. | | 25 |
| „ 9.—For the best Cultivator Ditto ditto .. | | 25 |
| „ 10.—For the best Skim-Plough or Scarifier ditto .. | | 20 |
| „ 11.—For the best Roller Ditto ditto .. | | 10 |
| „ 12.—For the best Harrow Ditto ditto .. | | 10 |
| „ 13.—For the best Drill Ditto ditto .. | | 20 |
| „ 14.—For the best Root or Stone Extractor ditto .. | | 10 |
| „ 15.—For the best combination of any of the above Implements not qualified to compete in Classes 1, 2, or 3 .. | | 20 |
| „ 16.—For the best Implement, or part of Tackle, suitable for steam-cultivation, of any other description, not qualified to compete in the preceding classes .. .. .. | | 20 |
| „ 17.—For the best Agricultural Locomotive Engine applicable to the ordinary requirements of farming .. .. .. | | 50 |
| „ 18.—For the best Waggon for Agricultural purposes to be drawn by an Agricultural Locomotive Engine .. .. | | 20 |

"A SILVER CUP, value 100*l.*, offered by the Right Hon. Lord Vernon, President, will be given for the best combination of Machinery for the cultivation of the soil by Steam-power, the cost of which shall not exceed 700*l.* The Engine to be Locomotive, and adapted for Threshing and other Farm purposes.

"SECTION II.—*Hop Machinery.*

| | |
|---|---|
| CLASS 1.—For the best Machine for the cultivation of Hop Gardens, to supersede manual labour .. .. .. .. .. .. | £20 |
| CLASS 2.—For the best Machine for washing the Hop Plant to remove the aphis blight .. .. .. .. .. .. .. .. .. .. | 10 |

CLASS 3.—For the best Hop-presser .. .. .. .. .. .. .. .. £10
CLASS 4.—For any other improved Implement or Implements used in the cultivation or management of Hops .. .. .. .. .. 10

"MISCELLANEOUS AWARDS to Agricultural Articles and essential improvements therein .. .. .. .. .. .. .. .. 10 Silver Medals."

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In the Classes for which one prize only was offered, the Judges were empowered to divide it equally between two competing Implements, if they considered them equal in merit.

These offers were accompanied by the following

"CONDITIONS.

"*Steam Engines.—All Engines* must be fitted with a Steam Indicator, in addition to the ordinary Spring Balance, which Indicator must be proved by the Indicator of the Society.

"*Steam Cultivation*:—1. The weight of the Engine shall be deemed to be exclusive of coal, water, and rope, but to include the weight of the drum or windlass.

"2. The Implements for Steam Cultivation must be tested by dynamometer, if possible, and such experiments made as will enable the Judges to ascertain the relative value in usefulness of such Implements.

"3. The Steam Boiler must be provided with a pipe or tube, the thread of which mustbe equal to the 'half-inch gas-pipe thread,' for the purpose of attaching the forcing-pump of the Society. The Exhibitor may declare to work the Engine at any pressure he thinks fit, if the Judges are satisfied the Boiler would bear safely three times that pressure. The Boiler shall then be tested by the forcing-pump to twice the pressure before the Engine is set to work, and the declared pressure must not be exceeded by the Exhibitor while he is working before the Judges.

"4. Any Engine which is entered for competition, or for working in the yard of 'Machinery-in-motion,' which, from defect in construction, or any other cause, is, in the opinion of the Judges and Consulting Engineer, *unsafe*, shall not be allowed to work on the Society's premises; and further, the word *unsafe* shall be attached to the Engine during the remainder of the Exhibition.

"5. The trials of the Steam-Engines will be made with Llangennech coal."

It will be useful here to transcribe the following clauses of the *General Regulations* which related to the trials:—

"The Specification must state the selling price of each article *complete* and in good working order; and each Exhibitor will be bound to execute all orders given to him in the Show-yard, at the price stated in this Specification, and to deliver the Implements within six months of the close of the Show, on pain, in case of failure in such engagement, of not being again allowed to exhibit at the meetings of the Society.

"In order to ensure a *bonâ fide* selling price being specified for competing Machinery, it shall be a condition that, if the price certified by the Exhibitors shall in the opinion of the Engineer Judge, or Judges, together with the Consulting Engineer of the Society, be stated so manifestly low, that the Exhibitor cannot consistently supply at such price, the Judges shall have power to decline to try such machinery.

"Manufacturers of all Entries for the Prize offered by Lord Vernon, must enter into a contract with the Society to execute all orders (received by them within a period of three months from the close of the Show), at the price stated in their specification, and that the machinery supplied shall be in all respects the same as that entered to compete for the prize."

On the 31st of May, Messrs. Eastons, Amos, and Anderson, the Society's Consulting Engineers, issued, for the guidance of exhibitors, the following

"General Instructions.

"1. There will be no restrictions on the construction of the Steam Engines or Boilers, nor any limits to the pressure of steam used, subject always to Clause 3 of the General Conditions.

"2. Each Boiler must be provided with at least two safety-valves, two sets of gauges for ascertaining the water level, a steam-pressure gauge, and a half-inch cock, terminating in a half-inch male gas thread for the purpose of receiving the pipe of the Society's testing-pump.

"3. Each Boiler will be subjected to a hydraulic test of double the pressure at which it is intended to work, and the Exhibitors must be prepared to produce working drawings of the Boilers, to illustrate the construction of any inaccessible part, or to enable the Engineers, in case of doubt, to satisfy themselves of the safety of the Boilers by calculation.

"4. Each Engine will have to be taken to pieces, to enable the Judges to examine all its working parts, and the Exhibitors are required to provide the necessary tools and tackle for the purpose.

"5. The merits of the Machinery in Classes I., II., III., and Lord Vernon's prize, will be determined by the weight of earth moved per hour, the depth of cultivation, the goodness of design and workmanship, the economy of fuel, water, oil, attendance, and the price of the apparatus. Indicator diagrams will be taken from the cylinders during the trials.

"6. All the Machines in Class III. will be tried by one and the same ordinary portable Engine, which the Society assume the right to hire from any of the Exhibitors, at a charge not exceeding 1*l*. per day, and such Engine will be driven during the trials by a driver appointed by the Society's Engineers.

"7. The Implements and Machines in Classes IV. to XVI., both included, will be tested by the Ploughing Engines entered for trial, the Society assuming the right to select such as it may require, on payment of a sum not exceeding 3*l*. per day, including the necessary stores and attendance. The merits of the implements will be determined with reference to the weight of land moved per hour, the depth of cultivation, quality of design and workmanship, economy of attendance, and price. The traction dynamometers will not be used, except att he discretion of the Judges, to assist in deciding between implements of very equal merit. Classes IV. and V. will not be tested in any way, but will be judged with reference to design, workmanship, and price.

"8. The nature of the tests and trials to be applied to Classes XV. and XVI. will be decided by the Judges, on inspection of the machinery brought for exhibition.

"9. The trials of Class XVII. will be of two kinds—firstly, for the purpose of ascertaining the merits of the Engines for ordinary farm purposes; and, secondly, for determining their efficiency as Traction-Engines. In the first series, the usual break dynamometer will be employed, and the merits of the Engines will be decided with reference to the power developed, the economy of coal, water, oil, the price and merits of design, and workmanship. There will be no restriction as to the power to be developed on the break, but each Exhibitor must specify the pressure of steam, number of revolutions, and horse-power on the break at which he wishes his Engine to be tested. Indicator diagrams will be taken during the trials on the break. The second series will be conducted over a course of some four of five miles in length, and selected with the view to the greatest possible variety of surface, such as hard road, fields, level and hilly, wet and dry. A train, composed of waggons, to be procured by the Society, will be made up, and loaded in any manner and to any extent the Exhibitor may determine. He will then state the quantity of coal and water he will require to take the load so prepared once round the course, and the quantity he asks for will be placed on board his Engine, no further supply being permitted during the run. Any fuel or water remaining after the trial will be weighed or measured back. To assist the Exhibitors in estimating the work to be done, a longitudinal section of the course will be prepared, and care will be taken to keep the average condition of it as nearly as possible the same for all the competing Engines. The figure of merit will depend upon the load drawn, the economy in fuel, water, oil, and attendance, price, and goodness of design and workmanship. The distribution of weight upon the wheels will also be ascertained.

"10. The accompanying sheet, marked Form A, of Lithographs and Instructions, will explain the means which will be adopted, and the preparations the Exhibitors will have to make for taking indicator diagrams, measuring the water and oil, weighing the ashes, placing the Engines with reference to the break dynamometer, and adapting them to connect to it.

"11. The Waggons in Class XVIII. will be tested by means of traction dynamometers. Each Exhibitor will be permitted to determine the load which his waggon is to carry, and the figure of merit will depend on the load, the tractive power required, the merit of design and workmanship, and the price."

It is not necessary to reprint here the sheet of drawings upon Form A referred to. Fig. 1 showed the details and measurements for affixing the steam indicator; Fig. 2 was a section of the measuring tank to hold thirty gallons; Fig. 3 was a section of the Society's new break dynamometer, fitted with three friction-pulleys, and driven by a coupling shaft with universal joints instead of by belt as heretofore; and Fig. 4 was an enlarged view, with dimensions of the clutch which each exhibitor would have to provide and key upon the crank-shaft of his engine. The letterpress of Form A will illustrate the care taken to be clear and definite in the

"Instructions to Exhibitors.

"*Indicator Diagrams.*—The Indicators used will be supplied by the Society, and will be those known as Richards's, manufactured by Messrs. Elliott, Bros., 449, Strand, London. The accompanying Illustration, Fig. 1, gives the principal dimensions. The Indicator must be fixed as nearly as possible midway between the two ends of the cylinder, and connected to them by ½-inch pipes well lagged and provided with cocks fitted with convenient handles, placed as near the cylinder ends as practicable. The motion of the paper cylinder must coincide with that of the piston, and be exactly proportional to it; it will not therefore answer to work it from one of the slide-valve spindles or eccentric rods, but the motion of the piston itself must be reduced by levers, speed-pulleys, or other means. If the Engine has more than one cylinder, each one must be prepared to receive an Indicator. The Exhibitor must provide the cocks, pipes, and means of communicating motion to the paper cylinder of the Indicator.

"*Measurement of Feed Water.*—Figure 2 in the annexed Drawing represents the measuring vessel which will be provided by the Society. Each Engine must be adapted to receive such a vessel, and it must be fixed in some convenient position, so that the 1½-inch cock *A* may discharge either direct into the filling hopper of the tank or into a temporary funnel fitted up for the purpose, the bib of the cock being left visible, so that it may be known at once when all the water has run out. The water tanks of the Engines must be fitted with cocks by which all the water in them may readily be drawn off into a measuring vessel, similar to the one represented in Fig. 2.

"*Measurement of the Ashes.*—In order to ascertain as accurately as possible the weight of fuel used, means must be provided for readily raking out the fires without first slaking them with water, and transferring the hot ashes to air-tight vessels, which will be provided by the Society, in which the unconsumed fuel will at once be weighed.

"*Measurement of Oil and Tallow.*—Previous to the commencement of each trial, and after the Exhibitor has filled all his lubricators, all his oil and tallow will be taken from him. He will then receive a can containing a certain weight of lard-oil, and a box containing a certain weight of tallow for use during the trial. At the conclusion he will again fill up his lubricators, and then return the oil and tallow unconsumed, which being weighed again, the exact amount used will be ascertained.

"*Dynamometers.*—Fig. 3 represents the Break Dynamometers to be used in ascertaining the power of the Steam Engines, and gives the dimensions necessary for placing the Engines to be tried with reference to the rails laid down for the break to travel on. Each Exhibitor will have to provide and key on to his crank-shaft a coupling shown in detail in Fig. 4, and bore out the holes *A A*, and face the inner sides of the jaws *B B*, to gauges to be supplied by the Society. The Engines at the trials must be run so that the breaks shall revolve in the direction of the arrow.

"*Examination.*—Each Engine must be fully provided with screw keys, and all tools necessary for taking its working parts to pieces for the purpose of examination.

"EASTONS, AMOS, AND ANDERSON,
"The Grove, Southwark Street, London, S.E.,
"Consulting Engineers."

In addition, a plan of the course proposed for the traction-engines, together with a section showing all the gradients, was furnished to each exhibitor in Class XVII.

On the morning of Monday, June 26th, the opening day of the trials, the Stewards, namely, Lieut.-Colonel F. M. Wilson, Mr. W. J. Edmonds, and Mr. Thomas C. Booth (Mr. C. Wren Hoskyns, M.P., being absent through sudden domestic affliction), and the Honorary Director, Mr. Brandreth Gibbs, proceeded to arrange with the Judges and the Consulting Engineers the order of the fortnight's yard and field operations. Of ten Judges invited to award the Society's prizes, seven answered to the roll-call. Mr. Richard Kay, of Forcett Valley Farm, Darlington, was prevented by illness, while the two gentlemen appointed to the Hop-machinery and Miscellaneous Department were not due till the following week. The duties of adjudication were allotted thus:—Mr. F. J. Bramwell, C.E., of 37, Great George Street, London, S.W., and Mr. James Easton, jun., C.E., of the Grove, Southwark Street, London, S.E., undertook Classes XVII. and XVIII., that is, the Farm Locomotives and Traction-engine Waggons, to be assisted in the field-experiments by the Agricultural Judges. Mr. W. Menelaus, C.E., of Dowlais, Merthyr Tydvil, Major H. V. Grantham, of West Keal Hall, Spilsby, Lincolnshire, Mr. John Hemsley, of Shelton, Newark, Nottinghamshire, and Mr. F. Sherborn, of Bedfont, Hounslow, Middlesex, took the sets of Steam-cultivating Machinery in Classes I., II., III., and in the competition for Lord Vernon's cup. Mr. John Hicken, of Dunchurch, Rugby, and Mr. J. W. Kimber, of Tubney Warren, Abingdon, Berkshire, took the Implements and parts of Apparatus in Classes IV. to XVI. But this division of labour and responsibility was by no means rigidly adhered to throughout the trials. The Judges of the four Classes of Hop-machinery and of the Miscellaneous Department were Mr. H. B. Caldwell, of Monkton Farleigh, Bradford-on-Avon, Wiltshire, and Mr. C. Whitehead, of Barming House, Maidstone, Kent. It soon appeared that, by help of the admirable preparations made by the Stewards and the active members of the Local Committee, and under the skilful organization, untiring superintendence, and zealous assiduity of Mr. Anderson as Consulting Engineer in the field, and of Mr. James Easton in the trial-yard, aided by Mr. Rich and a staff of assistant-engineers, with Mr

Elphick as ever-ready and business-like assistant-steward, the Judges would encounter little difficulty, in their prolonged series of investigations, beyond the delays and mishaps which are inseparable from such public field-days. And in fact, apart from the failures in competing machinery and hindrances traceable to Exhibitors and their men, the principal interruptions and impediments to progress arose from the unsettled state of the weather, the weakness of Wolverhampton horse-flesh, and a miscalculation as to the service adequate for maintaining the water-supply to the engines at work in the different trial-fields. On a future occasion this latter cause of delay will probably be obviated by substituting a steam-pump and gas-piping for the slow and irregular relays of water-carts. Owing to the heavy rains, the task of hauling the ponderous pieces of machinery into and out of a show-ground of black vegetable soil, which was, in parts, ploughed up by innumerable wheels till trucks and trolleys sank in to the axles, and of transporting them to the trial-fields, 2½ miles away, may be said to have been superhuman. At least it was beyond all bestial power; and one of the great incidents of the meeting was undoubtedly the unlooked-for demonstration of the capability of road locomotives and self-propelling engines to convey themselves with trains of waggons and other rolling stock over wet roads, yielding soil, up hills, along narrow winding lanes, and through awkward gateways. The public also took many a lesson in the art of getting a bite for engine-wheels by means of gravel and cinders on a hard road, spuds or shoes on the tires upon soft soil, and beams and planks when the weighty motive-power has cut its way down into a hole. As it was, bystanders had many a laugh over the many apparently inextricable but always triumphantly surmounted difficulties of the strong-hearted iron giants; and it was remarked how "Talpa" might fairly claim a royalty on many of those engines, converted by force of circumstances into slowly progressing locomotives, armed with revolving diggers.

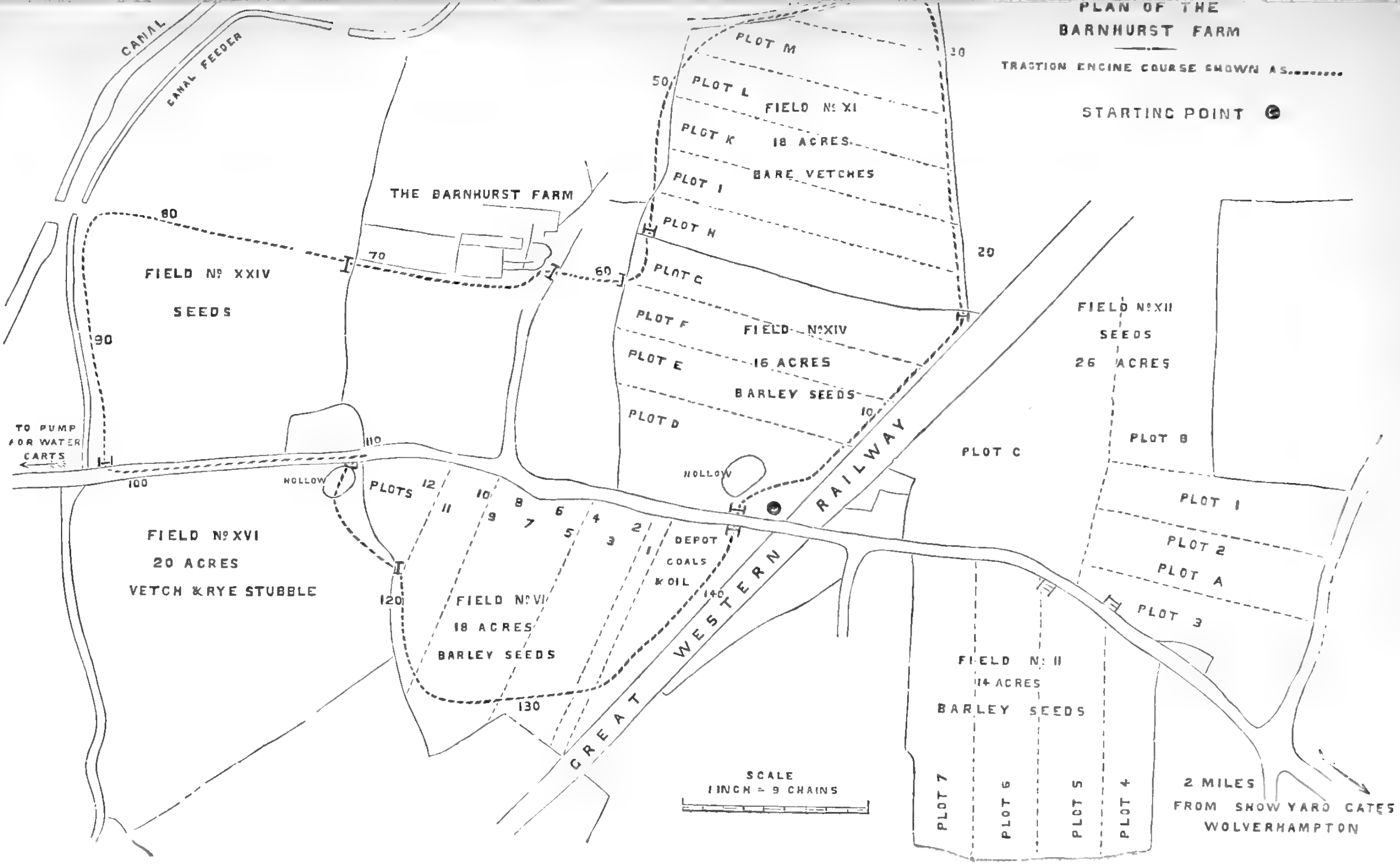
From the Schedule of Prizes, the Conditions, the General Regulations, Instructions to Judges, and Instructions to Exhibitors (as already quoted), it was clear that the trial of steam-cultivating machinery at Wolverhampton was designed to be not so much a competitive test of steam-tillage against horse-tillage as of one set of steam-tilling apparatus against another. Indeed, there appeared little value in going over the old ground again, merely to show for the hundredth time that steam-power can plough or cultivate with greater economy and far greater expedition than any force of teams that can be found upon a farm. At the very earliest of the Society's trials of steam-ploughs, namely, at Chelmsford and Boxted Lodge, in 1856, the Judges arrived at the result, that by Mr. John Fowler's machine "the ploughing was admirably done, fully equal in regularity and precision to anything that could be done by horse-labour. To estimate the cost of the operation was a work of great care and time; and Mr. Amos has given the result in the table which is subjoined. By this table the money cost of ploughing is shown to be 7*s.* 2½*d.* per acre. The Judges are of opinion that the cost of the like work by horse-power would be at least 7*s.* per acre, leaving the cost of the two processes almost identical." Mr. Amos had allowed, however, only 15 per cent. upon prime cost of machinery for repairs, depreciation, and interest of capital, and assumed as a basis of calculation 1000 acres to be ploughed annually. At Chester, in 1868, the Judges allowed 15 per cent. upon first cost for repairs and depreciation, together with 5 per cent. interest of capital, making 20 per cent. spread over 200 days' working in a year. They reported that Fowler's apparatus ploughed light land at the rate of 7¾ acres in ten hours, and heavy land at the rate of 5 acres in ten hours; the total cost being in the first case 6*s.*, and in the latter 9*s.* 2*d.* per acre. "Our estimate," they said, "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 for less than

12*s.* 6*d.* per acre; and that the deep trenching could not have been done by horse-power at all." In the same trials the Woolston implements exhibited by Messrs. Howard cultivated heavy land twice over, at the rate of 3½ acres in ten hours, for a total cost of 12*s.* 9*d.* 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." The Judges concluded that the prize-machine was "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." At the Canterbury trials in 1860, the Judges went very fully and elaborately into the economical comparison between steam and horse power. "Throughout the whole of the trials," they reported, "the quality of the work done was very satisfactory. This point, however, we look upon as secondary to the more important question of the application of steam-power to the cultivation of the soil; as when we are in possession of a well-arranged system of steam-power, we can make use of any form of implement we please to act upon the soil." On a strong loam, with an indurated gravelly subsoil, the land in some places strongly held together by "indigenous herbage," Messrs. Fowler's machine ploughed at the rate of 11 acres in ten hours, at a total cost of 4*s.* 6*d.* per acre, allowing 15 per cent. upon first outlay for repairs and depreciation, and 5 per cent. for interest, and assuming 200 days' work to be done in a year; and Messrs. Robey and Co.'s machine ploughed at the rate of 5¾ acres in ten hours, at a total cost of 6*s.* 8*d.* per acre. The average draught of a good horse-plough turning similar furrows in the same parts of the field was found by dynamometer to be 6 cwts. Then, according to the valuable tabulated calculations of Mr. J. C. Morton, the Judges say, "the average cost of horse-power on a farm may be taken at 6*d.* per cwt. drawn 2½ miles. In ploughing an acre of land with a 10-inch furrow, the plough has to be drawn about 10 miles; consequently the draught, 6 cwts. × by the distance 4, × by the cost per cwt., 6*d.*, gives 12*s.* per acre as the *minimum* cost of ploughing an acre of the land in question by horse-labour; which, indeed, was the estimate given by practical farmers on the ground during the trials. The comparison, then, between steam and horse ploughing is largely in favour of the former on ground offering such resistance. The least efficient of the competing machines (Beard's) showed a saving of 1*s.* 10*d.* per acre, or 15 per cent; Robey and Co.'s and Eddington's showed a saving of 5*s.* 4*d.* per acre, or 45 per cent.; while Fowler's work was done at a saving of no less than 7*s.* 6*d.* per acre, or 68 per cent. less than by horse labour." Now that we are by no means afraid of a field-engine working up to 180 lbs. or 200 lbs. pressure, it is worth noting, that in the Canterbury Report, the Judges recorded the pressure of Robey and Co.'s steam as 50 lbs. on the square inch, and reckoned the effective power of the engine at 28 horses; and reported that Messrs. Fowler's double cylinders of 7½ inches diameter, with 12-inch stroke, worked at a pressure of 68 lbs., giving off at 140 revolutions per minute 35⅓-horse power, after allowing three-tenths for friction. Inventors had increased their power at the Worcester meeting in 1863: the pressure in Mr. Savory's and Messrs. Fowler's engine running up to 100 or 105 lbs.; and at Newcastle, next year, the Judges recorded with reprehension that, in both Messrs. Fowler's and Messrs. Howard's engines the pressure of steam ranged between 105 and 115 lbs. Among the greatest performances at Leeds, in 1861, Messrs. Howard's 10-horse engine cultivated a strong and stubborn soil, 5 to 6 inches deep, at the rate of 6¾ acres in ten hours, at a computed cost of 6*s.* 8*d.* per acre. Messrs. Fowler's 12-horse engine cultivated the same soil, 7 inches deep, at the rate of 6¼ acres in ten hours, at a total cost of 7*s.* 2*d.* per acre. In land where the ploughing of a single furrow

8 inches deep took a draught equivalent to the tractive power of five horses, the same engine ploughed at that depth at the rate of 5¾ acres in ten hours, for a total cost of 7*s.* 10*d.* per acre. It was considered that the cost by horses would have been double. No such comparison was instituted at Worcester in 1863; and complete as were the trials at Newcastle-on-Tyne in 1864, and again at Leicester in 1868, the effectiveness of the work done was tested, not by any measurement of the draught of the implements, but by inspection and by weighing the amount of earth moved per acre, the Judges entering into no calculation of the relative cost by horses.

In the Wolverhampton trials, therefore, it appeared to the Judges that the extraordinary economy in cost of steam as compared with horse-tillage might be taken for granted as already thoroughly proved and well known; and as for founding an estimate of total cost per acre upon an experiment of one or two hours' duration, it was desirable that a practical result should be obtained by some more exact method than roughly approximating to the weight of coal burned, valuing the highly skilled labour at ordinary farm-wages, and reckoning the performance per day from the high-pressure celerity of execution kept up through the spurt of a short race. Indeed, the number of competing sets of powerful machinery, each with its several different kinds of tillage to be shown in operation, and executing perhaps at the rate of three or more acres per hour, added to the necessary grouping of the machines into four separate classes involving repetitions of performance, forbade anything more extended than short runs upon plots of a few acres apiece, notwithstanding that the Society had provided 140 acres of light land near Wolverhampton and 60 acres of heavy land near Stafford for the purpose of giving full play to the operations. The steam-cultivator trials of 1871 naturally resolved themselves into public exhibitions of the several systems in work, the consideration of the Judges being mainly devoted to the quality of the tillage performed, to the rapidity and cheapness of execution as made apparent by the labour engaged, to the engineering tests of power exerted, and to the obvious mechanical merits and capabilities of the machinery.

The Barnhurst Farm in the occupation of Mr. Taylor, forming part of the estate on which the Wolverhampton sewage is being utilized, is situated two miles north-west from the Show-yard gates, and approached by narrow uphill and downhill lanes after leaving the Tettenhall turnpike-road; and here as much of the steam-cultivating apparatus as had arrived at the Wolverhampton railway-stations and been transported up country, was found on Monday, June 26th, in the depôt-field, No. VI. (see Plan, p. 481), where stores for coal and oil had been provided; and the engineers had dammed a stream and erected a pump for supplying the water-carts at rather more than a quarter of a mile from this central point. As appears from the plan, the seven fields made use of range from 14 to 26 acres in area, some of them of an awkward shape for partition into rectangular plots; the fences are mainly of quick, planted upon high banks, and the surface presents only gentle undulations, no part lying in high-backed ridge and furrow. The crops were principally clover and seeds and part vetches. The old seeds had been closely grazed, the young seeds and vetches mown green and carted off, and the land for the most part may be described as a sandy loam containing gravel upon a sandy subsoil, which in many places presented beds of big sandstone and other boulders severely trying to the deep-working implements. The principal portion of the depôt field No. VI., 18 acres of barley-seeds, was divided into plots of about one acre each, upon which the several competitors might make their "preliminary canter" and arrange their machinery in good working order; the soil, a light sand loam of considerable depth, and in a moist, free-working condition, being well suited for the purpose. On Plot 1, Messrs. Amies, Barford, and Co., of Peterborough, did some good cultivating, ploughing, and digging, with their round-


PLAN OF THE
BARNHURST FARM
TRACTION ENGINE COURSE SHOWN AS
STARTING POINT
CANAL
CANAL FEEDER
THE BARNHURST FARM
FIELD No. XXIV
SEEDS
FIELD No. XVI
20 ACRES
VETCH & RYE STUBBLE
TO PUMP FOR WATER CARTS
HOLLOW
PLOTS
FIELD No. VI
18 ACRES
BARLEY SEEDS
DEPOT
COALS
& OIL
PLOT M
PLOT L
FIELD No. XI
PLOT K
18 ACRES
PLOT I
BARE VETCHES
PLOT H
PLOT C
PLOT F
FIELD No. XIV
PLOT E
16 ACRES
BARLEY SEEDS
PLOT D
HOLLOW
GREAT WESTERN RAILWAY
FIELD No. XII
SEEDS
26 ACRES
PLOT B
PLOT C
PLOT 1
PLOT 2
PLOT A
PLOT 3
FIELD No. II
14 ACRES
BARLEY SEEDS
PLOT 7
PLOT 6
PLOT 5
PLOT 4
SCALE
1 INCH = 9 CHAINS
2 MILES
FROM SHOW YARD GATES
WOLVERHAMPTON

about and self-moving anchor tackle. On Plots 2, 3, and 4, Messrs. J. and F. Howard, of Bedford, executed some good digging and cultivating with their transverse boiler-engines, and a beautiful piece of ploughing with their 12-horse engine set. Their new water-tube boiler-engines were unable to work owing to an accident, one engine having stripped several cogs out of a spur-wheel of her road-gear in extricating herself from a deep hole. Messrs. John Fowler and Co., of Leeds, worked on Plot 5 their clip-drum engine and anchor set; on Plot 6 their double-drum engine and anchor set, with a balance plough and digger; on Plot 7 their roundabout tackle with turning cultivator; on Plot 8 their pair of 12-horse single-drum engines, with cultivator and new subsoil plough; and on Plot 9 their pair of 20-horse single-drum engines, with cultivator and deep Flemish mouldboard-plough. On plots 10 and 11 was arranged the endless-rope machinery of the Ravensthorpe Engineering Company, of Mirfield, Yorkshire, which, however, was unable to proceed beyond a first start owing to the plough accidentally catching and breaking off one of the windlass travelling-wheels. Plot 12 was allotted to the roundabout set of Messrs. Barrows and Stewart, of Cherwell Works, Banbury.

## Class I.

For "the best combination of Machinery for the Cultivation of the Soil by Steam-power" there were eight entries. Messrs. Robey and Co. (Limited), of the Perseverance Iron Works, Lincoln, entered for trial an 8-horse-power patent road-steamer, with indiarubber tires, invented by Mr. R. W. Thomson, of Edinburgh, and improved and manufactured by the Exhibitors. It is described in the Catalogue as "a modern traction-engine for direct steam-ploughing, driving, threshing, and other farm-machinery, as well as for conveying corn and other farm produce to market. Price 700*l.*" To be hauled by this field locomotive was a 6-furrow plough, invented and manufactured by Messrs. Robey and Co. But as neither the engine nor the implement put in an appearance, and no other competitor came forward on the travelling-engine principle, the Judges had no opportunity of putting to the test the alleged cheapness and facility of this system of steam-cultivation. However, the behaviour of other traction-engines in transporting themselves or in hauling loads over the Barnhurst fields was not calculated to confirm any great expectations of their possible performances in tillage; and setting aside the question of loss of power in continuously carrying a weight of several tons over an arable surface,—a loss very seriously increased upon even slight gradients,—the general impracticability of the system was illustrated by the dents or depressions, two to three inches in depth, left in the moist land by the 15-inch wide wheels of traction-engines, whether indiarubber-tired or not. For, plainly, it must be an imperfect and insufficient form of steam-cultivating apparatus which can be available without injury to a heavy soil only when that soil is hard and dry, and which prohibits the farmer from "crossing" a piece once broken up by the cultivator. It remains for experiment to determine whether or not, in certain situations, as upon farms having specially level fields, the travelling-engine system (with its avoidance of windlasses, anchors, ropes, pulleys, and its minimum use of manual labour) may be applicable for the smashing up of stubbles in the commonly dry season after harvest. But we consider it very unlikely that such an application of steam-power would be found successful.

Messrs. J. and F. Howard, of the Britannia Works, Bedford, entered a pair of patent self-propelling engines, fitted with winding drums for working a to-and-fro or double-action implement, on what is called the "double-engine" system. These engines, of remarkably novel construction, are the first attempts of Messrs. Howard to introduce upon wheels the water-tube or safety-boiler, of which they have successfully erected about ten thousand horse-power in mills, works, and factories, and have also arranged for marine engines. The boiler is placed upon a plate-iron framing which carries the two steam-cylinders, the crank-shaft, driving-gear, and rope-drums, and is mounted upon three road-wheels; it consists of thirty-two wrought-iron tubes arranged in a nearly horizontal position, that is, with an inclination of one in eight, and communicating at their upper ends with vertical tubes. The horizontal tubes are 5 feet in length, those of the inner part being 9 inches in diameter, and the outer ones 7 inches in diameter; and while the six tubes of each inner section have spaces between them for the passage of flame and heated gases from the fire, the seven tubes of each outside section are placed close to each other, so as to form, with a covering of lagging cement, air-tight walls which are almost non-conductors of heat. An idea of the arrangement is given in the accompanying sketch (Fig. 2), a supposed cross section of what may be called the back of the boiler. Each tube, closed at one end, is connected by its other end with an upright tube of horse-shoe section; the five upright tubes (shown by the dotted lines in the drawing) supporting five sets of horizontal tubes, while these several sets communicate with each other by means of a square tube, A B, uniting the ends of the lowest horizontal tubes, and by steam connection pipes, C C C, at the top of the vertical tubes. The feed-water enters at A, and at B is the blow-off cock. Circulation of water is promoted by an inner tube having a

Fig. 2.—*Ideal Vertical Cross-Section of the Boiler in Messrs. J. and F. Howard's Patent Self-propelling Engine, No.* 1168.

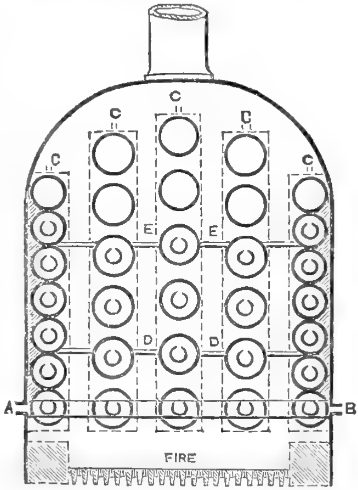
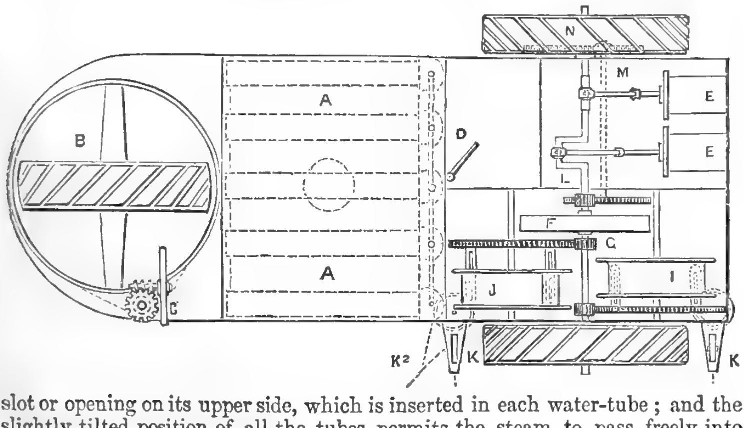



Fig. 3.—*Ground-Plan of Messrs. J. and F. Howard's Patent Self-propelling Engine, No.* 1168.



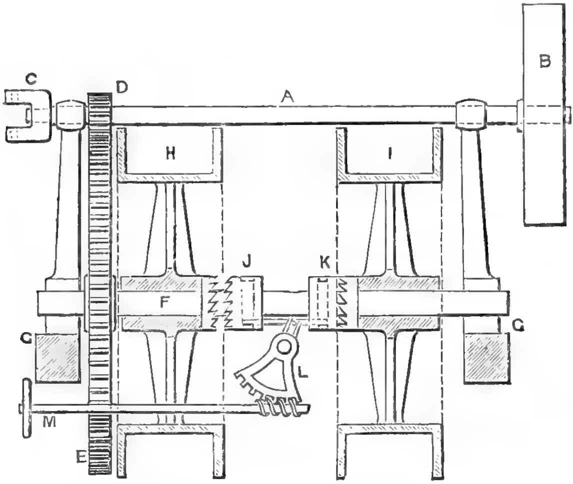

slot or opening on its upper side, which is inserted in each water-tube; and the slightly tilted position of all the tubes permits the steam to pass freely into the upright ones. Two sheet-iron diaphragms, D D and E E,—the lower one placed directly over the fire-box, the other toward the back of the boiler, and both somewhat shorter than the tubes,—cause the heated products of combustion to traverse to and fro, doubling from back to front, and finally to surround the upper tubes in the several series before their exit into the chimney,—these upper tubes being above the water-level, and therefore filled with steam. This safety boiler is intended to work at 180 lbs. pressure, but is tested up to 500 lb. pressure upon the square inch. In Fig. 3 (p. 483) is shown in plan the general arrangement of working parts upon the engine. AA is the water-tube boiler; B is the steerage wheel, hung in a transom or ring, which supports the frame upon friction-balls or rollers; C is the steersman's handwheel; D is the fire-door. The steam cylinders, E E, are placed horizontally at the rear end of the framing; and the crank-shaft with fly-wheel, F, drives the rope-drums, I and J, by means of two spur-pinions, G and H. The even coiling of the ropes is effected by Messrs. Howard's peculiar method of slowly traversing the drums endwise upon their axles with a to-and-fro movement, the ropes being fed on at fixed points as determined by the position of the guide-rollers. To admit of running off the ropes in an angular direction, these guide-rollers are hung in brackets, K K, which will swing in any direction upon swivels, as indicated at K [2]. The road motion or propelling gear consists of a pinion, L, actuating a spur-wheel upon a shaft which carries a pinion, M, gearing with a spur-wheel, N, upon the axle of the travelling-wheels.

Owing to the breakage on the preparation Monday (already alluded to), followed by a similar mishap to the companion engine, namely, the stripping of cogs out of the traction spur-wheel, on the very next day, Messrs. Howard's double-engine apparatus was disabled from proceeding into competition, and the Judges had therefore no performances of these novel pieces of machinery upon which to report.

On Tuesday, June 27th, the first day of actual trial, six sets were in the field, offering themselves as "the best combinations of machinery," without any limitation, reservation, or condition, for cultivating the soil by steam-power. Two were on the double-engine system; two were on the headland-engine and self-moving anchor plan; and two had stationary engines. We may consider them in the order of the plots as drawn by lot, though the work was not done precisely in this rotation; for the failure of Messrs. Howard to take their place upon Plot 2, and a tiresome delay on the part of Messrs. Barrows and Stewart in making ready for a start upon Plot 1, threw upon Messrs. Fowler the onus of getting to work upon plots 3, 4, and 5, two places in advance of their proper turn.

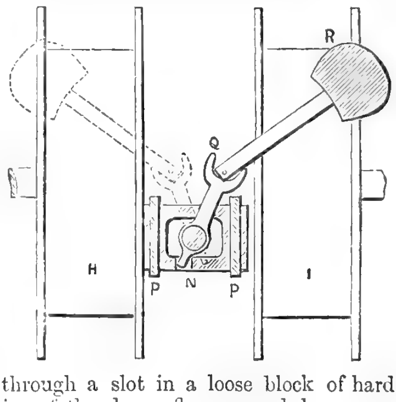
*Plot* 1 *in Field No. XII. Messrs. Barrows and Stewart's Stationary Engine and detached Windlass Tackle* (Catalogue No., 865), invented by Mr. William Smith, of Woolston, improved and manufactured by the exhibitors, consisting of a 12-horse-power portable engine, having double cylinders of $8\frac{1}{2}$ inches diameter and 13 inches stroke; a detached two-drum windlass upon four wheels, driven by a connecting-shaft with universal joints or by rigger and belt; steel-wire ropes of $1\frac{3}{4}$ inch diameter; snatch-block, claw-anchors, dead-anchors, twenty-two porters, tools, &c.; with a five-tined Woolston cultivator, fitted with turning-bow. Price, 486*l.*; or with a three-tined cultivator (No. 866), in addition, 500*l.* The plan of working is by surrounding or partially enclosing the field or plot by the ropes, with anchored snatch-blocks at the angles, of which two, namely those opposite the line of traverse of the implement, are shifted forward along the headlands by manual labour. The snatchblock pulleys, of two feet diameter, are of light construction, with rather small bosses upon stud bearings. The implements are of the well-known simple and strong Woolston pattern, having tines of the spade shape, and are turned round at the ends of the field by the pull of the return rope. The windlass has several peculiarities of construction. In the ideal cross-section, Fig. 4, which is not drawn to any scale, A is the driving-shaft, having at one end a

Fig. 4.—*Ideal Cross-Section of Messrs. Barrows and Stewart's detached Windlass.*




rigger, B, for an engine-belt, and at the other end a coupling, C, for being connected with the engine crank-shaft by universal joints and a coupling-shaft. The machine was driven in this latter way during the trials. A pinion, D, gears with a large spur-wheel, E, which is fast upon an axis, F F, mounted in brass bearings upon the windlass-frame, G G. Hung loose upon this axis are the two rope-drums, H and I; and these are set alternately in and out of gear with the axis by means of the ratchet-clutches, J and K, the clutches being connected together, slided simultaneously, and held in any position (that is, in gear with one or other of the drums or out of gear with both) by the quadrant and worm, L, adjusted by the hand set-wheel, M. It will be seen that, with this arrangement, it is impossible for both drums to be in gear at one and the same time, and thus the risk of wheel breakage is greatly reduced. The relative sizes of the spur-wheel and pinion are as six to one, and each drum is capable of receiving 800 yards of $1\frac{3}{4}$-inch wire-rope. The brake of the slack drum is thus managed:—The shaft carrying the quadrant piece passes through a slot in a loose block of hard wood, N in Fig. 5, near the outer rim of the drum flanges, and by means

Fig. 5.—*Diagram of the Brake-apparatus of the Slack Drum in Messrs. Barrows and Stewart's detached Windlass.*



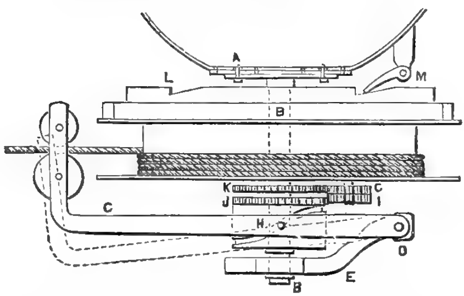
of a short finger, entering into a small aperture in the block, slides the block for a short distance toward one drum or the other. The block is held in position by two rings, P P, which are fixed to the windlass-frame. A jointed lever, Q, fastened upon the shaft, and carrying at its upper end the weight, R, is thrown sideways in the same direction as the clutches are moved; and thus, when the drum, I, is in gear, the brake-block is urged with considerable pressure against the side of the flange of the other drum, H. The dotted lines show the position of the weight and jointed lever when the clutches are shifted so as to gear with the drum, H, and the partial turning of the shaft throws the jointed lever to the opposite side, pressing the block against the flange of the drum, I. Messrs. Barrows and Stewart recommend that, in ordinary work, the engineman should work the windlass; but the trial did not show the expediency of such an attempt at saving labour.

On Wednesday, June 28th, the engine, windlass, and cultivator were moved from the former place in the depôt-field to Plot 1, a distance of nearly half a mile, by eight horses, in 9½ minutes; the remainder of the apparatus being conveyed in a van in 7 minutes. Ten horses would be required for shifting the whole simultaneously. After reaching the field, the tackle was fixed in position and laid out ready for starting work in 50 minutes, 6 men and 4 horses being engaged. In work, the customary "roundabout" force was employed,—namely, 1 engine-man, 1 windlass-man, 1 implement-man, 2 anchor-men, and 2 porter-boys; or together, 5 men and 2 boys, not including the water-cart man. The engine, indicating a maximum force of 32⅓ horse-power, cultivated with the 5-tine implement at 7½ inches depth an area of 3 acres in 2 hours 54 minutes, which is at the rate of 10 acres, 1 rood, and 15 perches in a day of 10 hours. The time occupied in turning the cultivator at the ends varied from 30 to 140 seconds, averaging 54 seconds; and this absence of smartness about the hands had very much to do with the slow rate of performance. But the ground was unfavourable; a very grassy piece with a deep and awkward hollow, and a few large stones were caught by the implement. The maximum pace of the cultivator was 3¾ miles per hour, and hence the ground was not so well broken up as by some of the more rapidly moving apparatus tried in the same field; and the tines ribbed the bottom in "scrows." The whole, however, was noted as "fair work; uneven bottom."

*Plot* 3, *in Field No. XII. Messrs. John Fowler and Co.'s Double-Engine* 20-*Horse Set* (Catalogue No., 6480); consisting of a pair of 20-horse self-moving engines, with single cylinders, fitted with single winding-drums, 800 yards of best steel-wire rope, and working a 13-tined turning cultivator (6497). Price, 1975*l.*; with 6-furrow balance combined plough and digger (6488), in addition, 2070*l.* The system of working an implement by two engines moving themselves at intervals and opposite to each other along two headlands of a field, and alternately winding up and paying out the single ply of rope which hauls the implement to and fro, is so well known that it need not be described here in detail. Its advantages are the rapidity and ease with which the tackle is brought into the field and put to work, the absence of all detached gear, such as windlass, anchors, snatch-blocks, &c., the shortness of the wire-rope used,—which is a *minimum*, the rope out being merely the length of the field cultivated,—and the safety arising from the furrow ending always at that engine which is drawing the implement, where the engine-driver can see the implement arrive at the end of its journey, so that in foggy weather or with an intervening hill there is no difficulty about signals. In these engines the boiler is of the ordinary locomotive type, of sufficient power to supply steam abundantly at a pressure of 150 lbs. per square inch. The heating surface of the fire-box amounts to 44 square feet, of the tubes 234 square feet, making a total heating surface of 278 square feet, and the fire-grate area is 9½ square feet.

With a view of securing diminished piston-friction, lighter weight, and a smaller number of wearing parts, a single cylinder is preferred to double cylinders, even for an engine of nominally 20-horse power; and this cylinder of 13 inches diameter with 14 inches stroke, and steam-jacketed, is placed over the smoke-box end of the boiler, steam being admitted from a dome which is formed in one piece with the cylinder. By this arrangement steam-pipes are dispensed with, steam is taken from the quietest part of the boiler, and, in ascending inclines where great power is required, at the greatest distance from the water, thereby securing a supply of dry steam. The crank-shaft being turned toward the foot-plate brings the fly-wheel within reach of the driver, enabling him to use it for the purpose of getting the crank over the dead centres—which it is occasionally, though rarely, found convenient to do. This rearward position of the crank-shaft permits the traction or road-gear, which is subject to the greatest strains, to be driven in a very direct manner by simple spur-wheels; while a vertical shaft, driven by a pair of bevel-wheels from the crank-shaft, carries a pinion engaging with a large spur-wheel secured to the winding rope-drum. Instead of brackets to carry the crank and road-motion shafts, plummer-blocks are bolted to the fire-box side-plates, extended for the purpose; and by this mode of construction, which was first introduced by Messrs. Aveling and Porter, of Rochester, in their traction-engines, the various strains are distributed over a considerable number of the rivets and stays of the boiler, and liability to leakage through stud and bolt holes avoided. The rope-drum, of the average diameter of 6 feet, is placed horizontally beneath the boiler, turning upon a vertical centre-stud; and it is so constructed that, with its guide-pulleys and automatic coiling-gear, it is self-contained in a frame, the whole being easily detached by removing six bolts, A A (Fig. 6), which connect

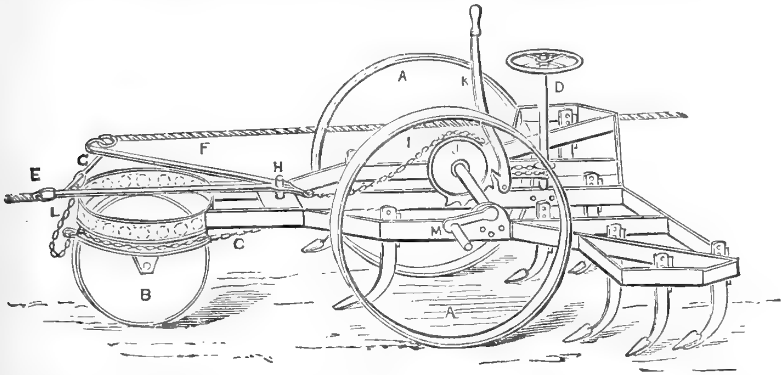
Fig. 6.—*Diagram showing the arrangement of the Rope-Drum on Messrs. Fowler and Co.'s Engine, No.* 6480.




the stud B to a plate riveted to the outer shell of the boiler. The lever, C, carrying the guide-pulleys, is attached by a joint or hinge, D, to a bracket, E, which swivels round the drum-stud or centre, so as to allow of the wire-rope being run off and on without bend at very considerable angles with the direction travelled by the engine on the headland. The correct coiling of the rope —a very important point as regards its durability—is effected by the guide-pulley lever C, having a slow vertical reciprocating motion imparted to it by a pin or die, H, traversing in the inclined groove of a very slowly revolving cam-wheel placed under the drum, and ingeniously worked by a train of differential wheels. The spur-wheel J, which is fast upon the cam, and the spur-wheel K, which is fixed upon the stud B, are of equal magnitude with the same number of teeth, and engaging with them are two pinions, G and I, cast in one piece, but the upper one having one tooth more than the lower one. These pinions are hung upon a stud-pin which is carried round by the rotation of the rope-drum, so that the pinions are continually rolling around the spur-wheels; and the result of the variation in cogging is that, as the spur-wheel K is a fixture, every time the pinions perform one circuit they cause the spur-wheel J (and therefore the cam to which it is attached) to turn to the extent of one tooth. This slow motion of the cam gradually raises the die or pin of the lever C in the inclined groove or thread—this groove raising the lever during one semi-revolution of the cam and depressing it during the other. The dotted lines indicate the lowest position of the lever. The movement is so timed that the cam lifts or sinks the guide-rollers three-fourths of an inch, or whatever may be one thickness of the rope, for each revolution of the rope-drum, and the range and direction of traverse of the guide-rollers thus coincide at all times with the progress of either the coiling or unwinding. The rope when running out is kept partially taut, and the revolution of the out-of-gear drum restricted, by means of a simple friction-strap, L, and ratchet-pall, M, which ceases to act upon the strap when the drum rotates in the opposite direction for winding up the rope. The wrought-iron road-wheels, of 6½ feet diameter and 22 inches breadth of tire, are provided with loose rings for attachment by bolts when it may be desirable to increase the breadth for traversing soft land, and also with strong spuds for being temporarily affixed when required. The capacity of the water-tank is 290 gallons, of the coal-bunker 16½ cubic feet; and the total weight of the engine in complete working trim is 17 tons. The normal speed of the engine is 130 strokes per minute, the corresponding pace of the rope 2¾ miles per hour, and of the road-motion 2 miles per hour; but at Barnhurst a *maximum* speed was noted of 285 revolutions per minute, giving a speed of rope and of the implement of 5¼ miles per hour; and at Stafford the indicator showed a *maximum* of no less than 143-horse-power, given out by the nominally 20-horse engine. The engines being fitted with broad-rimmed fly-wheels, are adapted for driving any kind of machinery by belts, and when divested of the ploughing-tackle, can be used as traction-engines. Very little cast iron is used in their construction, most of the parts exposed to severe strain being either of wrought iron or steel. The proportion of all the parts of these engines is extremely massive and the workmanship throughout excellent. As illustrating the completely locomotive and self-acting character of Messrs. Fowler's double-engine sets of machinery, it may be observed that not only the various implements, but also the spare-gear, water-carts, and even dwelling-vans for the men, are so arranged as to be transported by the engines themselves, so that the whole moves from place to place and gets to work without the assistance of horses.

The turning-cultivator employed is constructed with a horizontal main-frame of a nearly trefoil shape (Fig. 7, p. 489), carried principally by a pair of large-sized wheels, A A, having a common axle about midway of the implement, and also by a small steerage-wheel, B, in front, attached by means of a ring fore-carriage turning upon friction-balls. The implement is guided by locking this wheel to right or left by means of two chains, C, and a pinion, short upright shaft and hand-wheel, D; the attendant, of course, having a seat provided for him, which our sketch does not show. The draught-rope, E, and tail-rope, F, are hooked to a large forked or Y-shaped lever, G, which is connected with the main-frame by a strong stud or pivot, H. The fork, being free to turn horizontally upon this stud, as upon a centre, while this position of the draught-stud is considerably behind the steering-wheel (further back, indeed, than it appears in our drawing), gives to the wheel ample steering power for a cultivator of any reasonable width. While the pulling-rope, E, holds one arm of the fork in the direction travelled, the other arm stands out sideways, leading the tail-rope clear of the implement in the track of the next journey. On arrival at the headland the rope F begins to pull, producing four successive effects. The fork G, in being turned at right angles to the course of the implement, first tightens the piece of chain I, which connects the short

Fig. 7.—*Messrs. Fowler and Co.'s Turning Cultivator, No.* 6497.




tail-end of the fork with the segment J, keyed to the cranked axle, M, of the wheels A A (of which the spokes and bosses are omitted from the drawing in order to display the action); the segment an l axle are thus turned part of a revolution, so that the wheels are depressed, or rather the cultivator is raised upon the axle, and the tines lifted clear out of the ground. Ratchet-teeth upon the segment, being held by a catch on the lever-handle K, retain the cultivator suspended out of work until the attendant pleases. In the next place, the short piece of chain L, which connects a link sliding along the cross-bar of the fork G, with the transverse ring of the steering-wheel, is tightened, so that the steering-wheel is turned in a sideway direction, in readiness for running round the semicircle requisite for turning the implement. The continued pull of the rope F then hauls the cultivator end for end, at the same time wheeling it round upon fresh ground. And lastly, the rope F, having brought the fork piece again to its place over the fore-carriage, draws the implement along its new journey, the rope E becoming the tail-rope, held out by the fork-arm in the line of the succeeding course. The return of the fork to its front position loosens the chain I, leaving the segment free to turn, and to lower the cultivator when the attendant releases the catch, which he does by pulling the handle K. In this way—occupying only a few seconds in practice, though rather tedious to describe in words—the reversal of a cultivator of any width is effected without the attendant leaving his seat, and the compactness of the turning leaves small and neat headlands, without a series of long wedge-shaped strips of untouched ground at the ends. The depth of work is regulated by a stop, which prevents the cranked axle turning beyond a certain point; but each tine can be set higher or lower by its fastening. Diamond points, spud points, or broad double-winged shares, in fact, twelve different shapes are used upon the tine-stems, according to the nature of the operation desired. The cultivator is constructed wholly of wrought iron, and the tines are of great strength, and supported by solid forged sockets. It will be observed that the tines are arranged so as to break up the wheel-tracks, leaving the work without any marks of the wheels whatever. Dishes or expanded covers convexed outwards are placed round the bosses of the wheels A A, between the spokes and the main-frame, as a protection against falling dirt.

The 6-furrow balance combined plough and digger need not be described, the form of the two sets of plough-bodies upon an angular beam-frame nearly balanced upon a pair of wheels, with the draught-rope hooked at a point close to the ground, being very well known; and the ploughs are converted into diggers by simply removing the mould-boards, and attaching short upward-curved double-prong breasts instead.

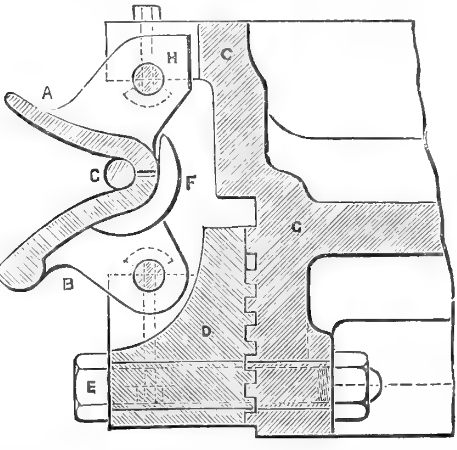
On Tuesday, June 20th, at Barnhurst, the two 20-horse engines, conveying their implements, left the depôt field, travelled for a quarter of a mile, turning through two gateways, and were in position ready for starting in 17 minutes. Six men were engaged in the operation; but, in ordinary work, fewer hands would be required. After the trial was concluded, the whole of the machinery was out of the field in 14 minutes from the completion of the last bout. Two engine-men and one implement-man, exclusive of the water-cart service, were engaged during the trial upon Plot 3, with the 13-tine turning cultivator. The breadth taken was at first 10 feet 10 inches; but, after one bout, a couple of tines were taken out, because of their tendency to muffle in the grassy clover-lea, the reduced width being then 9 feet 2 inches, and the average depth of work $8\frac{1}{2}$ inches. The sand-loam soil, containing a little gravel, and in moist condition, was thoroughly well broken up, and the bottom left level. The power of the cultivator was shown during the last bout by the severing of several tree-roots, one of them 8 inches round. The time occupied in doing the three acres was 43 minutes, including $1\frac{1}{2}$ minute lost in taking out the tines; and at this rate, if maintained, 41 acres, 3 roods, and 10 perches, would be cultivated in ten hours. The time occupied in turning the implement at the ends was sometimes only nine seconds; sixteen observations gave an average of 16 seconds. The average time occupied in the journey of 285 yards was $2\frac{1}{18}$ minutes, being a speed of nearly $4\frac{3}{4}$ miles per hour; and of the whole time at work $11\frac{1}{2}$ per cent. was taken up by the reversal of the implement at the ends. Had the length of the field been one-half greater, and the duration of the journey of the implement therefore one-half longer, while the time in turning remained as before, only eight per cent. of the whole time would have been occupied by the reversal of the cultivator, and the rate of performance would have been $3\frac{1}{2}$ per cent. greater, or 44 acres, 1 rood, 5 perches, in ten hours, or about 53 acres in an autumn day of twelve working hours. On the other hand, had the field been, say, one-third shorter, $16\frac{1}{3}$ per cent. of the whole time would have been occupied at the ends, and the rate of work would have been about $4\frac{1}{2}$ per cent. less, or 39 acres, 3 roods, 38 perches, in ten hours. This calculation illustrates the advantage of large fields and the disadvantage of small ones in working a rapidly-moving implement. The 6-furrow digger was not tried in Class I. at Barnhurst.

*Plot 4 in Field No. II. Messrs. John Fowler and Co.'s Double-Engine 12-Horse Set* (Catalogue No., 6481), consisting of a pair of 12-horse self-moving engines with single cylinders, fitted with single winding-drums; 800 yards of best steel-wire rope, with 9-tine turning cultivator (6501). Price 1360*l.* With 5-furrow balance combined plough and digger (6492) in addition, 1447*l.* 10*s.* Our general description of the 20-horse set is applicable also to this. The leading dimensions of each engine of this set are as follows:—Diameter of cylinder, $10\frac{1}{2}$ inches; length of stroke, 12 inches; heating surface of the fire-box, $33\frac{1}{3}$ square feet, of the tubes 161 square feet; total heating surface, $194\frac{1}{3}$ square feet; firegrate area, $7\frac{2}{3}$ square feet; normal speed of the engine, 150 revolutions per minute; corresponding speed of the rope, $2\frac{3}{4}$ miles per hour; corresponding speed of the road motion, $2\frac{1}{2}$ miles per hour, or with the slow gear, $1\frac{1}{4}$ mile per hour; diameter of road or driving wheels, $5\frac{1}{2}$ feet; breadth of tire, 20 inches; capacity of water-tank, 187 gallons; capacity of coal bunkers, $11\frac{1}{2}$ cubic feet; weight in complete working-order, 14 tons. The indicator experiments at Stafford showed a *maximum* of 103 horse-power. The two engines with implement (no rope-porters being used) moved themselves at Barnhurst for a quarter of a mile, and through two gateways, and took up position on Plot 4, ready for work in 15 minutes. Six men were engaged, but fewer would be requisite in ordinary farm-work. After the trial, the whole machinery transferred itself back again to the depôt in only 8 minutes. It is this remarkable facility in handling, resulting in a waste of almost no time beyond that required for travelling on the road, that forms one chief advantage of the double-engine system. Worked by three men, this tackle cultivated 2 acres 3 roods 8 perches in 49½ minutes, including three-fourths of a minute lost soon after starting, by a tine catching in a hedge-root, the work lying next to a fence. The 9-tine turning cultivator was fitted with alternate 5-inch and 8-inch wide shares, taking a breadth of 7½ feet, at a depth of fully 8½ inches. The land, a clover lea, with light sandy soil upon a very sandy subsoil, containing a considerable amount of gravel at bottom, was thoroughly broken up, without pieces dropping flat again into their original position; and the bottom was evenly cut. The rate of work was 33 acres 3 roods and 10 perches in 10 hours, or 40½ acres in an autumn day's work of 12 hours. From 24 observations taken, the average time occupied in reversing the turning cultivator at the end was 10 seconds; and as the plot of 220 yards length by 62 yards breadth was cultivated in 25 journeys in 49½ minutes, the total time occupied at the end was 4 minutes 10 seconds, or less than 8½ per cent. of the whole time at work. A comparison here will illustrate the great gain from quick turning at the ends. In Messrs. Fowler's single-engine sets, the average time occupied at the ends was about 24 seconds; and had this been the case in the above trial, the tackle would have been 54 minutes 40 seconds in cultivating the 2 acres 3 roods 8 perches, or at the rate of 3 acres in 10 hours less than was done with the quicker turnings.

*Plot* 5 *in Field No. II. Messrs. John Fowler and Co.'s* 12-*Horse-power Clip-Drum Engine and Travelling-Anchor Set* (Catalogue No., 6482), consisting of one 12-horse-power self-moving engine with single cylinder, fitted with a clip-drum, a travelling anchor with pulley and six anchoring discs, 800 yards of best steel-wire ¾-inch rope, 20 "self-moving" and "pick-up" rope-porters, and 7-tine balance cultivator, fitted with slack-rope gear (6508). Price 799*l.*; with 4-furrow balance combined plough and digger fitted with slack-rope gear (6496), in addition, 884*l.* The engine is very similar to those of the double-engine set of machinery just described; but the boiler, as well as the shafts, axles, and the whole of the gear, are made of steel; the side-plates at the fire-box end are extended, so as to serve instead of brackets for supporting the principal running bearings; and the water-spaces around the fire-box are constructed with a sloping bottom, for more effectual action in "blowing off." The heating surface of the fire-box is 33⅓ square feet, of the tubes, 161 square feet; total heating surface, 194⅓ square feet; and the fire-grate area is 6¼ square feet. The cylinder is of 10½ inches diameter, with 12 inches stroke; the normal speed of the engine 150 revolutions per minute; corresponding speed of the wire rope 2¾ miles per hour; the two speeds of the road-motion 2½ and 1¼ miles per hour; diameter of the road or driving wheels 5½ feet, breadth of tire 14 inches; capacity of water-tank 159 gallons, capacity of coal-bunkers 25½ cubic feet; and the weight of the engine in complete working-trim 12 tons. The indicator experiments at Stafford showed a *maximum* of 68½ horse-power given off by this engine.

In place of a winding-drum and coiling-gear, there is attached beneath the boiler, and driven in a similar manner, a horizontal drum or sheave, having a V-shaped groove, composed of a series of pairs of gripping-pieces or "clips." These are self-acting, pressing the rope in exact proportion to the tension or strain upon it; and one half-turn of the rope round the groove is found sufficient to hold it tightly, and without surging or slipping, no matter what amount of pull may be exerted by the engine. Rubbing friction is to a great extent avoided; as the jaws or clips close upon the rope by its directly central pressure upon their curved parts forming the bottom of the groove, and when arrived at the point where the rope begins to leave the groove, fall open of their own accord. Experiment has not determined whether the consolidation of the rope, and the preservation of its form by continually closing down any protruding wires, which are effected by the pressure applied around a considerable portion of its circumference, are more conducive to durability than the tendency to flattening which is observable when wire rope is pressed upon the bottom of an ordinary open groove; but there can be little doubt that the treatment of wire-rope by the clip-drum is less damaging than the constant grinding of coil against coil, and the severe pressing of outer strands upon the sharp angles of outer strands, which are always an effect of imperfect coiling upon a winding-drum. A Report on "The Underground Haulage of Coal," by a Committee appointed by the North of England Mining Institute to investigate the subject, gives examples of steel-wire rope lasting three years in collieries, when in daily and incessant action upon clip-drums in hauling trains of heavily-loaded "tubs" up and down inclines. But there is an advantage in the clip-drum which is wanting in the winding-drum. An efficient coiling-gear may insure regular and uniform coils, free from over-wrapping, so long as the rope be new and not unevenly worn; but at present, no coiler, however ingenious, has mastered the difficulty of accommodating its speed of traverse to the thinner dimensions of an old rope. In the clip-drum, however, is provided a means of adjusting to a nicety the calibre of the groove to any altered size of the rope, as exhibited in section Fig. 8. A and B are one pair of the clips, which surround the entire circum-

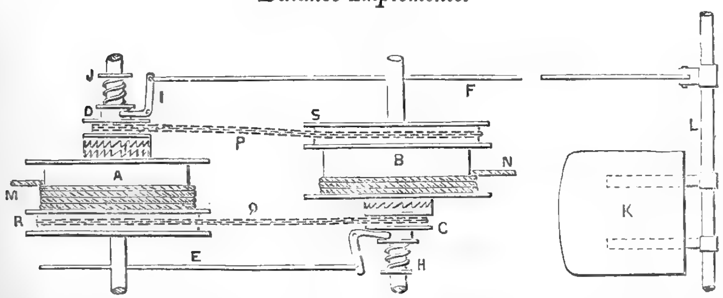
Fig. 8.—*Section of the Clip-Drum attached to Messrs. Fowler and Co.'s 12-Horse-power Engine, No.* 6482.




ference of the drum; the upper clip A hinged or centred upon the main flange G G, and the lower clip B upon a ring D, which is screwed upon the flange or body of the drum by a thread chased round its periphery. Thus, by slipping the ring, D, part of a revolution upon the drum, it is gradually shifted a slight distance nigher or lower, with the effect of diminishing or increasing the space between the centres of all the upper and lower clips simultaneously. The ring D is held in any required place upon the drum by means of bolts, E. By this regulation of the distance between the centres of each pair of clips, any greater or less degree of pressing-power is given at pleasure to the knee-joint lever-action of the clips; so that no more compression need be used than is found absolutely necessary for holding the rope against slipping. It will be seen that, upon the rope leaving the jaws, the pieces open outwards, the lower clip B being formed with a weighted lip, for the purpose of falling open and at the same time raising the upper clip A by means of the tongue F. The extent of opening is limited by the stop H coming against the drum-flange.

The parts attached below the engine boiler are extremely simple, because no automatic coiling apparatus is required; the rope merely passing, over two guide rollers, one half-turn round the clip-drum, and thence in two plies along the length of the field to the anchor-pulley on the opposite headland. In fact, the arrangement is that of an endless rope stretched between the clip-drum and the anchor-pulley, the junction of the two plies of rope being at the implement. It is indispensable for the outgoing rope to be moderately taut as it leaves the clip-drum; for as the rope, soto speak, pinches itself between the clips, no grip at all would be exerted unless there were some, even the slightest, tension or strain upon the rope, and this strain at any one pair of clips is due to the hold of the preceding clips, while any grip of the last pair on the paying-off side is dependent upon some degree of pull or tension in the rope as it leaves the drum. Hence the necessity for a taking-up, or so-called "slack gear," upon the implement, which also furnishes a means of carrying a reserve portion or short length of rope upon the implement and, in a self-acting manner, regulating the quantity of rope out according to the varying distances between the engine and anchor—a condition obtaining in all cases except that of perfectly parallel headlands. The slack gear consists of two small rope-barrels placed at the centre of the implement, and connected with each other by means of pitch-chains, spike-wheels, and ratchet-clutches; the wheels being so proportioned that the pulley-rope uncoiling from one barrel causes the other barrel to rotate and to wind in the tail-rope at five times the speed. The smaller spike-wheels are thrown in or out of gear with their respective barrels by levers and rods connected with the ploughman's two seats at the opposite ends of the implement; so that the act of the man's seating himself in readiness for steering on his journey reverses the gearing of the barrels, and permits the strain on the pulling-rope to wind in the slack or following-rope until the tension of the latter becomes one-fifth that of the former. The

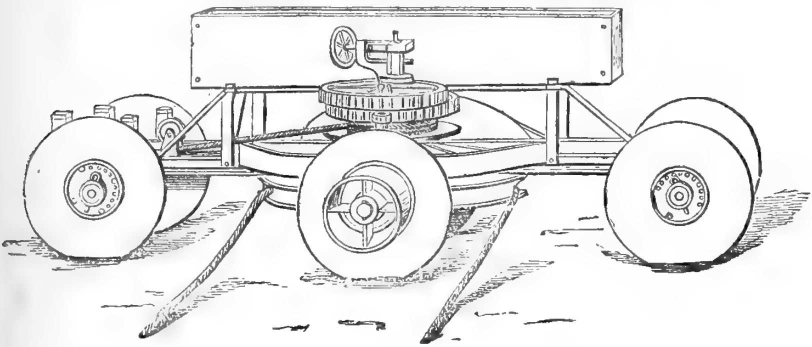
Fig. 9.—*Slack-gear arrangement attached to Messrs. Fowler's Balance Implements.*




arrangement is explained in the Plan, Fig. 9, where A and B are two small drums (mounted upon axles placed across the implement frame) to which the two ends of the rope are fastened, one end being wound a few times round the drum A and the other upon the drum B. The rope M, by causing the drum A to revolve, can drive the drum B at five times the speed by means of the spike-wheel R, pitch-chain Q, and spike-pinion C, which is held in gear with the drum B by a ratchet-clutch and spiral spring H. In the same way the rope N, by causing the drum B to rotate, can drive the drum A at five times the speed by means of the spike-wheel S, pitch-chain P, and spike-pinion D, when held in gear with the drum A by the ratchet-clutch and spiral spring J. In the sketch M is supposed to be the pulling and N the tail rope; the clutch C is represented in gear, and the clutch D is held out of gear by the weight of the ploughman upon the seat K, which is hinged upon the cross-shaft L, and by means of a rod, F, and bell-crank lever, I, compresses the spring J. In this position one foot length of the rope M, paid off the drum A, gathers up 5 feet of the rope N, which takes place when the anchor in travelling makes the furrow 2 feet shorter. The motion of the drums is brought to a standstill directly the tension of the tail-rope N has become one-fifth of that of the pulling-rope M. On the contrary, if the anchor has travelled further from the engine and increased the length of furrow, say by 2 feet, the automatic differential action of the drums allows 5 feet of the rope N to pass off the drum B, which has the effect of simultaneously winding one foot length of the rope M on to the drum A; the result being that the total length of rope out is 4 feet more than it was before, or just the quantity required for 2 feet increase in the length of the furrow. When the implement is to move in the opposite direction, the ploughman leaves the seat K (which instantly rises by the force of the spring J, at the same time permitting the clutch D to drop into gear with the drum A), and takes his place upon a similar lever-seat at the other end of the implement (not shown)—the effect being to throw the clutch C out of gear with the drum B, compressing the spring H by means of the rod E and bell-crank lever G. The rope N is now the pulling-rope, and for one foot length passing on or off the drum B five feet of the rope M (which is now the tail-rope) pass on or off the drum A. It will be seen that the rope does not move the implement (which is hauled by the attachment of the drum-axles to the main frames) until the adjusting revolution of the drums has ceased by reason of the relative strains of the pulling and tail ropes (namely, five to one) having been established. And the peculiarity is that the strain of thus keeping the tail-rope tight is not lost power, but is all recovered by the pull of the tail-rope assisting the revolution of the clip-drum on the engine. And this advantage of being able to support the entire length of the tail or following rope upon porters, without the loss of motive-power which occurs when the same thing is attempted by retarding with a brake the rotation of a paying-out winding-drum, secures a *minimum* of friction and therefore *maximum* economy of the motive-power requisite for performing a given amount of work. In some situations where there may be a difficulty about the deep penetration of the discs or the holding power of the soil, a drawback is that the strain upon the anchor is somewhat greater than when winding-drums are employed instead of the clip-drum. In the latter case, when the implement is approaching the anchor, the strain upon the anchor, tending to pull it away from its hold, is twice the draught of the implement: with the clip-drum and slack gear the strain is twice the draught *plus* one-fifth. Space has been devoted to a detailed description of this beautiful mechanical contrivance because its working is not generally understood.

The travelling anchor, as is well known, consists of a rope-pulley of large diameter (and therefore not calculated to injure the wire rope by sharp bending) mounted under a frame which rests upon rollers low on the ground, furnished with six cutting discs pressed into the soil by the weight of the machine, and easily urged forward, though presenting a great resistance to movement sideways. Fig. 10 is a view of the anchor, showing the arrangement by which, upon the tightening of a strap by the anchor attendant, the motion of the

Fig. 10.—*View of Messrs. Fowler and Co.'s Travelling Anchor.*

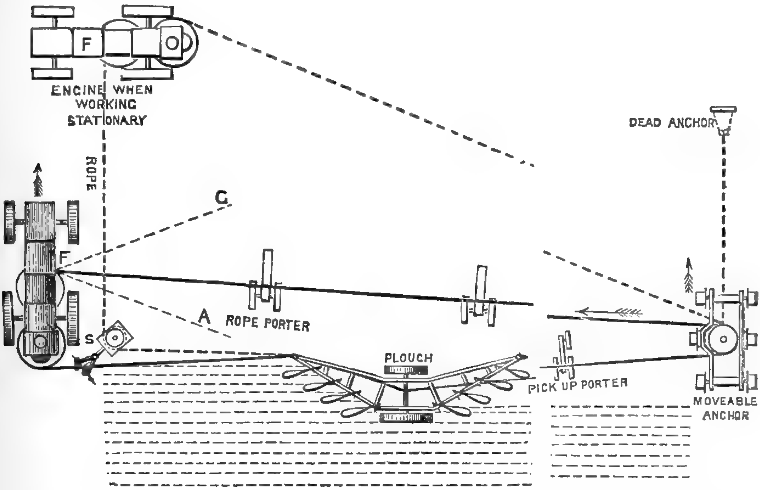


pulley causes a small barrel to rotate and slowly wind its way along a fixed rope anchored forward on the headland. The distance travelled is limited by unloosing the strap or clamp, and thus throwing the onward motion out of gear. The modes of guiding the anchor in conformity with a tortuous field-boundary, and of taking up upon wheels or setting down in readiness for work by aid of a portable leg or tripod, and the position and loading of a counterpoise box for preventing the anchor being toppled over, need not be described in detail. Like the rest of Messrs. Fowler's tackle, this set of machinery is completely self-transporting; and the design and workmanship are of the same excellence throughout.

At Barnhurst, on June 27th, the apparatus, with 7-tined double-action balance cultivator, was moved from the depot-field to Plot No. 5 and set down to work in 36 minutes, four men and two boys being engaged. The force when working consisted of one engine-man, one anchor-man, one implement-man, and two boys shifting the rope-porters. The plot, 233 yards in length by 58 yards across, and containing 2 acres 3 roods 11 perches, was cultivated 7 inches deep in 1 hour 28 minutes, this time including one or two stoppages, from the implement being ill-steered into already worked land. The average time at the ends was about 24 seconds. The rate of work in similar soil to that of Plot 4 was 19 acres 35 perches in ten hours, or 22 acres 4 roods 10 perches in an autumn day of twelve hours. The work was good, but the bottom uneven, and the surface somewhat gathered into ridges, owing to the angular or wedge-form arrangement of the tines in the cultivator, which track apex hindmost like a flight of wild geese reversed. But from the necessity of employing the slack gear a turning cultivator cannot be worked with this tackle.

*Plot 6 in Field No. II. Messrs. John Fowler and Co.'s 8-Horse-power Double-Drum Engine and Travelling-Anchor Set* (Catalogue No., 6484); consisting of one 8-horse-power self-moving engine with single cylinder, fitted with two winding rope-drums, a travelling anchor with pulley and six anchoring discs, 1200 yards of common steel rope, sixteen rope-porters, and a 5-tine turning cultivator (6503), price 678*l.*; with 4-furrow balance combined plough and digger (6493) in addition, 758*l.* In this engine the cylinder is placed towards the foot-plate end of the boiler, and the crank-shaft towards the smoke-box end; and the axle of the main road or driving wheels being also at the smoke-box end of the boiler, while the fore carriage and front wheels are underneath the water-tank and foot-plate, the engine travels firebox end foremost. This arrangement is necessary in order to obtain direct driving of the road or traction gear (which consists of simple spur-wheels on one side of the boiler communicating motion from the crank-shaft to the main travelling-wheels, whose axle lies immediately under the crank-shaft), and also to make room for the two horizontal rope-drums of large diameter, one underneath the boiler between the main-wheel axle and the firebox, the other behind that axle and underneath the smoke-box. Two upright shafts on the opposite side of the boiler to the road gear, connected together by small spur-wheels and driven by a pair of bevel-wheels from the crank-shaft, communicate motion to the two drums by spur-pinions engaging with the cog-teeth upon their upper flanges. Each rope-drum, with its guide-rollers and automatic coiling motion, is centred, as usual, upon a stud; and by unscrewing four nuts from bolts which attach the stud of one drum to a plate riveted to the shell of the boiler, and similarly unscrewing four nuts which attach the other drum-stud to a curved plate projecting in the rear of the smoke-box, both drums, with their self-contained gear, may be removed. The engine then becomes a simple self-propelling engine, adapted for general farm or other purposes; and when again required for cultivation the drums can be readily replaced. The cylinder is of $9\frac{1}{2}$ inches diameter and 12 inches stroke; the firebox heating surface is $33\frac{1}{3}$ square feet; the tube heating surface 139 square feet; total heating surface $172\frac{1}{3}$ square feet; the fire-grate area $6\frac{1}{4}$ square feet; the normal speed of the engine 150 revolutions per minute; corresponding speed of the wire rope $2\frac{3}{4}$ miles per hour; corresponding speeds of the road motion $2\frac{1}{2}$ and $1\frac{1}{4}$ miles per hour; diameter of the travelling or driving wheels $5\frac{1}{2}$ feet; width of tires 14 inches; capacity of water-tank 135 gallons; capacity of coal-bunker 10 cubic feet; and weight of the engine in complete working trim $12\frac{1}{2}$ tons. At Stafford, the indicator showed a *maximum* of $63\frac{3}{4}$-horse-power exerted by this nominally 8-horse single-cylinder engine. The boiler is made of steel, as well as all the principal working parts; and the design and workmanship are of the same massive and excellent character observed in all the machinery of Messrs. Fowler. The set is completely self-transporting. When working with the engine and anchor shifting ground upon opposite headlands, the rope is required to be three times the length of the field, one length being always upon the drums. A special facility of the double-drum engine and anchor tackle, however, is that it can be worked also upon the stationary-engine system, which is advantageous in some situations. Fig. 11 is a plan of both arrangements. The travelling anchor is common to both modes of working; but, when the engine is stationary, one snatch-block, S, with claw anchor, is shifted by hand in the usual manner. It will be observed that there is no detached windlass to be transported, set down, and taken up, with exact placing and pinning down in position, as in the ordinary "roundabout" system. Engine and windlass are combined, or "self-contained," and the drums are self-coiling; so that to man the tackle for stationary-engine work requires one engineman, one ploughman, two anchormen—in all four men—and two porter-boys. This is one extra hand beyond those employed when the engine moves along the headland. One drawback that should be mentioned is, that the position of the rope-drum near to the firebox, F, restricts the ability to run off the rope in one angular direction. Thus, while the engine can freely work the implement in the direction of the dotted line A, it is unable to work in the direction of the dotted line G, in consequence of the rope from one drum coming in contact with the corner of the firebox. Hence there would be a difficulty in dealing with some fields; while in working at right angles (as in the Fig. 11) great care has to be taken in keeping the engine well forward, or somewhat in advance of the line of furrow. For stationary working, the engine is planted as shown in Fig. 11, so that the headland rope runs off at right angles from the firebox-drum, the other drum hauling without hindrance in any direction.

Fig. 11.—*Plan illustrating the two modes of ploughing with Messrs. J. Fowler and Co.'s Double-Drum Engine and Travelling-Anchor Set, No.* 6484.




At Barnhurst, on June 27th, this apparatus was moved into the field and set down ready for work in 40 minutes, which includes the time lost in adding 40 yards length to the rope. Six men were engaged. On leaving the field, after the trial was completed, the accidental breaking of an axle of the anchor occurred. The hands engaged in working were two men and three lads, one of these regulating the advance of the anchor. The plot of 2 acres 3 roods 11 perches was broken up with the 5-tine turning cultivator in 1 hour 42 minutes, being at the rate of 16 acres 2 roods 13 perches in 10 hours, or 19 acres 3 roods 30 perches in an autumn day of 12 hours. The average time in turning at the ends was 26 seconds. The work was exceedingly good, well broken up, and the bottom quite level. The depth, which was $6\frac{1}{2}$ inches at first, was increased to 9 or $9\frac{1}{2}$ inches, and averaged 8 inches.

*Plot 7 in Field No. II. The Ravensthorpe Engineering Company's* 10-*Horse Portable Engine and High-speed Rope Set* (Catalogue Nos., 6022 and 6024), consisting of 10-horse-power portable double-cylinder engine of Clayton and Shuttleworth; the cylinders of $7\frac{1}{4}$ inches diameter with 12 inches stroke, weight 4 tons 17 cwts.; two travelling windlasses, six corner anchor-pulleys, one tension anchor-pulley, two claw-anchors, thirty light rope-porters, 1200 yards of Manilla rope, 800 yards of best steel-wire rope, one 4-furrow Fowler combined plough and digger, one 9-tine Howard reversible cultivator, &c., price 687*l.* The question of light swift-running ropes *versus* strong slow-running ropes for driving cranes and other machinery, has occupied of late years a great deal of attention and provoked much controversy; and it is interesting to find the same problem reappearing among the various methods of steam-cultivation. The arrangement adopted, in what is called, after the inventor, the "Fisken" system, is as follows:—An ordinary portable engine, A (in the sketch Fig. 12), or it may be a self-moving engine, for the purpose of

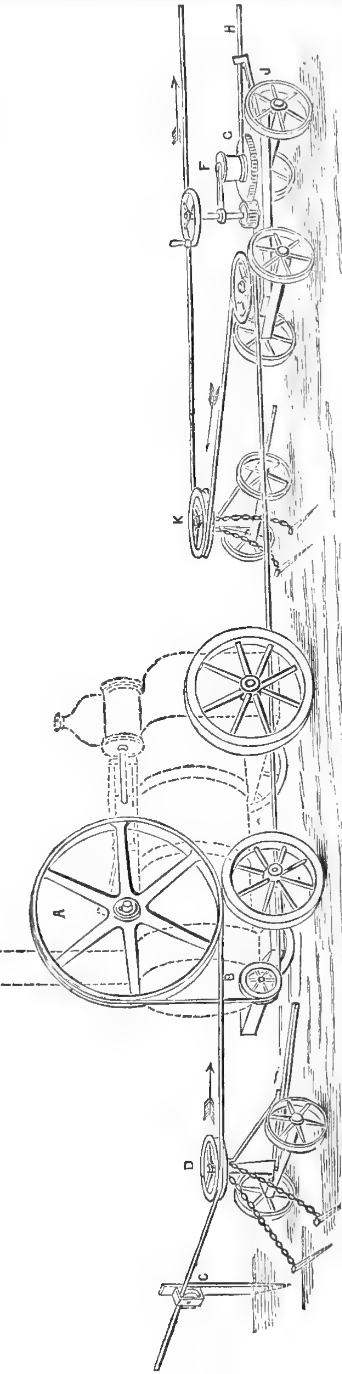
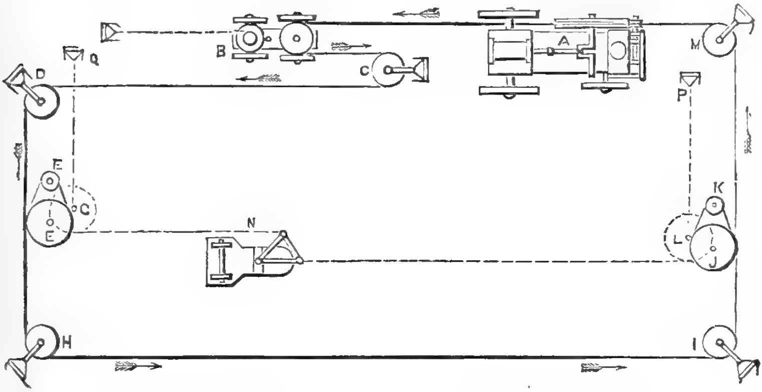



Fig. 12.—*Sketch Illustrating the Fisken System of Steam Cultivation, Nos.* 6022 *and* 6024.

transporting the apparatus without horses, is fitted with a fly-wheel or rigger, having a deep V-groove suitable for receiving a Manilla hemp rope of $\frac{5}{8}$ or $\frac{3}{4}$ inch diameter. This rope is led a three-quarter turn round the fly-wheel by means of a guide-pulley, B, which is temporarily attached upon the engine fore-carriage; or, if the engine has its fly-wheel at the other end, this pulley is supported by a bracket strutting from the firebox. Any portable engine can be fitted with a large grooved rigger and the smaller guide-pulley, both made to take off and on in a few minutes. The rope is completely supported, at a height of 3 feet 9 inches above the ground, upon a number of light friction-rollers, or grooved pulleys, secured in a very simple manner to wooden stakes, C, which are driven upright into the ground at intervals all round the field or plot to be worked. The angles are turned over larger pulleys, D, mounted upon light two-wheeled carriages or barrows, each being held in position by a couple of short chains fastened to iron stakes in the ground. As the weight of the Manilla hemp rope is only 6 to 8 ounces per yard, and as the strain upon it when driven by a 10-horse engine is only between 3 and 4 cwts., the pressure upon the fixed rope-porters and upon the pulleys of the corner anchors is comparatively small; and hence, so long as the bearings are kept in order, the friction, notwithstanding the high speed of 30 up to 40 miles per hour, is not excessively great. It is not necessary to place the engine in the same field as the cultivating machinery; and at Stafford one of the trials was made with the engine stationed 200 yards from the plot, for the purpose of letting it draw its water from a stream which happened to be near. The outgoing ply of rope (the rope running always in one direction) is conducted round a tension-anchor E, consisting of a pulley upon a light movable carriage, for the purpose of tightening-up the endless rope; this being done when requisite by the hand-wheel F and pinion and small barrel G slowly winding up a piece of wire rope H, which is anchored ahead. To guide this light machine, the fore carriage has an arm, J, with an eye through which the wire rope is passed. The hemp rope being led again towards the engine and round the fixed pulley K, before passing along the field in the direction indicated by the arrow, a loop is formed; so that an advance of 1 foot by the tension-pulley carriage gathers or tightens up 2 feet length of the rope. For altering to different sizes of field, rope is easily added or removed, a splice of about 2 feet in length being done in from five to ten minutes. As represented in the plan, Fig. 13, the endless hemp rope, running always in the direction indicated

Fig. 13.—*Plan illustrating the Fisken System of Steam Cultivation.*




by the arrows, is conducted from the grooved fly-wheel of the engine, A, round the movable tension-anchor B, the fixed anchor C, the corner anchor D, then once round the two riggers, E and F, of a travelling windlass, G, thence round the two corner anchors H and I, one turn round the riggers J and K of another travelling windlass, L, and finally round the corner anchor M to the engine fly-wheel, A. It will be observed that when the windlass L is in work, hauling the implement N by the drum and single ply of wire rope shown by the dotted lines, only the portion of hemp rope between A and the windlass L is subject to full tension, the remainder of the rope being only tight enough to support itself clear of the ground; and the strain due to the work is sustained only by one corner anchor, M. When the other windlass, G, is in gear and hauling the implement, the hemp rope is tight between the engine and that windlass, and the strain is taken upon the three corner anchors, M, I, and H. The windlasses gradually shift themselves forward, so as to be always opposite the line of work, by slowly winding up fixed headland wire ropes anchored at P and Q. Fig. 14 is an enlarged view, not drawn to any scale, but illustrating the action of the windlass. A horizontal iron frame, mounted upon four wheels, which are ribbed on the tires to give them some hold upon the ground, carries a 4-feet diameter rope-drum, A, underneath, and driving-spur gear and riggers above. The driving-rigger B, of 3¼ feet diameter, has two V-grooves; and the guide-rigger C, of 20 inches diameter, with a single round-bottomed groove, is hung on a skew axis, so as to divert the rope from one V-groove to the other upon the rigger B. The rope takes more than half a turn round the bottom groove of the driving-rigger, and lies for a few inches length only in the upper groove; but this extent of bite or pinching of the rope is found sufficient for transmitting the full power of a 12-horse engine. At the lower end of the vertical axis of the driving-rigger a pinion, D, engages with a spur-wheel E; and the axis of this intermediate motion carries two pinions, one (not shown in the drawing) gearing with the spur-wheel, which is secured to the rope-drum A, the other pinion, F, driving the small rope-barrel G. The pinion D is thrown in or out of gear by means of a friction-cone, H, which is tightened or loosened by the lever J and hand-wheel and screw K. The pinion F is similarly put in or out of gear by a friction-cone, not represented in the sketch; and the rope-drum A, being hung upon a stud or shaft which can be turned eccentrically, can be moved by the lever L so as to set the drum spur-wheel in or out of gear with the pinion on the axis of the intermediate spur-wheel E. When paying-out the plough-rope M the drum is thus released, but its motion is restricted and the rope held partially taut by means of a friction-strap round the upper flange of the drum; this strap being caught and held by a pall and ratchet-teeth, which cause the brake to operate only when the drum is paying out rope. A radial arm, which swings round upon a swivel, carries a guide-roller for upholding the rope as it feeds on or runs off the drum; but there is no coiling gear. The action is easily understood. Upon the implement arriving nearly at the windlass, the anchor-man instantaneously releases the clutch H by the hand-wheel K, and then withdraws the drum out of gear by the lever L. The other anchor-man, at the opposite end of the field, immediately upon finding the rope cease to pass off his windlass sets the drum in gear and screws his friction-clutch tight, and the implement begins its return journey without any delay. Thus, in the first trial at Barnhurst, the average time occupied at the ends was only 6 seconds, and frequently did not exceed 5 and sometimes 4 seconds. While the windlass is paying out wire rope, it is made to advance for the required distance along the headland by putting the pinion F in gear, so as to wind slowly upon the barrel G the wire rope N which is fixed

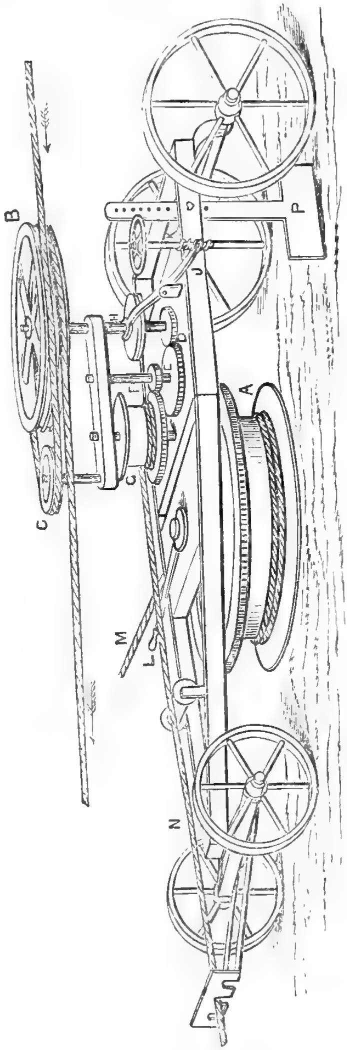



*Fig. 14.—Sketch illustrating the action of the Windlass in the Fisken System of Steam Cultivation.*

to a dead-anchor ahead. The windlass is guided by being made to follow this headland rope, with the fore-carriage held straight and set at an angle by a ratchet-piece placed across the shafts and resting upon the rope. The windlass is anchored against the side-strain due to the plough-rope, not by cutting-discs, but by a single spade-shaped coulter, P, about 15 inches long by 7 or 8 inches deep, which is attached to the main frame by a strong upright stem, and lowered into the ground at any requisite depth. When setting down to work or removing, there are no travelling-wheels to be removed or put on. A spit of earth is dug up, and the anchor-blade, lowered into the hole, cuts its way at an invariable level through the soil at every advance of the windlass along the headland. Being placed in the proper position, a little backward from the line of direction of the plough-rope M, the blade P, held down by the weight of the windlass—3 tons 2 cwts.—is found able to sustain any side-strain due to the work of hauling the implement; and this holding power is not surprising when it is remembered that from the fact of there being only one ply of pulling-rope the strain is only one-half that upon the anchor of a Fowler's double-drum set, and less than one-half the strain upon the anchor of a clip-drum tackle.

The lighter windlass, also made by the Ravensthorpe Company, which weighs 2 tons 6 cwts., is constructed without the intermediate-motion shaft E; and the same lever which connects and disconnects the friction-clutch H, also connects and disconnects the other friction-cone for driving the small coiling-drum G, the hauling and travelling motions not being required to be in gear at one and the same time. From the short trials which it was alone possible to make, it is difficult for the Judges to pronounce decidedly upon the mechanical merits of the system. The plan appears to be eminently flexible—that is, it can be very readily adapted to any form of field; and the power of placing the engine at a distance, without great cost of rope, is an important advantage, more especially as it is not necessary for the engine-driver to see any signals. The engine, when fitted with a good governor, in a great measure regulates itself; and at any rate the driver can readily tell by the variation of speed what is doing in the field. The two travelling-windlasses possess one advantage of the double-engine system, in the furrows always ending at the windlass, so that the windlass-man can see in all weather what he has to do. On the other hand, there is considerable loss of power, amounting to between 5 and 10 per cent., in driving the swift rope (a speed which is $12\frac{1}{2}$ times the pace of the implement), even for a 3-acre plot, and necessarily much more when dealing with a large field. The consumption of oil and tallow is also large, perhaps wasteful, owing to imperfect lubricating appliances; and the high-speed rope-pulleys are apt to heat, so that in dry and dusty weather an attendant would be necessary to look after them. It is much to be regretted that the design and workmanship, of the windlass especially, are not so good as might be desired. It is also to be regretted that the machinery is not arranged to be completely self-moving, the supply of horses being always a troublesome matter, that should indeed be unnecessary where the driving-power is a good traction-engine.

On Plot 7, at Barnhurst, the time in moving to the field and setting down to work was 46 minutes; in removal after the trial $15\frac{1}{4}$ minutes. Eight horses and four men were engaged. To work the tackle took one engine-man, one implement-man, and two anchor-men; no lads being required, as rope-porters are not used for the wire rope. Working with one of Messrs. Howard's 7-tined reversible cultivators with large-sized wheels, the apparatus finished the 2 acres, 3 roods, and 11 perches in 1 hour and 19 minutes, which is at the rate of 21 acres, 1 rood, 17 perches in 10 hours, or 25 acres, 2 roods, 20 perches in an autumn day of 12 hours. The depth of the tillage was only about $5\frac{1}{2}$ inches;

the work fair, but not well broken up; the bottom, however, was cut perfectly level.

The several sets of machinery in Class I. were subsequently tried at the New Buildings Farm, about three miles north-east of Stafford, in the occupation of Mr. John Darlington; the field consisting of some 60 acres, for the most part old turf, in some places hilly, with steep-sided hollows, and the soil a strong clay loam with red marl, and in some parts a pebbly bottom.

On July 4th, *Messrs. Fowler's 20-Horse Double-Engine Set* began the heavy land operations upon Plot 1, but, interrupted by heavy rain, it had to complete its performance on the next day. On a piece of six-years-old grass on a very strong red marly loam, with a deep hollow to cross, the 9-tine turning-cultivator made good work at 7½ inches depth. An area of 1 acre and 16 perches was finished in 24¼ minutes, being at the rate of 27 acres and 34 perches in 10 hours, or 32½ acres in an autumn day of 12 hours. But a long stoppage occurred for attaching the gear of the steam-indicator. No dynamometer tests were applied: the engineers, however, estimated the pull upon the hauling-rope and upon the implement from the pressure in the engine-cylinder, allowing 25 per cent. for the friction of the machinery; the net pull upon the implement they calculated to be 8985 lbs., or fully 4 tons! At 1½ cwt. per horse, this represents 52½ horses. In the experiment, the implement moved at the speed of 4½ miles per hour, which is about double the natural pace of a plough-horse; and hence, according to the engineers table of observations, no fewer than 107 horses would have been required in order to accomplish as much work in the same time. Again, if the draught of the implement was 8985 lbs., this was a draught of 1198 lbs. for each foot breadth, seeing that the width taken by the cultivator was 7½ feet: or, in other words cultivating 7½ inches deep in a soil where probably four horses can readily plough a furrow 6 inches deep, required the power of more than ten horses for each foot of breadth taken. It is much to be regretted that dynamometer experiments were omitted from the trials, as it would have been of great interest and importance to ascertain the proportion of motive power lost between the engine cylinder and the implement, and this in the case of each set of steam-cultivating machinery which entered into trial. Elaborate investigations were made into the weights of earth moved per acre; but it is evident that such weights of themselves form a very insufficient criterion of the power expended in the work of the implement. For instance, two cultivators, working at 8 inches depth in precisely similar soil and leaving a level bottom, would move equal weights of earth per acre; but if implement No. 1 broke up the ground into pieces of the average size of 8-inch cubes, while implement No. 2 left the ground in masses of the average dimensions of 16 inches square by 8 inches thick, then implement No. 1 would have produced four times the mechanical effect so far as cutting and breaking are concerned, and may have accomplished even more in upturning and scattering the pieces in different positions. Inspection must always be mainly relied upon for determining the relative efficiency and quality of such work as cultivating and digging; but draught experiments would have been of value if applied to ploughs turning furrows of a given width and depth.

Messrs. Fowler's 20-horse tackle made very good work, with a 6-furrow digger, at 9 inches depth, in Plot 1 above-mentioned, the ground being all thoroughly moved. The rate of the deep work was 13 acres, 2 roods, 26 perches in 10 hours, or 16 acres, 1 rood, 23 perches in an autumn day of 12 hours.

On Plot 2, in the same field, Messrs. Fowler's 12-horse double-engine set made good work with a 5-furrow digger, at 8½ inches depth, the broken slabs of earth left tumbled in regular form, and presenting an appearance like wave following wave when the tide is coming in. Next, the red clay with pebbles was torn up by the 7-tined turning-cultivator, making good work at $7\frac{1}{2}$ inches depth; the bottom, however, was slightly ribbed.

*Messrs. Fowler's 12-Horse Clip-Drum and Travelling-Anchor Set* was worked on July 5th, on Plot 12, in a field of two-years-old grass, having a strong clay loam soil. The 4-furrow digging at $6\frac{1}{2}$ inches depth was well done. The 5-tine cultivating at $7\frac{1}{2}$ inches depth, was also good work, but the land was in too moist a condition for the operation. During this tough work the disc-anchor was dragged once from its position.

*Messrs. Fowler's 8-Horse Double-Drum and Travelling-Anchor Set* was tried upon Plot 10 in a field of eight-years-old turf; the soil a strong loam on a pebbly bottom. The 4-furrow digging was very good, the bottom level; the 4-furrow ploughing was also exceedingly well done, the furrow slices being beautifully turned. The cultivating with the 5-tine implement was well done, considering the strength of the turf.

*The Ravensthorpe Company's High-Speed Rope-Tackle on the "Fisken" System* was tried on Plot 14, in the field of two-years-old grass. The 4-furrow digging of this strong clay-loam at 7 inches depth was very good work; the cultivating also was good, and the ground well broken up.

*Messrs. Barrows and Stewart's 12-Horse Stationary Engine and Windlass-Tackle*, worked upon Plot 4, a two-years-old turf, on a strong clay loam with fast bottom; the piece, however, being specially difficult, owing to the undulations. The 9-tine cultivator, at $8\frac{1}{2}$ inches depth made fair work, but left a very uneven bottom. The 5-tine cultivating was very inferior work; and the ploughing, with a Fowler 4-furrow balance implement, was also inferior work, but with a level bottom.

The Judges awarded the first prize of 100*l.* to Messrs. John Fowler and Co., for their 12-horse-power double-engine set; and the second prize of 50*l.* to Messrs. John Fowler and Co., for their 20-horse-power double-engine set.

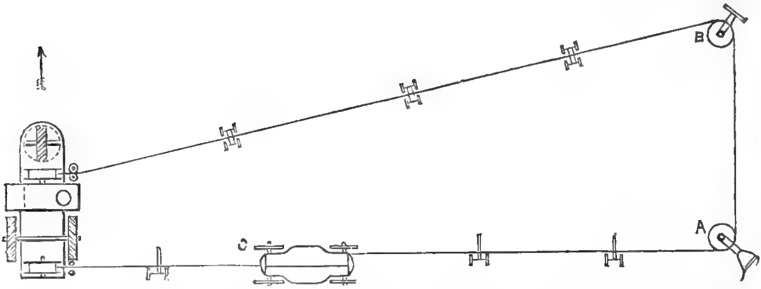
## Class II.

For the "best combination of machinery for the cultivation of the soil by steam-power, the weight of the steam-engine not to exceed 10 tons," there were six entries: four sets of apparatus with single stationary engine, and two with single movable engines and anchors. At Barnhurst, the trials in this class were made on June 28th and 29th.

*Plot A in Field No. XII. Mesrs. J. and F. Howard's 12-Horse Double-Drum and Anchor Set, working on the "Skew" plan;* consisting of 12-horse double-cylinder self-moving engine, fitted with two drums, 1600 yards of steel-wire $\frac{3}{4}$-inch rope, snatch-blocks, claw-anchors, rope-porters, 5-tined reversible cultivator, &c. (Catalogue No., 1168). Price 660*l.* A great peculiarity in the construction of the engine is that the boiler, of the locomotive type, is placed transversely upon a plate-iron framing, which is mounted upon three wheels: thus longitudinal inclination of the boiler in ascending or descending gradients is avoided. The cylinders, of $8\frac{1}{2}$ inches diameter with 12 inches stroke, are placed, also transversely, underneath the boiler; and the crank-shaft, at a similarly low level, is extended from the fly-wheel at the rear of the engine nearly to the steerage-wheel in front. This arrangement enables the two vertical rope-drums—one at the rear of the engine and the other between the boiler and the steerage-wheel—to be driven directly from pinions upon the crank-shaft below them, while bevel gear is requisite for communicating motion to the travelling or driving wheels. The mode of working on the "skew" system is represented in Fig. 15. The engine moves forward at intervals in the direction of the arrow; the snatch-block and claw-anchor A are shifted along the headland by hand in the usual manner; and the pulley

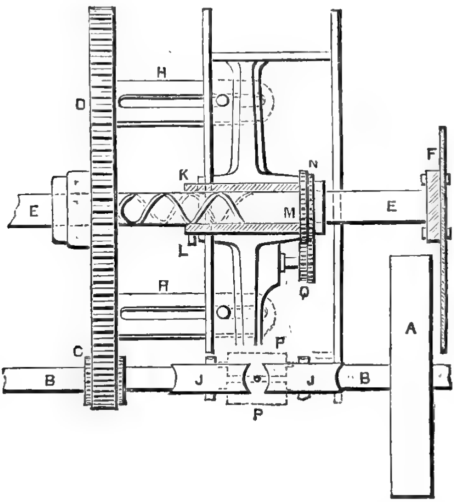
B is fixed. The hands required are the engine-man, one anchor-man, one man on the cultivator C, and two porter-boys. Of course, the self-contained

Fig. 15.—*Diagram illustrating Messrs. Howard's mode of working Steam-cultivating Machinery on the "skew system."*




engine and windlass are adapted also for working on the stationary engine and roundabout rope system, when, as the windlass-drums are self-coiling, and are set in or out of gear by the engine-driver, no windlass-man is required. The method of effecting a perfect coiling of the rope is explained in our vertical section, Fig. 16. A is the fly-wheel on the engine crank-shaft; B B and a

Fig. 16.—*Vertical Section showing the method of effecting the perfect coiling of the Rope in Messrs. Howard's Double-Drum and Anchor Set, No.* 1168.

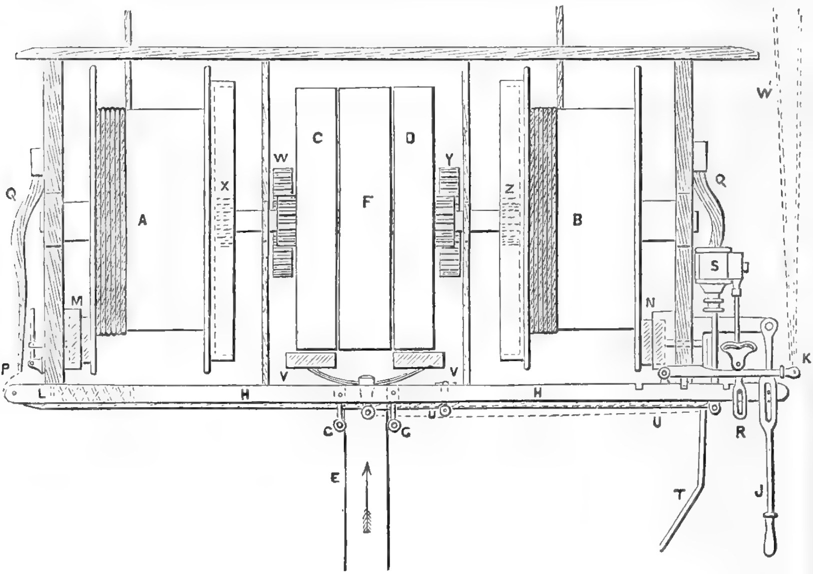



pinion, C, upon this shaft drive a large spur-wheel, D, turning loose upon a fixed horizontal axis, E E, which is supported at each end by a flange bolted to the main frame, as at F. The drum G is connected with the spur-wheel by means of two brackets, H H, projecting sideways from the arms of the spur-wheel at opposite diameters, and a slot in each bracket receives a friction-roller stud, which is fixed upon the inner side of the drum-flange. Thus the drum is caused to revolve with the spur-wheel, while at the same time it is free to traverse sideways along the axis. By a reciprocating movement, alternately approaching to, and receding from, the spur-wheel, and at a rate of travel equivalent to one thickness of wire rope for each revolution, the drum is able to lay on the coils with exact regularity, the rope being fed on at one invariable point, namely, between the guide-rollers J J, which are mounted in immovable bearings. The slow traverse of the drum is effected in this way: the drum boss or centre turns upon a short hollow axle, K, which is loose upon the fixed axis E E, and this hollow axle is gradually shifted along the fixed axis by a screw motion, the hollow axle being made very slowly to rotate, while a pin or die, L, traverses in a screw-thread cut in the fixed axis. This thread returns from end to end of the range; so that the continuous rotation has the effect of sliding the hollow axle, and with it the drum, slowly to and fro for a distance equal to the breadth of the drum. The hollow axle carries a small spur-wheel, M, close beside a spur-wheel, N, which has one cog-tooth less than the number upon M; and this wheel, N, does not rotate, but is cast in one piece with a ring, which is slided along the fixed axis, always keeping close to the wheel M. A double pinion, Q, hung upon a stud on one arm of the drum, and so carried round M and N by each revolution of the drum, gives the required slow motion to the hollow axle, the movement being very similar to that which actuates the lever-coiler of Messrs. Fowler's rope-drum. The traversing drum avoids heavy strain upon a coiling apparatus, and, being in a vertical position, the coils do not shift their places and overlap when there happens to be a loosening of the outgoing rope. But as the guide-rollers are not upon a swinging or movable arm, the rope is sharply bent over one or other of the rollers P P, according as the coils are being wrapped nearer to or farther from the drum centre; and again, the rope is subject to a sharp bend round one or other of the side-rollers J J in every case, excepting when it is passing on or off exactly at right angles with the line of advance of the engine along the headland. The rollers J J have a diameter of 11 inches; and in working on the "skew" plan (see Fig. 15) the rope between the engine and the anchor B is of necessity thus bent round one roller, while the other rope can be saved from like treatment only by preserving its drum constantly in exact line with the furrow.

At Barnhurst, on June 28th, this machinery was moved to the plot and set down to work in 19 minutes, by the aid of two horses, four men, and two boys. When at work four men and two boys were engaged, and the average time taken in reversing (not turning) the implement was 23 seconds. The 5-tined cultivator was worked on June 29th with 4 tines set 12 inches apart; the points were $1\frac{3}{4}$ inch wide, but shares of 13 inches breadth being also attached, the cutting parts overlapped, and hence the bottom was left very level. Each of these broad stirring-shares carries a couple of 4-inch prongs, which, being attached by joints, slope either way according to the direction travelled; and the tine, with points fore and aft, is clasped to the beam in such a manner as to allow it a little play or rocking movement, which tilts the tine a little forward, with the effect of dipping the front point and easing upward the other point, which is being trailed backward in readiness for the return journey. The work done was fair, but was not left sufficiently rough. The average pace of the implement was $3\frac{1}{4}$ miles per hour. The foul clover-ley was cultivated $8\frac{1}{2}$ inches deep at the rate of 1 acre per hour; but in the run of 1 hour and 32 minutes there was a stoppage of 12 minutes for the purpose of changing the points, and the plot was very stony in places. This set was not tried at Stafford in Class II., as the engine, upon being weighed, was found over 10 tons.

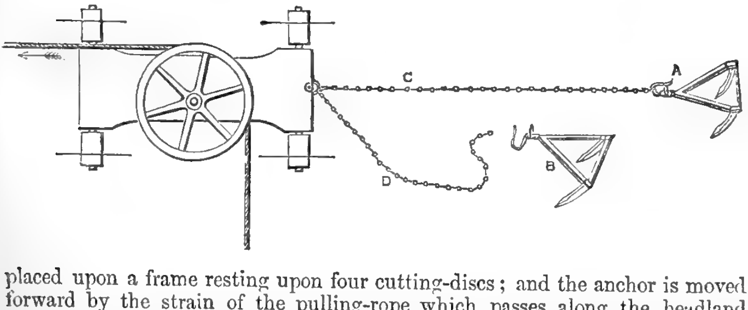
*Plot B in Field No. XII.* 12-*Horse Portable Engine and Detached-Windlass Set of Mr. Edward Hayes, of Watling Works, Stony Stratford, Buckinghamshire*; consisting of a 12-horse power portable engine, with single cylinder of $10\frac{1}{2}$ inches diameter and 16 inches stroke, patent "self-acting" windlass, 1400 yards of steel-wire rope, snatch-blocks, claw-anchors, two self-travelling anchors, rope-porters, 5-tine turning cultivator, &c. (Catalogue No., 3696). Price 580*l*. To the crank-shaft of a common portable engine Mr. Hayes affixes a belt-rigger, having a periphery of 21 inches breadth, the shaft being elongated for the purpose, or otherwise; the rigger, attached by clasps to the arms of the fly-wheel and a small pulley for tightening the driving-belt, is mounted upon a bracket temporarily clamped upon the felloe of one of the front-wheels of the engine; this pulley having ample sideway play upon its axis, and thus accommodating its position to the place occupied by the belt upon the broad driving-rigger. The belt E (in Fig. 17, which is a

Fig. 17.—*Plan of Mr. Edward Hayes's detached Windlass, belonging to Set No.* 3696.



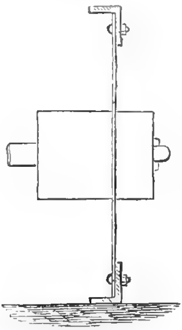

plan of the windlass) drives one of three riggers, of which the centre one, F, is loose upon the axis, and C and D give motion to the rope-drums A and B respectively by means of pinions, intermediate spur-wheels, W and Y, and pinions, X and Z, gearing with internal cog-teeth upon the drum-flanges. By a guide G G upon the sliding bar H H, shifted by the lever-handle J, the engine-man throws the driving-band E upon the dead rigger F, or upon the rigger C for actuating the drum A, or upon the rigger D for actuating the drum B. The bar H H has a tendency to return always to the out-of-gear position shown in the plan, this being effected by a couple of strong spiral springs, one of which is represented at L. When shifted to right or left by the handle J, the bar H is held locked in that position by the catch K dropping into one of the notches shown; and immediately upon this catch being withdrawn, the bar, released, moves to its normal position, throwing the belt upon the loose pulley F. At the same time another action takes place. The sliding of the bar H in either direction moves a short lever, R, which, by means of a small double-acting slot-cam, opens and again closes the valve of a little cylinder, S, which has a piston acted upon by steam, or rather condensed water, admitted from the engine-boiler by the pipe T. The motion of the piston actuates a lever, U, which causes the two brake-blocks V V to be pressed tightly against the peripheries of the two driving-riggers C and D. Hence, when either of the rope-drums is being driven, a simple releasing of the catch K causes the bar H to throw the belt on to the loose rigger F, and instantaneously brings both rope-drums to a standstill by the operation of the steam-brake upon the riggers C and D. The method of working is to lay out the ropes on the roundabout plan, and to lay two cords across the field, one to each anchor-man; so that, upon the implement arriving at the anchor, the cord is pulled, and being connected (see $W^1$) with the catch-lever K, the motion is instantly stopped. This gives the same advantage of avoiding signals, &c., as we found in the double-engine or travelling-windlass systems. The windlass is started for the next journey by the engine-driver moving the lever J. The breaking or slight retardation of the paying-out drum is effected by blocks, M and N, pressed by springs, Q Q, against the drum-flanges. Each spring is connected with the bar H by a short piece of chain, P; so that when the bar is shifted to the left, bringing the belt upon the rigger C, and driving the rope-drum A, the chain P takes the pressure of the spring off the block M. A similar action at the other end of the windlass relieves the block N when the drum is winding up rope. This ingenious invention enables the implement to be turned in the shortest possible time; and, as the engine keeps always running, there is no delay whatever by pulling up and again starting. The frame of the windlass is constructed of plate-iron on the truss principle, and it is mounted upon four wheels. Mr. Hayes employs two self-shifting anchors, worked as represented in plan in Fig. 18. The pulley is

Fig. 18.—*Diagram illustrating the mode of working of Mr. Edward Hayes's Self-shifting Anchor.*




placed upon a frame resting upon four cutting-discs; and the anchor is moved forward by the strain of the pulling-rope which passes along the headland in the direction of the arrow. To regulate the distance advanced, a couple of claw-anchors are shifted forward by hand alternately; the anchor being held back by the chains C and D in turn, each tight chain being released at the proper moment by knocking loose the "dog-link" A and B. Another method exhibited, but not in working order, consisted in fitting the anchor with a small worm-wheel and barrel, slowly working spike-wheels and chains on the principle of the Weston pulley-blocks,—wheels of three different sizes being provided for three different rates of advance. Mr. Hayes does not attach travelling-wheels to his anchors for removal, but easily and expeditiously incloses each disc in an angle-iron ring by three bolts and nuts (Fig. 19).

Fig. 19.



The implement used with this apparatus is a cultivator, working with three, four, or five tines, and much resembling the Woolston cultivator in form. On June 28th, five men and a boy, with the help of ten horses, moved and set down the machinery ready for work in 1 hour and 35 minutes. Five men and one boy were engaged in the work of breaking up the foul clover-lea at a depth of about 6 inches; deeper work, from 7 to 7½ inches, being also done with 3 tines in the implement. But there were so many stoppages, mainly from the want of training in the men, and also from the anchors giving way, that the trial was ultimately abandoned and the set withdrawn from competition.

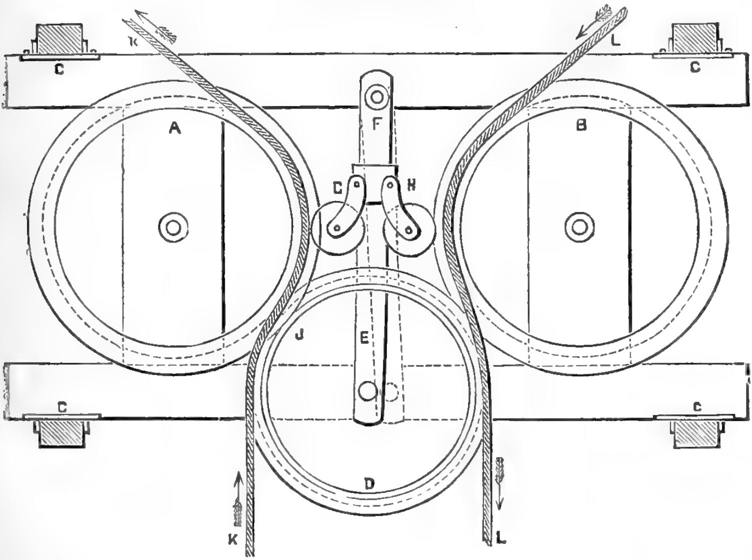
*Plot C in Field No. XII. The Ravensthorpe Engineering Company's 10-Horse Self-moving Engine and High-speed Rope Set, working a Fowler's 5-tine Turning Cultivator* (Catalogue No., 6023), price 690*l.*; consisting of a Clayton and Shuttleworth's 10-horse self-moving engine, with double cylinder of 7¼ inches diameter and 12 inches stroke, two self-moving windlasses, six corner-anchors, one driving-rope anchor, two claw-anchors, twenty-five rope-porters, 1200 yards of ⅝-inch Manilla hemp rope, 700 yards of ½-inch steel rope, and a 5-tine turning cultivator. Weight of the engine, 9 tons 9 cwts. 1 qr. 9 lbs.; of the two windlasses, 9 tons 4 cwts. 7 lbs. Five men, with the help of five horses, moved and set this machinery down in readiness for work in 14 minutes. Four men were engaged in working, and the cultivator made fair work in the foul clover-lea, at an average depth of 8 inches. After 1½ acre had been cultivated, the work was brought to a conclusion by a step-bearing of one of the windlasses becoming hot and melting away, for want of proper lubrication, the shaft then getting out of line and stripping several cogs off a spur-wheel. The trial was consequently abandoned.

*Plot E in Field No. XIV. Messrs. Fowler's 12-Horse Clip-drum Engine and Travelling-Anchor Set* (Catalogue No., 6482) *and 7-tine Balance Cultivator, with Slack Gear* (Catalogue No., 6508). Price 799*l.* The weight of the engine is 9 tons 18¾ cwts. With three men and two boys this apparatus was set down to work in 19¼ minutes. The 3-acre plot of barley seeds was cultivated in 1 hour 58 minutes, including 24 minutes' delay from the accidental fracture of the advance-motion spur-wheel of the anchor. The average time occupied in reversing the implement was only 12 seconds. The rate of performance, taking 3 acres to have been done in 1 hour 34 minutes, was 19 acres 23 poles in ten hours, or 22 acres 3 roods 35 poles in an autumn day of twelve hours. The work, averaging 7½ inches deep, was exceedingly good, and thoroughly well broken up.

*Plot F in Field No. XIV. Messrs. J. and F. Howard's 10-Horse Portable Engine and Detached-Windlass Set, with 5-tine Reversible Cultivator* (Catalogue No., 1170); consisting of a 10-horse portable engine with single cylinder of 10 inches diameter and 14 inches stroke, detached windlass, 1600 yards of 1¾-inch circumference steel rope, one compensating double snatch-block, five single snatch-blocks, seven anchors with steel claws, four wood anchors, eleven three-wheeled rope-porters, eight lever rope-porters, two angle-iron porters, 5-tine reversible cultivator, &c. Price 500*l.*; with 4-furrow combined plough in addition, 580*l.* The weight of the engine is 5 tons 9 cwts. 1 qr., and of the windlass 2 tons 16 cwts. The plan of working is on the roundabout system. The two-wheeled windlass is well known for its simple arrangement for throwing either drum in or out of gear, and for simultaneously bringing the self-acting brake into play. Avoiding the rattle and wear of sliding clutches or pinions, Messrs. Howard key two malleable-iron pinions upon the driving-shaft, which receives motion from the engine crank-shaft by a coupling with universal joints; and the rope-drums are hung upon hollow axes or bosses set eccentrically upon a fixed axle, so that by partially turning these centres by lever-handles for the purpose, the drums are raised or depressed, setting the cog-teeth of the flanges in or out of gear with the pinions. And the same movement which drops a drum out of gear leaves it resting, by the inner side of its flange or rim, upon a fixed block, which thus serves as a brake.

The compensating double snatch-block is a contrivance for recovering upon the pulling-rope a portion of the motive power which is lost in retarding, or rather maintaining a degree of tension in the outgoing rope. It is owing to a common misunderstanding as to the action of this apparatus that it is often set down in an improper position and its whole value sacrificed and Fig. 20,

Fig. 20.—*Diagram-plan of Messrs. J. and F. Howard's Compensating Double Snatch-block.*




which is a plan not drawn to scale, may assist in an explanation. A and B are the two pulleys, mounted upon a rectangular frame held fast to the ground by stakes, C C C C, driven deeply in, the iron cheeks also being made to penetrate the soil and thus tend to secure the frame against shifting its position. A third and smaller pulley, D, is mounted upon a loose bar, E, which is centred at F upon the frame, so that the pulley D is at liberty to approach one or other of the two fixed pulleys A and B. Thus, when L is the pulling rope, as in the figure, passing in the direction of the arrow towards the windlass, it forces the movable pulley D towards the fixed pulley A, and, in fact, presses a ring or flange, J, against the rim of the pulley A. On the contrary, when K is the tight or pulling rope, it presses the ring J of the pulley D in contact with the rim of the pulley B. The ring J, being of smaller diameter than the pitch-line of the rope-groove in the periphery of the pulley D, moves with less velocity, or, in other words, at the rate of a less number of feet per minute, than the rope L which gives motion to the pulley D. Both ropes, however, move with precisely equal speed, namely, the pace of the implement to which they are respectively attached out in the field; and hence the outgoing or slack rope K also moves with greater lineal speed than does the ring J. But this rope drives the pulley A, because pressed tightly into the groove by the roller G; and the rim of the pulley A being further from the centre than the pitch-line occupied by the rope, moves with a velocity greater than that of the rope, and therefore greater than that of the ring or flange J which is pressed against it. The result is that the pulley D tends to retard the pulley A, which in turn endeavours to drive the pulley D; and any power expended in holding back the slack rope K is recovered in driving the pulley D and consequently assisting to urge forward the hauling-rope L. When K becomes the pulling-rope and L the slack, the movement of the pulley D and arm or bar E toward the pulley B presses the roller H upon the rope L, thus holding it tightly in its groove; and the retarding of the rope L tends to help in pulling the rope K.

The two single snatch-blocks at the ends of the furrow are shifted by hand in the ordinary manner. The working force of five men and two boys, with eight horses to move the tackle, set down to work in 21 minutes. The 5-tine cultivator, with four tines having on 13-inch-wide blades, with the rocking prongs or stirrers, made good work in the clover-lea, at an average depth of $7\frac{1}{2}$ inches, leaving a very even bottom, but the surface not sufficiently rough. Allowing for a delay, but including time lost in an upsetting of the double snatch-block owing to its having been insufficiently fastened down by the stakes, the 3-acre plot was finished in 2 hours 14 minutes; being at the rate of 13 acres, 1 rood, 29 perches in ten hours, or 16 acres and 28 perches in an autumn day of twelve hours. The average time occupied in reversing the implement at the ends was 28 seconds.

At Stafford, on July 5th, on Plot 3, upon a two-years-old turf, the soil a strong clay loam with fast bottom, and with a very deep hollow in the field, this set of tackle worked a plough at $6\frac{1}{4}$ inches depth, making good work. In cultivating at $5\frac{3}{4}$ inches depth, and digging at $6\frac{3}{4}$ inches depth, very fair work also was performed.

*Plot G in Field No. XIV. Messrs. Barrows and Stewart's 12-Horse Portable Engine, and Detached-Windlass Set, with 5-tine Woolston Cultivator, &c.* (Catalogue No., 865); price 486*l*. The weight of the engine is 4 tons 11 cwts. 1 qr. 16 lbs.; of the windlass, 3 tons 19 cwts. 21 lbs. With five men and two boys, and a force of eight horses, this tackle was set down in $28\frac{1}{2}$ minutes. The clover-lea was cultivated at an average depth of 9 inches; but the work was inferior, not well broken up, and the bottom very irregular, owing to the tines working from 3 to 5 inches deeper than the spaces between them. The average time occupied in turning the implement at the ends was 33 seconds; and the 3-acre plot was finished in 2 hours, 19 minutes; being at the rate of 12 acres, 3 roods, 31 perches, in 10 hours; or 15 acres, 2 roods, 5 perches, in an autumn day of 12 hours.

The work done at Stafford for Class II. by the apparatus of Messrs. Barrows and Stewart, the Ravensthorpe Engineering Company, and Messrs. J. Fowler and Co., was the same as for Class I. It may be observed here that the limitation as to weight—namely, "the weight of the steam-engine not to exceed 10 tons" as interpreted in the "condition," that "the weight of the engine shall be deemed to be exclusive of coal, water, and rope, but to include the weight of the drum or windlass"—evidently has reference to the engine with its self-contained machinery upon the same travelling wheels, and in no way embraces the weight of any detached parts of the apparatus, whether they be windlasses or otherwise. The palpable intention of the condition is to limit the weight of the heaviest piece of machinery in a set—which is, in fact, the engine with its attachments; and hence there could be no doubt that the Ravensthorpe Company's traction-engine tackle was qualified to compete in this Class II. The actual wording of the condition, however, told the other way.

The Judges awarded the first prize of 50*l.* in this class to Messrs. John Fowler and Co. for their clip-drum engine and travelling-anchor set (Catalogue Nos., 6842, 6508), and the second prize of 25*l.* to the Ravensthorpe Engineering Company for their high-speed rope set, with self-moving engine (Catalogue No., 6023).

## Class III.

For "the best combination of machinery for the cultivation of the soil by an ordinary agricultural engine, whether self-propelling or portable," there were four sets of machinery in competition, all working on the "roundabout" system, the detached windlass in each case being driven by belt from a 12-horse double-cylinder portable engine of Messrs. Clayton and Shuttleworth, engaged by the Society for the purpose. The condition laid down in the "General Instructions," to the effect that "all the machines in Class III. will be tried by one and the same ordinary portable engine," excluded from competition the Ravensthorpe Engineering Company, whose apparatus would have required either a V-groove in the fly-wheel of the engine or the temporary attachment of a large V-grooved rigger and a smaller guide-sheave, and excluded also Mr. E. Hayes, whose machinery would have required the temporary fixing to the engine fly-wheel of a broad-belt drum and also the temporary attachment of a tightening pulley. It is plain that both these sets of machinery are essentially adapted for being driven by either portable or self-moving engines; but they were not able to comply with the condition of being driven by one and the same engine, and consequently were not tried, though the Stewards did not really exclude them from this class.

*Plot* 1, *in Field No. XI. Messrs. John Fowler and Co.'s Detached-Windlass Set;* consisting of two-wheeled windlass, 1600 yards of steel-wire rope, double snatch-block, and single snatch-blocks, claw-anchors, 20 rope-porters, &c. (Catalogue No., 6486), with 4-furrow balance combined plough, digger, and cultivator (6493); price 280*l.*; with combined drill, and two sets of harrows (6510), in addition, 375*l.*

In the hauling tackle there are no special features of construction to call for remark, beyond the fact that the windlass, working with pinions and a double clutch for throwing in or out of gear by a lever in the ordinary manner, is strongly made, and that the winding drums and also the pulleys are of large diameter, so as to save wear and tear of the rope and economise motive power.

On July 1st, the apparatus, employing five men and two boys, worked a 4-furrow balance-plough fitted with digging breasts. At 7½ inches deep very good work was made, with the bottom cut level. The same implement, with plough mould-boards, accomplished some well-laid ploughing at 6¾ inches depth; and after one hour and three minutes spent in digging, and 53 minutes in ploughing, the skifes were fitted for scarifying. That is, the mould-boards were removed, and short prong-breasts substituted while the three forward coulters were taken out and the hindmost left in; the implement then acting as a cultivator of 3½ feet width, cutting a level bottom at 7¼ inches depth, as well as thoroughly well breaking up the ground. Owing to the wheel-tracks, however, this is not such splendid cultivating as that done by the turning implement.

The drill consists of an iron frame upon a pair of large-diameter wheels, made with deep wooden felloes to prevent clogging in wet soil, with a single steering-wheel in front which is guided in the same manner as in the turning cultivator. The same kind of fork-lever is used also for attaching the draught and tail ropes, and for turning round at the ends of the field; but instead of turning a crank-axle to lift the frame, this fork-lever, when moved to right or left, turns a ring which gathers up chains for lifting a set of harrows off the ground. These harrows are trailed just behind the steering-wheel, and in advance of the drill-coulters, and are lifted and dropped again by a bar suspended to the chains which are connected with the lever-fork ring. There are 14 drill-coulters, taking a breadth of 8½ feet, lifted by chains and barrel in the ordinary manner; another barrel also winding up two chains which raise off the ground a second set of lighter harrows which follow. The drill-man stands upon a board or platform extending the whole width of the drill; the steersman rides upon the box in front. The seeding parts, coulters, cups, &c., are manufactured by Mr. James Coultas, of Grantham, and are adapted for sowing from 6 up to 28 pecks of wheat per acre; and the whole is furnished as a complete general-purpose seed- and manure-drill. The weight is about 17 cwts. In the trial the harrowing and drilling were well done, and the drill and harrows were completely under the control of the drill-man; but in turning at the ends the pivot-wheel was found to wrench up the soil. When drilling, the tackle requires six men and two boys. The drill and harrows were not tried at Stafford.

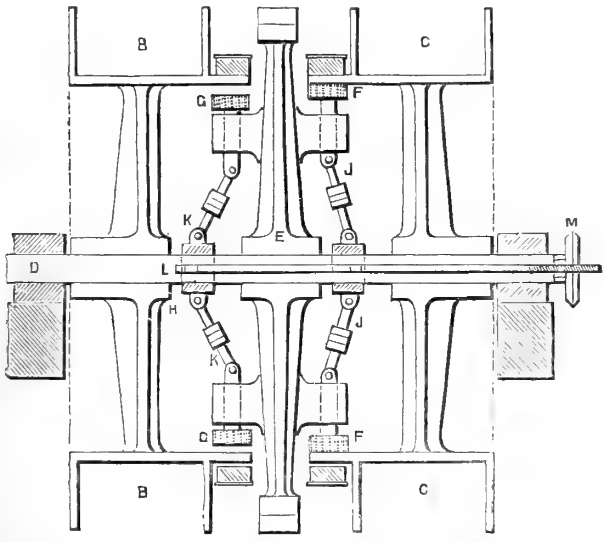
At Stafford, where each exhibitor was allowed to drive by his own engine, this apparatus was tried on July 5th, on Plot 5, in 4-furrow digging a two-years-old turf on strong clay loam with fast bottom. The ground was very undulating, with a deep marl-pit; the work, however, was exceedingly well done, at an average depth of 8 inches.

*Plot K in Field No. XI. Messrs. J. and F. Howard's Detached-Windlass Set;* consisting of a 2-wheeled detached windlass, 1600 yards of best steel-wire 1¾-inch (circumference) rope, one compensating double snatch-block, 5 single snatch-blocks, 7 claw-anchors, 4 wood anchors, 11 3-wheeled rope-porters, 8 lever 2-wheeled porters, 5-tine reversible cultivator, &c. (Catalogue No., 1170); price 250*l.* With 4-furrow combined plough and digger with steel beams (1174), one set of double-action steam harrows No. 1 (1185), and a steam drill complete with harrows (1182), in addition, 416*l.* 10*s.* The windlass, tackle, and cultivator, are similar to those already described. The double-action harrows, which work to and fro without turning at the ends, and are most easily steered, take a breadth of 12½ feet. The drill, with 12 coulters, taking a breadth of 8¼ feet, has a 2-wheeled fore-carriage for steering; and to each main wheel is fitted a small turntable or pivot-skid, which is brought under the wheel at pleasure by means of a lever-handle, so that whichever side wheel may form the pivot in turning round at the end of the field is centred for the time being upon the disc or turntable, and the movement is effected without tearing up or boring much into the soil. A set of harrows is attached by a draught-chain to a cross-bar at the rear of the drill; and as the chain slides from end to end of the bar when the drill is turning round for the next journey, the harrows are drawn "on the quarter," always covering in the seed, with the exception of a few drill-rows left as a guide for the steersman. At the trial, turning the drill at the end occupied one minute. The sowing and harrowing operations were exceedingly well performed, and the manner of turning was admirable. One hand was required in addition to the usual "roundabout" force. On June 30th, the cultivator, with 3 tines in use, made fair work at 7½ inches depth, with a very level bottom; but the ground was not sufficiently broken up. The 4-furrow plough did some specially good work at a depth of 7¾ inches, and also good digging, with a level bottom, at 7½ inches depth. The harrowing was inferior work, the implement being too heavy for the soil operated on, and, indeed, more like a drag than a harrow. The reversal of the set of harrows at the end (or rather changing the position of the steersman, and running in an angular direction into fresh land), occupied on an average $1\frac{1}{2}$ minute. The work done at Stafford in this class was the same as that in Class II.

*Plot L in Field No. XI. Messrs. Barrows and Stewart's Detached-Windlass Set*, consisting of their four-wheeled windlass, ropes, snatch-blocks, claw-anchors, twenty-two rope-porters, tools, 5-tined Woolston cultivator, 4-furrow balance plough, &c. (Catalogue No., 865), price 280*l.* Owing to the windlass being too highly speeded for being driven by the belt from the Clayton and Shuttleworth engine, which was employed in all cases at a pressure of 60lbs., the trial could not be proceeded with. At Stafford, the cultivating and ploughing were the same as in Class I.

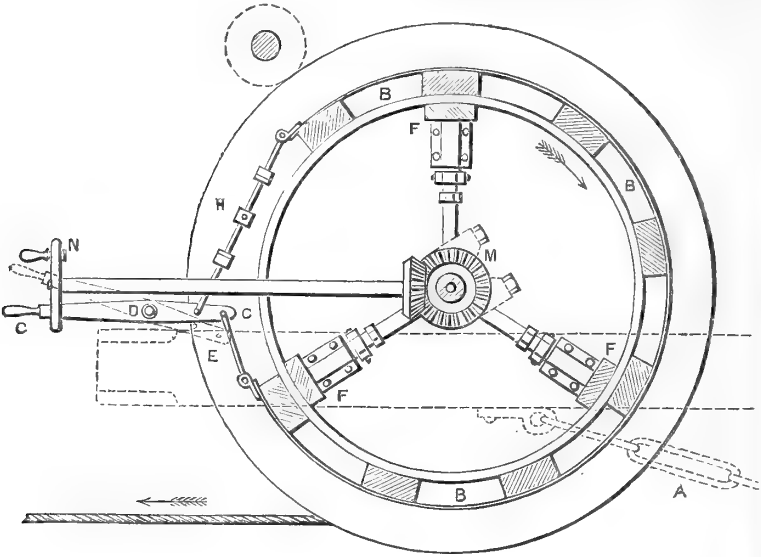
*Plot M. in Field No. XI. Messrs. Amies and Barford's Detached-Windlass Set*, consisting of a Tuxford's patent windlass, 1600 yards of steel rope, two self-moving Campain's patent anchors, one double snatch-block, six single snatch-blocks, six claw-anchors, twenty-six rope-porters, levers, 7-tined cultivator, 3-furrow semi-balance combined plough and digger, &c. (Catalogue No., 2663), price 310*l.*; with steam-roller and set of harrows in addition, 375*l.* The windlass, invented and manufactured by Messrs. Tuxford and Sons of Boston, is very ingeniously constructed. The main portion of the weight is carried by a pair of large travelling-wheels, while a third wheel is placed in front for steerage, so that when descending an incline weight is not thrown upon the horse's back and the use of a slipper and chain is rendered available. When fixed for work, a couple of strong chains or shackles, A (Fig. 22), are fastened to two iron stakes, which are screwed into the ground on the principle of the screw pile. The two winding drums, B and C (Fig.

Fig. 21.—*Ideal Section of Messrs. Tuxford and Sons' Patent Detached Windlass, No.* 6914.




22, which is a cross section not drawn to scale), run loose upon the horizontal axis D; and between the drums and keyed upon the shaft or axis is a spur-wheel, E, actuated by a pinion upon an upper shaft, which receives motion from the steam-engine either by rigger and strap (as during the trial in Class III.), or by a coupling-shaft with universal joints. The spur-wheel is con-

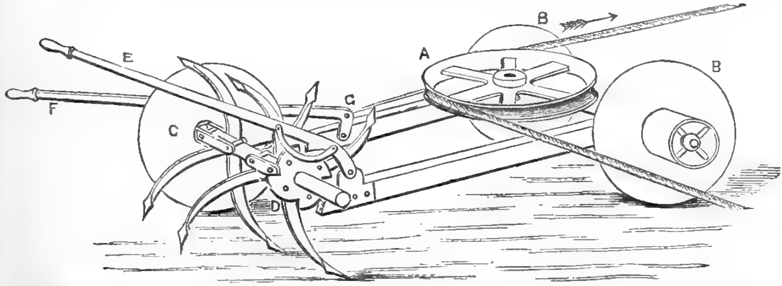
Fig. 22.—*Section of Messrs. Tuxford and Sons' Detached Patent Windlass.*




nected or disconnected with either drum by "adjustable expanding friction-couplings," which may be thus described. Carried in guides or cheeks cast upon the arms of the spur-wheel, are "toggle-blocks," F F and G G (Figs. 21 and 22), three upon one side of the wheel and three on the other; the stems by which the blocks are supported sliding in the guides, so that they can be thrust outwards against the inner part of the rim of each drum or withdrawn from contact. For effecting this movement each set of three blocks is connected with a loose boss or ring surrounding the shaft and sliding upon a feather, by means of three "toggle-bars" jointed and made with right and left hand adjusting screws for altering their length. Thus, when the ring H is drawn toward the spur-wheel, the bars J J press the blocks F F against the flange of the drum C, the pressure being exactly equal upon all three blocks, while the amount of thrust from this triple knee-joint action can be regulated by lengthening or shortening the toggle-bars J J. In this position the spur-wheel E is in gear with and drives the drum C. By sliding the boss along the shaft away from the spur-wheel, the toggle-blocks are withdrawn from contact with the drum, as represented in Fig. 21, where the ring or boss K, drawn aside, causes the blocks G G to approach the centre, thus leaving the drum B released from connection with the spur-wheel. It will be understood that as both the rings or bosses H and K are secured by keys through lateral slots to a spindle, L, passing up the centre of the shaft D, the disconnection of one drum and gearing of the other are simultaneously effected by simply sliding the spindle L further in or out of the shaft. The outer end of the spindle has a screw cut on it, and carries a light bevel-wheel, M, in the boss of which a thread is formed; and by means of another bevel-wheel, shaft, and hand-wheel, N (Fig. 21), the windlass-man screws the spindle L one way or the other, the leverage being such that a very slight pressure upon the hand-wheel will thrust the blocks out with sufficient force to hold a drum without slipping against any strain, though the action may be so adjusted that the blocks shall slip in case of the implement encountering a root, a rock, or other immovable obstacle. While the windlass is in motion the hand-wheel slowly revolves, and upon the windlass-man catching hold of the handle the hauling-drum is instantly stopped; both drums are then out of gear till a further movement of the hand-wheel brings into gear the drum which had been paying out the slack rope. The spur-wheel is never stopped, so that all delays in pulling up and starting the engine are avoided; and the stopping and reversal of the action of the drum are accomplished with the smallest possible motion, free from the slightest shock or jar. The "automatic friction-brake" upon each drum consists of an ordinary wood-lined brake-strap, B B (Fig. 22), embracing the outer surface of the rim or flange immediately over the driving toggle-blocks. The iron strap is attached to a differential lever, C, of the same character as that invented by the late Mr. Appold some twenty years ago, and used ever since upon the Society's friction-brakes. When the rope is being paid out and the drum revolving in the direction of the arrow, the brake, so to speak, keeps itself tight, the strap with its wood blocks closing round the drum flange with a force proportioned to the difference in length between what may be called the two arms of the lever C, or, in other words, the two distances of the points of attachment from the fulcrum D. On the contrary, when the drum is winding up the rope and revolving in the direction opposite to that of the arrow, the brake simply rests with its own weight upon the drum-flange, and by depressing the end of the lever, as shown by the dotted lines at E, opens itself so as no longer to compress the drum. Any requisite degree of tightness can be given to the brake by the adjusting screw F. A uniform strain is maintained upon the outgoing rope; no slack can run off the windlass unless the lever be purposely lifted by hand; and as the brakes pass into and out of action by the motion of the drums, no further attention is required after they have been once regulated, and there is no possibility of any entanglement from the attendant's carelessness.

Messrs. Amies and Barford lay out their rope upon the roundabout system, but in place of the ordinary snatch-blocks and claw-anchors shifted by manual labour at the ends of the furrow, they employ two self-moving anchors, patented by Mr. S. Campain, of Deeping Fen, near Spalding, Lincolnshire. The very ingenious contrivance referred to consists of a strong horizontal

Fig. 23.—*Sketch of Campain's Patent Self-moving Anchor, No.* 2675.




frame, mounted upon four ordinary anchor-discs and rollers (BB and C, Fig. 23), with a rope pulley, A, placed towards the forward end. The hind axle is a strong square shaft, to which are affixed by clamps and bolts two or more sets of diamond-pointed tines, four in each set, the sets being parallel so that two or more tines shall be in the ground at once. The square shaft, carrying also the discs C (of which one is removed in the drawing), is mounted in bearings upon the frame, but its revolution is controlled by a four-toothed ratchet, D, into which drops a catch on the under side of the long lever handle E. Riveted to one side of the lever, and working close to the face of the ratchet D, is a double inclined plane, so formed that when pins are put into holes which are in the ratchet face and corresponding in number and position to the teeth, the round heads of the pins projecting sideways and bearing against the inclined plane prevent the lever falling into the teeth of the ratchet and locking it. The action of the anchor is as follows: As soon as the implement starts on its journey toward the anchor, the strain upon the rope tends to draw the anchor along the headland in the direction of the arrow; the tinse on the rear shaft being embedded in the ground cause the shaft to turn, the rotation being assisted by the revolution of the disc-plates C, which are fast upon that shaft or axle, and the motion continues until arrested by the lever-catch E dropping into the ratchet D. Directly the implement reaches the end of its furrow next to the anchor, either the ploughman or the porter-boy releases the ratchet by raising the lever handle, when the ratchet D at once springs forward just sufficiently to hold up the lever by the catch. The man or boy then puts into the holes one or more pins, according to the intended distance of advance of the anchor at its next shift, but without a pin in that hole next the tooth which is to be caught; and leaves the anchor thus regulated, immovable while the implement is on its return journey but ready to move forward when the pulling strain again comes upon it. The resultant strain upon the anchor being diagonal, the resistance offered is rightly arranged to be longitudinal by means of the tines and transverse by means of the disc wheels. A box for the reception of weights surmounts the frame (though omitted in the Fig. 23), overhanging that side which is farthest from the implement; and there appears to be a little difficulty in adjusting the load according to the nature of the ground and the draught of the implement. But when this is done, the action is tolerably certain; and at any rate the porter-boy, by means of a wood lever, can always give the anchor a start, and thus make it run forward to its place. Hence the two anchor-men required in working the common claw-anchor and snatch-block tackle are dispensed with. The Campain anchor is guided in its intermittent course along the headland by the front axle being locked or slightly angled by means of a rod and lever, F, working in a spring quadrant at G; and for travelling from place to place, road wheels are hung upon the disc axles, the wheels when removed being replaced by loose bushes. Messrs. Amies and Barford employ a very handy "pick-up" rope-porter, in which the rigger has a sliding movement upon its axle; so that while falling close to the ground when being inserted under the rope, it traverses along its slanting axle when the porter is in position, thus occupying a central place above the points of support and preserving the equilibrium of the porter.

The cultivator used is a modification of the Woolston implement, with a triangular locking frame in place of the "turnbow," a handwheel and chain movement instead of a lever for steering, and shares of a rounded-diamond or pear shape in place of the Woolston square spuds.

The plough invented by Mr. E. Proctor, of Pitstone, Tring, is constructed with parallel beams and trusses, upon what is called the "semi-balance" principle, and is lightly made, the 3-furrow implement weighing only 18 cwts. In the trial at Barnhurst on July 1st, with three men and two boys working the tackle, the cultivating at 7 inches depth was inferior work, with a very uneven bottom; the ploughing at 6½ inches depth was well done, but the bottom not quite level; and the digging by the same implement was good work at a depth of 6½ inches. At Stafford, on Plot 8, the plough made good work 5¼ inches deep in an eight-years-old turf, the soil a strong red loam upon a pebbly bottom. The digging was also fair work at 6½ inches depth, but with a very uneven bottom. The cultivating at 6½ inches depth was very inferior.

The Judges awarded the first prize of 50*l.* to Messrs. J. Fowler and Co. for their set of steam-cultivating apparatus (Nos. 6486, 6493, 6510); and the second prize of 25*l.* to Messrs. J. and F. Howard, for their set of steam-cultivating apparatus (Nos. 1170, 1174, 1182, 1185).

### Lord Vernon's Prize.

For "the best combination of machinery for the cultivation of the soil by steam-power, the cost of which shall not exceed 700*l.*, the engine to be locomotive, and adapted for threshing and other farm purposes," there were four sets in competition; of which two were on the stationary engine and windlass system, one worked with a stationary engine high-speed rope and moving windlasses, and one had a movable engine and anchorage.

*Plot D in Field No. XIV. Messrs. Amies and Barford's* 10-*Horse-power Detached-Windlass Set;* consisting of a Tuxford and Son's 10-horse-power single-cylinder self-moving engine, price 390*l.*; a Tuxford and Son's windlass with adjustable, expanding friction couplings, and automatic friction brakes, 1600 yards of $\frac{5}{8}$-inch best steel-wire rope, two self-moving "Campain" anchors, one double snatch-block, six single snatch-blocks, six claw-anchors, dead-anchors, twenty-six rope-porters, set of levers, &c.; 7-tine combined cultivator and broadsharer, and 3-furrow semi-balance combined plough and digger (Catalogue No., 2663), price 310*l.*; with the engine, 700*l.* The engine has a single cylinder of 9 inches diameter and 12 inches stroke, and part of the exhaust steam is sent into the water-tank which surrounds the smoke-box. Under the barrel of the boiler is a lever frame carrying the axle of the main road wheels and the intermediate motion which is driven by a pitch-chain from a pinion on the crank-shaft; and as this lever frame is supported by a fulcrum or joints at the fire-box end, and by indiarubber springs at the other end, the effect is to save the engine from shocks in travelling. The steering-wheels at the foot-plate end are supported by upright stems which have a vertical movement within boxes holding volute springs, so that the engine is entirely carried upon springs; and as the steering-wheels turn or lock independently upon their stems as upon swivels or castors, their angular direction is altered much more easily and quickly than if they were attached to a front axle for locking in the ordinary manner,—the arrangement combining to a considerable extent the facilities of a single steering-wheel with the stability and other advantages of a pair. The weight of the engine when empty is 8 tons.

At the trial on June 29th, four men and two boys, with the assistance of four horses, set down the apparatus ready for work in 52 minutes. The hands employed during the trial were one engine-man, one windlass-man, one ploughman, and two porter-boys. The cultivator, with seven 6-inch wide shares, and taking a width of 4½ feet, made good work at 6½ inches depth, the ground being well broken up and the bottom level. The implement was turned at the ends in from 15 to 20 seconds. The ploughing at 7 inches depth was fair work, but the furrows were not turned well owing to the parts being imperfectly set. The average time of the plough at the ends of the field was 30 seconds. It does not appear that the regulation of the anchors by the porter-boys occasions any delay. The whole time occupied in the trial was 3 hours 9½ minutes; but deducting the frequent stoppages occasioned by boulders, the performance was as follows. An area of 2 acres and 32 perches was cultivated in 1 hour 52 minutes; which is at the rate of 11 acres, 3 roods, 5 perches in 10 hours, or 14 acres and 22 perches in an autumn day of 12 hours. At Stafford, the work was represented in the competition in Class III.

*Plot II in Field No. XI. Messrs. J. Fowler and Co.'s 8-Horse-power Double-Drum Engine and Self-moving Anchor Set*; consisting of an 8-horse-power, single-cylinder, self-moving engine, with two winding-drums, one self-moving 6-disc anchor, 1200 yards of common steel-wire rope, 16 rope-porters, &c. (Catalogue No., 6484), price 618*l.*; and one balance combined 4-furrow plough, digger, and cultivator (Catalogue No., 6493), price 80*l.*; with the engine, 698*l.*

At the trial on June 30th, this apparatus was set in position ready for work in 23 minutes, by three men and two boys. When at work, the average time occupied in reversing the implement at the ends was 21 seconds, but many times it was only 15 seconds, and occasionally as short as 13 seconds; and the whole trial was accomplished without the slightest delay from beginning to end. The ploughing at $8\frac{1}{4}$ inches depth was exceedingly well done; the digging at $9\frac{1}{2}$ inches depth was also exceedingly good in every respect; and the same implement, fitted with short prong breasts and with all the coulters removed excepting that on the land side, made beautiful work in cultivating at $8\frac{3}{4}$ inches depth.

*Plot A in Field No. XII. Messrs. J. and F. Howard's 12-Horse-power Double-Drum Engine Set, on the "Skew" plan*; consisting of a 12-horse-power double-cylinder self-moving engine, with transverse boiler, fitted with two winding-drums, 1600 yards of best steel-wire rope, two single snatch-blocks, three steel-tined anchors, one dead-anchor, six 3-wheeled rope-porters, six 2-wheeled rope-porters, one wood lever, one 5-tine reversible cultivator with steel beams, one 4-furrow combined plough and digger with steel beams (Catalogue No., 1168), price 700*l.*

This apparatus, already described, was set down to work in 21 minutes by three men and two boys, with the help of two horses. In the trial on June 29th, the cultivator, with 4 tines, made fair work at $8\frac{1}{2}$ inches depth, the bottom cut very level, and the ground well broken up, though left too flat on the surface. The average time occupied in reversing the implement at the ends was 60 seconds; and an area of 1 acre 2 roods was finished in 1 hour and 32 minutes, being at the rate of 9 acres, 3 roods, 5 perches in ten hours, or 11 acres, 2 roods, 38 perches in an autumn day of twelve hours. The combined plough and digger was not tried at Barnhurst. On July 6th, at Stafford, the plough was worked upon Plot 9, on eight-years-old turf, the soil a strong red loam on a pebbly bottom. At 6 inches depth, the implement turned big flat furrows, but cut a very good bottom. The digging-breasts made fair work also with a good bottom. The 5-tine cultivator with one tine removed made fair work considering the strength of the turf. The bottom was cut very level.

*The Ravensthorpe Engineering Company's Stationary-Engine and High-speed Rope Set*; consisting of a Clayton and Shuttleworth 10-horse-power, cylinder, self-moving engine, two self-moving single-drum windlasses, double-six corner anchors, one tension-anchor, two claw-anchors, 25 rope-porters, 1200 yards of $\frac{5}{8}$-inch Manilla hemp rope, 700 yards of $\frac{1}{2}$-inch steel rope, &c.; one 7-tined cultivator, one 4-furrow Fowler's balance combined plough and digger (Catalogue No., 6023), price 700*l.*

On June 29th this tackle was set down to work in Field No. XXIV. in 14 minutes, and on the next day was taken up and packed ready for travelling in 16 minutes,—five men doing the work with the help of two horses. On June 30th, with four men employed to work the apparatus, cultivating was done at $7\frac{1}{2}$ inches depth, ploughing at 9 inches depth, and digging at an average depth of $7\frac{3}{4}$ inches; but the whole trial was very inadequate, owing to the nature of the ground. At Stafford the ploughing was fair work, but the depth very irregular.

The Judges awarded Lord Vernon's Cup, value 100*l.* to Messrs. J. Fowler and Co., for their 8-horse-power double-drum engine and self-moving anchor set (Catalogue Nos., 6484, 6493).

(Signed) W. Menelaus, C. E.
H. V. Grantham.
John Hemsley.
F. Sherborn.

Class IV.

For "the best Windlass, detached," there were nine entries, of which seven appeared in competition. In Messrs. J. and F. Howard's new windlass the drums have the same sideway traversing motion as upon their steam-cultivating engines, while the ropes are fed on or run off through swivel or castor guides fitted with friction-wheels, so that the coiling is effected without the attention of a windlass-man. But this did not arrive at Wolverhampton in time for the trials. Messrs. Amies and Barford had entered a new windlass, which is driven by friction brakes or clutches, the engine running continuously as in threshing; but this also failed to put in an appearance. The seven windlasses in competition were as follows,—one entered by Messrs. Amies and Barford, but made by Messrs. Brown and May of Devizes, in which common clutches are employed for throwing in or out of gear, and the breaking is effected by friction-straps applied to rims of the pinions instead of to the flanges of the drums; one entered by Messrs. Tuxford and Sons, and used by Messrs. Amies and Barford during the trials of their tackle; and others forming part of the sets of machinery of Messrs. J. and F. Howard, Messrs. J. Fowler and Co., Messrs. Barrows and Stewart, Mr. Edward Hayes, and the Ravensthorpe Engineering Company,—all of which are described in the former portion of this Report. We very carefully examined the windlasses tried at different times. That worked in Messrs. Howard's roundabout apparatus is a well-made and substantial machine; but the windlass of Messrs. Tuxford and Sons, worked by Messrs. Amies and Barford, was so perfectly under the control of the man in attendance, and so very safe, there being not the least danger or difficulty in reversing the action without stopping the engine, that we awarded the prize of 20*l.* in this Class to Messrs. Tuxford and Sons for their windlass with adjustable expanding friction couplings and automatic friction-brakes (Catalogue No., 6914).

## The following is the Report of the Judges on Classes V. to XVI. inclusive:—

Class V. *Best Snatch-block, or substitute thereof.*—In this class we had a novelty exhibited by Mr. Tenwick. His anchor, which he calls permanent, consists of an iron frame, which is to be sunk into the ground deep enough to be out of reach of the plough or cultivator, and fastened there, if necessary, by screws. This proved to be quite necessary in our trial, as it pulled up with the first strain of the rope, and the axle on which the pulley revolved was broken. Standards may be fixed into this frame on which pulleys may work. In the snatch-block pulley itself we have an old invention applied to a new purpose, viz., a ball-and-socket joint to give universal motion, of which we do not see the advantage in this particular case. The price of the whole is 5*l.* 5*s.*

Messrs. Howard exhibited both their double and single snatch-blocks. The double block, price 12*l.* 10*s.*, is strong and well made; the frame is well bolted and fastened, with strong wrought spindles and pulleys of large size, and a patent arrangement of flanges and pulleys to keep the ropes in position. The single block is equally well made. It has a cast wheel 34 inches diameter, on a strong wrought spindle, which is fixed into a plate and bolted on to the board, the board being braced to prevent its splitting. Price 2*l.* 10*s.*

" Messrs. Barrows and Stewart's single snatch-block, price 2*l.* 10*s.*, has a pulley 27 inches in diameter, which is rather small; it has a clip to prevent the rope from getting out of position.

In this class we included Campain's anchor, price 35*l.*, exhibited by Messrs. Amies and Barford, the prize being for the "best snatch-block, or substitute thereof." In this implement the axle used for carrying the discs is now dispensed with, and the discs are placed on the claw-axle, so that they become fixed when the claws are locked. More room is now obtained under the anchor, and there is also more firmness. A clutch on the axle can be set to allow the necessary amount of revolution to bring the anchor forward to any required distance; and when the anchor has to proceed, the axle is simply released, and the strain on the rope draws the anchor forward until it has reached the prescribed distance, when the axle becomes fixed and the claws prevent its further advance. This combination of anchor and snatch-block is calculated to save much time and labour, and we awarded it the prize of 10*l.* in this class.

Class VI. *Best Plough suitable for Steam Cultivation.*—Messrs. Howard began the trials with their semi-balance 3-furrow plough, price 65*l.*; the chief feature of its construction is a wrought-iron frame carried on three 4-foot wrought wheels, one running in the furrow, and the others following each other on the land-side. These are all under steerage, which is consequently very sensitive; but we question if this is an advantage in a plough which moves principally in straight lines and should work steadily. To this frame are fixed two steel plough-frames, which can work independently of each other, but are attached by chains working over a half disc. This arrangement gives the advantage of leverage to the frame which is in work, and a still greater firmness is obtained by a clutch which locks the plough-frame to the wheel-frame. The depth of furrow is regulated by perpendicular screws; the bodies are fitted with lever-necks to alter the pitch of the share; and the workmanship of the whole is of the superior description for which the ploughs of this firm are famous. This plough worked remarkably steadily and well at 7 inches in depth, making furrows 10½ inches wide.

Messrs. Howard next worked a 4-furrow plough, price 80*l.*; similar in construction to the preceding one, but without the clutch which locks the ploughs to the wheel-frame. This made equally as good work as the other, and the draught was light.

Messrs. Howard next tried their large 2-furrow plough, which is made expressly for exceptionally deep ploughing; price 75*l.* This made furrows averaging 16½ inches wide and 14 inches deep. These were so well proportioned, and so well turned, and the work was so extraordinary altogether, that this plot became most attractive and surprising to the hundreds of visitors who watched the trials.

Messrs. Howard's 6-furrow plough was not brought on for trial, in consequence of some breakage having occurred to it during transit.

Messrs. Fowler and Co. next came on with their 3-furrow plough, fitted for deep work, which we placed by the side of Messrs. Howard's deep ploughing. This implement consists of the ordinary 4-furrow frame, carried on two wheels (the land-wheel 4 feet 8 inches high) on the balance principle, and can be fitted with bodies to cut three 14-inch furrows, or four 10-inch furrows. In this trial Kentish breasts were used, and the work done was effective, though of a rougher description than that of Messrs. Howard's plough. The furrows average 13¾ inches wide and 13½ deep, and the plough appeared to be easily managed when ploughing at this depth. Messrs. Fowler's ploughs are so well known that a description of them is scarcely necessary. The frames are similar to those used at Leicester, with the same simple arrangements for raising or lowering, and for altering pitch of bodies; and now we have the simple and strong arrangement for setting and fixing

**Table I.—Synopsis of the Competing sets of Steam Cultivating Machinery at Wolverhampton.**

| 1 | 2 | 3. | 4. | | 5 | 6. | 7. | 8. | 9. | | 10. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of Exhibitor. | Number [illegible] Barnhurst | Catalogue Number | Price | | Description of Apparatus | [illegible] | [illegible] | Number of Horses required for Removal | Number of Men and Lads [illegible] Removal | | Remarks |
| | | | £ | s. | **Class I.** | Min. | Min. | | Men | Lads | |
| John Fowler and Co. .. | 1 | 6480 | 1975 | 0 | Pair of single-cylinder 20-horse self-moving engines, and 13-tined turning cultivator | 17 | 14 | None | 6 | 0 | In ordinary work fewer hands would be required. |
| John Fowler and Co. .. | 4 | 6481 | 1360 | 0 | Pair of single-cylinder 12-horse self-moving engines, and 9-tined turning cultivator. | 15 | 8 | None | 6 | 0 | Ditto |
| John Fowler and Co. .. | 5 | 6482 | 799 | 0 | 12 horse single-cylinder self-moving engine, with clip-drum, travelling anchor, and 7-tined balance cultivator, with slack gear | 36 | | None | 4 | 2 | |
| John Fowler and Co. .. | 6 | 6484 | 678 | 0 | 8 horse single-cylinder self-moving engine, with two winding drums, travelling anchor, and 5-tined turning cultivator | 40 | .. | None | 6 | 0 | Broke anchor axle in leaving the field |
| The Ravensthorpe Engineering Company. | 7 | 6022 | 687 | 0 | 10-horse double-cylinder portable engine, with high-speed Manilla rope, two travelling windlasses, and 7-tined reversible cultivator | 46 | 15½ | 8 | 4 | 0 | |
| Barrows and Stewart .. | 1 | 865 | 486 | 0 | 12-horse double-cylinder portable engine, with detached windlass, snatch-blocks, claw-anchors, and 5-tined Woolston cultivator. | 59½ | .. | 8 | 6 | 0 | |
| | | | | | **Class II.** | | | | | | |
| J. and F. Howard .. | A. | 1168 | 700 | 0 | Self-moving engine, with transverse boiler and two winding-drums, working on the "skew" system, with 5-tined reversible cultivator, &c | 19 | | 2 | 5 | 1 | This engine was subsequently weighed and found over ten tons. |
| E. Hayes .. .. .. | B. | 3696 | 580 | 0 | 12-horse single-cylinder portable engine, with detached windlass, two self-moving anchors, 5-tined "Woolston" cultivator | 95 | .. | 10 | 5 | 1 | |
| The Ravensthorpe Engineering Company. | C. | 6023 | 690 | 0 | 10-horse self-moving engine, two travelling windlasses, high-speed Manilla rope, steel-wire rope, 5-tined turning cultivator, &c | 14 | .. | 5 | [illegible] | 0 | |
| J. Fowler and Co. .. | E. | 6482 | 799 | 0 | 12-horse single-cylinder self propelling engine, with clip-drum, travelling anchor, 7-tined balance cultivator, with slack gear, &c | 39½ | .. | None | 4 | 2 | |
| J. and F. Howard .. | F | 1170 | 500 | 0 | 10-horse single-cylinder portable engine, detached windlass, 1600 yards 1½-inch steel rope, one compensating double snatch-block, five snatch-blocks, seven claw-anchors with steel tines, four wood anchors, eleven 3-wheeled rope-porters, two angle-iron porters, eight lever rope-porters, 5-tined reversible cultivator, &c. | 21 | .. | 8 | 5 | 2 | |
| Barrows and Stewart .. | G. | 865 | 486 | 0 | 12-horse portable engine, detached windlass, ropes, claw-anchors, snatch-blocks, 5-tined "Woolston" cultivator, &c. | [illegible]8 | | 8 | 5 | 2 | |
| | | | | | **Class III.** | | | | | | |
| John Fowler and Co. .. | I. | 6486 6493 6510 | 375 | 0 | Detached windlass, claw-anchors, snatch-blocks, rope-porters, 1600 yards of best steel rope, 4-furrow balance combined plough, digger and cultivator, combined drill, and two sets of harrows, &c. | | | | | | |
| J. and F. Howard .. | K. | 1170 1174 1182 1185 | 416 | 10 | Detached windlass, 1600 yards best steel 1⅜-inch rope, compensating double snatch-block, five snatch-blocks, seven claw-anchors, four wood anchors, eleven 3-wheeled rope-porters, two angle-iron porters, eight 2-wheeled lever porters, 5-tined reversible cultivator, 4-furrow balance combined plough and digger with steel beams, one set of double-action steam harrows, No. 1, one steam drill complete with harrows, &c. | | | | | | |
| Barrows and Stewart .. | L. | 865 | 280 | 0 | Detached 4-wheeled windlass, ropes, claw-anchors, snatch-blocks, 22 rope-porters, 3-tined "Woolston" cultivator, 5-tined "Woolston" cultivator, 4-furrow balance plough, &c. | | | | | | |
| Ames and Barford .. | M. | 2663 | 375 | 0 | Detached "Tuxford" windlass, 1600 yards of steel rope, two travelling "Campain" anchors, one double snatchblock, six snatch-blocks, six claw-anchors, 26 rope-porters, 7-tined turning cultivator, 3-furrow semi-balance combined plough and digger, one steam roller, one set of steam harrows, &c. | | | | | | |
| | | | | | **Class for Lord Vernon's Cup.** | | | | | | |
| Ames and Barford .. | D. | 2663 | 700 | 0 | 10-horse single-cylinder self-moving engine, detached "Tuxford" windlass, two travelling "Campain" anchors, one double snatch-block, six snatch-blocks, six claw-anchors, 26 rope-porters, 1600 yards of ¾-inch best steel rope, 7-tined turning combined cultivator and scarifier, 3-furrow balance combined plough and digger, &c. | 52 | | 4 | 4 | 2 | The time in all cases is exclusive of that occupied in the journey to the field. |
| John Fowler and Co. .. | H. | 6484 6493 | 698 | 0 | 8-horse single-cylinder self moving engine, with two drums, one travelling 6-disc anchor, 1200 yards common steel rope, sixteen rope-porters, and 4-furrow balance combined plough-digger and cultivator. | 23 | .. | None | 3 | 2 | |
| J. and F. Howard .. | A. | 1168 | 700 | 0 | 12-horse double-cylinder transverse-boiler self-moving engine, with two drums, 1600 yards of best steel rope, three steel-tined claw-anchors, one [illegible] anchor and chains, two snatch-blocks, six 3-wheeled rope-porters, six 2-wheeled ditto, 7-tined reversible cultivator with steel beams, 4-furrow combined plough and digger with steel beams, &c. | 21 | | 2 | 1 | 2 | |
| The Ravensthorpe Engineering Company. | .. | 6023 | 700 | 0 | 10-horse double-cylinder self-moving engine, two travelling windlasses, 1200 yards of ¾-inch Manilla rope, 900 yards of ¾-inch steel-wire rope, six pulleys, 25 fixed porters, 4-furrow balanced combined plough and digger, 7-tined turning cultivator, &c. | .. | 16 | 2 | 5 | 0 | |

*To face page 520.*

**Table II.—Synopsis of Work done by Competing Sets of Steam Cultivating Machinery at Barnhurst.**

| 1. | 2. | 3. | | 4. | | 5. | | | 6. | | | 7. | 8. | 9. | 10. | 11. | 12. | 13. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of Exhibitor. | Catalogue No. | Number of Men [illegible] | | Time of Work | | Area Cultivated | | | [illegible] | | | Description of Work | [illegible] | [illegible] | [illegible] | Quality of Work | [illegible] | Remarks |
| | | | | | | | | | | | | **Class I** | | | | | | |
| | | Men | Lads | Hrs. | Min. | A. | R. | P. | [illegible] | [illegible] | [illegible] | | Inches | | | | | |
| J. Fowler and Co. .. | 6480 | 3 | 0 | 0 | 43 | 3 | 0 | 0 | 41 | 3 | 10 | Cultivating foul clover-lea | 8½ | 1 47 | 4[illegible] | Very good, well broken up and level bottom | [illegible] | |
| J. Fowler and Co. .. | 6481 | 3 | 0 | 0 | 49½ | 2 | [illegible] | [illegible] | 33 | 1 | 10 | Cultivating clover-lea | 8½ | [illegible] | 4[illegible] | Ditto ditto ditto | 40 | |
| J. Fowler and Co. .. | 6482 | 3 | 2 | 1 | 28 | 2 | 1 | 11 | 19 | 0 | 35 | Cultivating clover-lea | 7 | [illegible] | .. | Work good, uneven bottom, surface somewhat gathered into ridges .. .. | [illegible] | |
| J. Fowler and Co. .. | 6484 | 2 | 3 | 1 | 42 | 2 | 1 | 11 | 16 | 2 | 13 | Cultivating clover-lea | 8 | [illegible] | .. | Exceedingly good, well broken up, level bottom | 2[illegible] | |
| Ravensthorpe Engineering Company .. .. | 6022 | 4 | 0 | 1 | 19 | 2 | 3 | 11 | 21 | 1 | 17 | Cultivating clover-lea | 5½ | [illegible] | .. | Fair work, not well broken up; bottom very level .. .. .. .. | [illegible] | [illegible] |
| Barrows and Stewart .. | 865 | 5 | 2 | 2 | 5 | 3 | 0 | 0 | 10 | 1 | 15 | Cultivating foul clover-lea .. | 7½ | 1 [illegible] | .. | Fair work, very uneven bottom .. .. | [illegible] | |
| | | | | | | | | | | | | **Class II.** | | | | | | |
| J. and F. Howard .. | 1168 | 3 | 2 | 1 | 32 | 1 | 2 | 0 | 9 | [illegible] | 5 | Cultivating foul clover-lea .. | 8½ | [illegible] | 3½ | Fair work, but not left sufficiently rough, very good bottom .. .. | 23 | Stopped 12 minutes to change points. |
| E. Hayes .. .. .. | 3696 | 5 | 1 | .. | | .. | | | .. | | | Cultivating foul clover-lea . | [illegible] | | | | | Anchor gave way, frequent stoppages, trial abandoned. |
| Ravensthorpe Engineering Company .. .. | 6023 | 4 | 0 | 1 | 9 | .. | | | .. | | | Cultivating foul clover-lea | 8 | 1414 | . | Fair work .. .. | | Windlass broke, trial abandoned. |
| J. Fowler and Co. .. | 6482 | 3 | 2 | 1 | 58 | 3 | 0 | 0 | 15 | 1 | 0 | Cultivating clover lea | 7½ | 1456 | 3 | Very good work, thoroughly well broken up, very good bottom | [illegible] | The time includes a stoppage from accidental fracture of a wheel on the motor. |
| J. and F. Howard .. | 1170 | 5 | 2 | 2 | 14 | 3 | 0 | 0 | 13 | 1 | 29 | Cultivating clover-lea | 7½ | 1480 | 3½ | Good work, but surface not left sufficiently rough, very even bottom . | 28 | A delay allowed for. |
| Barrows and Stewart .. | 865 | 5 | 2 | 2 | 19 | 3 | 0 | 0 | 12 | 3 | 31 | Cultivating clover-lea | [illegible] | 1747 | 2[illegible] | Inferior work, not well broken up, very irregular bottom . . | [illegible] | The tines worked 4 to 5 inches deeper than the spaces between them |

# TABLE III.—RESULTS OF THE TRIALS OF STEAM CULTIVATING MACHINERY AT WOLVERHAMPTON, 1871.

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. | 23. | 24. | 25. | 26. | 27. | 28. | 29. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | EXPERIMENTS WITH INDICATOR. | | | | | | | | | FIELD OBSERVATIONS. | | | | | | | | | | DEDUCTIONS. | | | | |
| | | | | | | | | | Indicated Pressure in Cylinder reduced to pull on Hauling Rope | | | | | | | | | | STORES CONSUMED. | | | | | | | | | |
| Date. | Class. | Name of Exhibitor, and Description of Tackle. | Implement Employed. | Description of Plot. | Width and Depth of Cultivation during Indicator Experiments. | Weight of Earth moved per yard run, being a Measure of Power of Implement during Trial. | Indicated Work of Engine in ft-lbs. per yard run of Implement. | Indicated Work of Engine in ft-lbs. per cub. ft. of Earth Moved, or Height in Feet to which Earth Moved must be Raised to represent Work Done. | Gross Pull so reduced in lbs. | Gross Pressure, less 25 per cent. allowed for friction of Tackle = Estimated Nett Pull on Implement in lbs. | Maximum Speed of Engine in Revolutions per Minute. | Maximum Speed of Implement in Miles per Hour. | Corresponding Maximum Horse-power Indicated in Engine. | Area Cultivated in Acres. | Time at Work. | Weight of Natural Earth per Inch Deep per Acre in Tons. | Mean Depth of Cultivation during Trial in Inches. | Weight of Natural Earth moved per Acre in Tons. | Coal in lbs. | Water in Gallons. | Oil in Ounces. | Tallow in Ounces. | General Remarks on Trials. | lbs. of Water [illegible] per lb. of Coal. | Coal used per Acre. | [illegible] | Tons of Earth moved per [illegible] of Coal. | |
| | | | | | | | | | | | | | | A. R. P. | H. M. | | | | | | | | | | | | | |
| June 27 | I | Fowler's Double Set of Single-Cylinder 12-Horse-power Engines. Cylinders 10" diameter, 14" stroke. Engine runs 1·82 revolution per yard run of implement | 11-tine Cultivator | Barnhurst. Field 12, Plot 3. Last furrow. | 9' 2" × 8½ | 2188 | 26,122 | 12 All tines not working | .. | .. | 285 | 5·25 | 123 | 3 0 0 | 0 43 | 182·0 | 8½ | 1547 | .. | .. | .. | .. | Indicator Gear altered after this trial, being defective. | | | | | |
| July 4 | .. | | 6-furrow Balance Digger | Stafford Plot 1 | 5' 7" × 9 | 1561 | 32,220 | 22·18 | 10,740 | 8055 | 240 | 4·5 | 128·7 | 0 2 2 | 0 22½ | 187·4 | 9 | 1688 | | | | | | | | | | |
| .. | .. | | 9-tine Cultivator | Ditto ditto | 7' 6" × 7½ | 1625 | 35,940 | 22·11 | 11,980 | 8985 | 240 | 4·5 | 143·6 | 1 0 16 | 0 24½ | .. | 7½ | 1406 | | | | | | | | | | |
| June 27 | I | Fowler's Double Set of Single Cylinder 12-Horse-power Engines. Cylinders 10½" diameter, 12" stroke. Engine runs 1·94 revolution per yard run of implement | 9-tine Cultivator | Barnhurst | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2 3 8 | 0 49½ | 196·2 | 8½ | 1668 | .. | .. | .. | .. | .. .. | | | | | |
| July [illegible] | I. | | 5 furrow Balance Digger | Stafford. Plot 2 | 57 × 8½ | 1160 | 26,340 | 22·6 | 8,780 | 6585 | 250 | 4·39 | 103 | .. | .. | 187·4 | 8½ | 1593 | | | | | | | | | | |
| July 5 | I | | 7-tine Cultivator | Ditto ditto | 77 × 7 | 1300 | 25,804 | 19·8 | 8,601 | 6451 | 250 | 4·39 | 100·8 | .. | .. | .. | 7½ | 1500 | | | | | | | | | | |
| June 27 | I. | Fowler's 12-Horse-power Single Cylinder Clip-Drum Engine and Travelling Anchor. Cylinder 10½ diameter × 12 stroke. Engine runs 1·94 revolution per yard run of implement. | 7-tine Balance Cultivator | Barnhurst. Plot 5 | .. | .. | .. | .. | .. | .. | 310 | 5·45 | .. | 3 0 0 | 1 27 | 196·2 | 7 | 1373 | .. | .. | | .. | Anchor broke and was replaced by another, the delay of 24 minutes included in time | | | | | |
| June 29 | I | | 7-tine Balance Cultivator | Barnhurst. Field 14, Plot E | 70 × 7½ | 1312 | 14,870 | 11·3 | 4,957 | 3718 | 250 | 4·34 | 58·1 | 3 0 0 | 1 58 | 194·0 | 7½ | 1456 | 450 | 293 | 10 | . | | | | | | |
| July 5 | I | | 4-furrow Digger | Stafford. Field 13, Plot 12 | 42 × [illegible] | 676 | 17,521 | 25·9 | 5,840 | 4380 | 250 | 4·39 | 68·5 | .. | .. | 192·3 | 6½ | 1250 | | | | | | | | | | |
| .. | .. | | 5-tine Cultivator | Ditto ditto | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 7½ | 1442 | | | | | | | | | | |
| June 29 | . | | Extra work to shift Anchor | Barnhurst | .. | .. | 3,663 | .. | 1,221 | 916 | .. | 4·39 | 14·3 | | | | | | | | | | | | | | | |
| .. | | | Friction of Anchor Pulley | Extra work in pulling implement towards anchor — Barnhurst | .. | .. | 972 | .. | 324 | 243 | 250 | .. | 3·8 | | | | | | | | | | | | | | | |
| July 5 | | | | over pulling it towards engine — Stafford | .. | .. | 1,513 | .. | 504 | 378 | | .. | 5·9 | | | | | | | | | | | | | | | |
| June 27 | I | Fowler's 8-Horse-power Double-Drum Engine, with Single Cylinder, 9½ diameter, 12" stroke, with Travelling Anchor. Engine runs 1·94 revolutions per yard run of implement. Weight 9 tons 19 cwts 2 qrs 9 lbs | 5-tine Cultivator | Barnhurst. Plot 6 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 0 0 | 1 42 | 196·2 | 7½ | 1422 | .. | .. | . | .. | .. .. | | | | | |
| June 30 | I. V. | | Plough, Digger, and Cultivator | Barnhurst Field 11, Plot H | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 0 0 | 2 26 | 188·6 | 8·8 | 1660 | 537 | 438 | 6 | .. | .. | [illegible] | [illegible] | | | |
| July 5 | I. V. | | 4-furrow Digger | Stafford Field 6, Plot 10 | 46½ × 8¼ | 1028 | 20,385 | 19·8 | 6,795 | 5096 | 200 | 3·51 | 64·7 | 0 2 33 | .. | 208·8 | 6 | 1255 | | | | | | | | | | |
| .. | .. | | 4 furrow Plough | Ditto ditto | 43 × 6 | 691 | 13,860 | 20 | 4,620 | 3465 | 200 | 3·51 | 43·3 | 0 1 20 | .. | .. | 6 | 1255 | | | | | | | | | | |
| .. | .. | | 5-tine Cultivator | Ditto ditto | 50 × 6½ | 871 | 19,480 | 22·4 | 6,493 | 4869 | 200 | 3·51 | 60·8 | 0 1 10 | .. | .. | 6½ | 1358 | | | | | | | | | | |
| July 5 | III | Fowler's 12-Horse-power Traction Engine driving detached Windlass and Roundabout Tackle. Single cylinder 10½ diameter, 12" stroke. Engine runs 1·25 revolution per yard run of implement | 4-furrow Digger | Stafford Plot 5 | 40 × 8 | 826 | 15,376 | 18·6 | 5,125 | 3844 | 200 | 4·2 | 57·3 | 0 2 38 | .. | 200·9 | 8 | 1607 | | | | | | | | | | |
| .. | .. | | 5-tine Cultivator | Ditto ditto | 50 × 7¼ | 935 | 20,685 | 22·1 | 6,895 | 5171 | 150 | 3·2 | 57·9 | .. | .. | .. | 7¼ | 1457 | | | | | | | | | | |
| July 1 | III. | Same Windlass, with Clayton and Shuttleworth's Portable Engine | 4-furrow Plough, 4-furrow Digger, Cultivator, Drill, and Harrows. | Barnhurst. Field 11 f | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 0 0 | 2 40 | 188·6 | 7¼ | 1367 | 358 | 248 | .. | .. | .. .. | [illegible] | [illegible] | | [illegible] | [illegible] |
| | I | Howard's Double Set of Self-propelling Engines, direct system | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | . | .. | Broke down in preliminary trials, and did not enter into competition. | | | | | |
| June 28 and 29 | .. | Howard's 12-Horse-power Double Drum Traction Engine. Boiler placed transversely. 2 cylinders 8½" diameter, 12" stroke. Engine runs 1·89 revolution per yard run of implement. Weight on hind wheels over 10 tons. | 5-tine Cultivator, with 4 tines | Barnhurst. Field 12, 2 | 50 × 8·8 | 1030 | 20,290 | 19·7 | 6,763 | 5072 | 180 | 3·2 | 58·6 | 3 0 0 | 3 19½ | 182·0 | 8½ | 1570 | 624 | 436 | 20 | 3 | An allowance made for leakage from tank. Piece of land very stony in places | 7·[illegible] | [illegible] | [illegible] | | [illegible] |
| July 6 | I. V. | | 4-furrow Plough | Stafford Plot 9 | 45½ × 5¾ | 701 | 16,260 | 23·2 | 5,420 | 4065 | 100 | 1·8 | 26·1 | 0 1 22 | .. | 208·8 | 5¾ | 1200 | .. | .. | .. | .. | Indicator Gear on one end of one cylinder only | | | | | |
| .. | .. | | 4 furrow Digger | Ditto ditto | 43 × 7¾ | 893 | 19,435 | 21·8 | 6,478 | 4858 | 200 | 3·6 | 62·3 | 0 1 19 | .. | .. | 7¾ | 1618 | | | | | | | | | | |
| .. | .. | | 4-tine Cultivator | Ditto ditto | 44 × 7¾ | 898 | 18,230 | 20·3 | 6,077 | 4588 | 180 | 3·2 | 52·6 | 0 1 20 | .. | .. | 7¾ | 1592 | | | | | | | | | | |
| June 29 | .. | | Traction of Engine itself | Barnhurst | | | | | | | | | | | | | | | | | | | | | | | | |
| .. | II | Howard's 10-Horse-power Portable Engine driving detached Windlass and Roundabout Tackle. Cylinder 10" diameter, 14" stroke. Engine runs 1·8 revolution per yard run of implement | 5-tine Cultivator, with 4 tines | Barnhurst Field 14 f | Say 44 × 7¾ | 837 | 11,307 | 15·9 | 4,436 | 3327 | 180 | 3·4 | 40·3 | 3 0 0 | 2 34 | 194·2 | 7½ | 1480 | 598 | 441 | 7 | .. | A break down caused delay of 20 minutes, not allowed. | 7·[illegible] | 1[illegible] | 7 | [illegible] | [illegible] |
| July 5 | III. | | Plough | Stafford Plot 3 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 200·9 | 6¾ | 1356 | .. | .. | .. | .. | Indicator Cock on one end of cylinder only. | | | | | |
| .. | III | Weight {Engine 5 9 1¾; Windlass 2 16 0½} 8 [illegible] (tons cwts qrs; tons cwts) | Digger | Ditto ditto | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 6¾ | 1356 | | | | | | | | | | |
| .. | III. | | Cultivator | Ditto ditto | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 5¾ | 1155 | | | | | | | | | | |
| July 6 | III. | | 2 furrow deep Plough | Ditto ditto | 32 × 12 | 991 | 17,327 | 17·5 | 5,776 | 4332 | 120 | 2·27 | 35 | .. | .. | 200·9 | 12 | 2411 | | | | | | | | | | |
| June 29 | III. | Ditto same Windlass and Roundabout Tackle, worked by Clayton and Shuttleworth's 12-Horse-power Portable. | Scarifier, Cultivator, and Plough | Barnhurst. Field 11 h | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3 0 0 (1 Acre to each Implement) | 3 0 | 188·63 | 7½ | 1415 | 487 | 313 | .. | .. | Stopped 9 minutes for belt coming off, also one other delay not allowed. | [illegible] | [illegible] | | [illegible] | |
| .. | III. | | | Ditto ditto | | | | | | | | | | | | | | | | | | | | | | | | |
| June 29 | I. V. | Amies and Barford's Roundabout Tackle with detached Windlass, worked by a Tuxford 10-Horse-power Traction Engine, with single cylinder, 9" diameter × 12" stroke. Engine runs 1·71 revolution per yard run of implement | 5-tine Cultivator | Barnhurst. Field 14 d | 52 × 6½ | 845 | 10,610 | 12·6 | 3,536 | 2652 | 190 | 3·8 | 35·7 | 2 0 32 } 2 27 Acres | 3 9½ | 194·2 | 6 } Mean 6·112 | 1188 | 323 | 242 | 17 | .. | .. .. | 7 | 1·[illegible] | 7·[illegible] | [illegible] | 7 |
| .. | | | Ditto at half-speed | Ditto ditto | 52 × 6½ | 845 | 10,800 | 12·8 | 3,600 | 2700 | 90 | 1·8 | 17·24 | .. | | .. | .. | | | | | | | | | | | |
| | | | 3 furrow Plough | Ditto ditto | .. | .. | .. | .. | .. | .. | .. | .. | .. | 0 0 27 | .. | .. | 7½ | .. | .. | .. | .. | .. | Bad piece of land, could not be ploughed. | | | | | |
| July 1 | III | Same tackle, driven by Clayton's 12-Horse-Power portable | Cultivator, Plough, and Digger | Barnhurst. Field 11 M | .. | .. | .. | .. | .. | .. | .. | .. | .. | Unknown. | 1 44 | 188·6 | 7, 6½, 6½ } Mean 6·7 | 1264 | 275 | 212 | .. | .. | .. .. | 7·[illegible] | | | | |
| July 6 | I. V | Ditto by Tuxford's Traction Engine | Plough, Digger, and Cultivator | Stafford. Plot 8 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 208·8 | 5¼, 6½, [illegible]½ | 1274 | | | | | | | | | | |
| June 28 | I | Barrows and Stewart's Roundabout Tackle, with detached Windlass, driven by Double-Cylinder Portable Engine. Cylinders 8¼" diameter × 14" stroke. Engine runs 1·402 revolution per yard run of implement. | 5-tine Cultivator | Barnhurst. Field 12, 1 | 50 × 7½ | 877 | 9,965 | 11·4 | 3,322 | 2491 | 150 | 3·7 | 32·3 | 3 0 0 | 2 54 | 182·2 | 7½ | 1366 | 400 | 283 | 5 | 1 | Indicator Pipes throttled at cocks to ⅛ inch diameter, thus making diagrams measure too small, and showing apparent back pressure probably not existent. | 7·1 | 1[illegible] | 7[illegible] | | |
| .. | .. | | Ditto at half-speed | Ditto ditto | .. | .. | 10,796 | 12·3 | 3,599 | 2699 | 60 | 1·5 | .. | | | | | | | | | | | | | | | |
| June 29 | II. | | 5 tine Cultivator | Barnhurst. Field 14, Plot g | 50 × 9 | 1125 | 11,313 | 10·0 | 3,771 | 2828 | 130 | 3·2 | 31·8 | 3 0 0 | 2 18 | 194·2 | 9 | 1747 | 456 | 320 | 8 | 2 | | 7 | 1·[illegible] | 7[illegible] | | |
| .. | .. | | Ditto at half-speed | Ditto ditto | .. | .. | 10,040 | 8·8 | 3,347 | 2510 | 60 | 1·5 | .. | | | | | | | | | | | | | | | |
| July 5 | I III and I. V. | | 3-tine Cultivator | Stafford. Field 9, Plot 4 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 0 2 1 | .. | 200·9 | 8½ | 1708 | | | | | | | | | | |
| .. | .. | Weight {Engine 4 11 1 16; Windlass 3 10 0 21} 8 10 2 9 (tons cwts qrs lbs) | Balance Plough | Ditto ditto | .. | .. | .. | .. | .. | .. | .. | .. | .. | 0 0 37 | .. | .. | 6 | 1205 | | | | | | | | | | |
| July 6 | .. | | 5-tine Cultivator | Ditto ditto | 50 × 6¾ | 871 | 13,000 | 14·9 | 4,330 | 3247 | 120 | 2·9 | 33·7 | .. | .. | .. | 6¾ | 1356 | | | | | | | | | | |
| June 30 | III. | Same tackle, driven by Clayton's 12-Horse-power Portable | .. | Barnhurst. Field 11 E | | | | | | | | | | | | | | | | | | | | | | | | |
| June 27 | I | [illegible] Co.'s High-speed Rope Fisken system Tackle, with 2 Windlasses driven by a Clayton and Shuttleworth 10-Horse-power Double-Cylinder Traction Engine. Cylinders 7¾ diameter × 12 stroke. Fast rope runs 12·6 to 1 of hauling rope | Howard's 7-tine Cultivator | Barnhurst. Plot 7 | .. | .. | .. | .. | .. | .. | 300 | 4·[illegible] | .. | 3 0 0 | 1 19 | 196·2 | 5·6 | 1099 | .. | .. | .. | .. | .. .. | | | | | |
| June 29 | II | | Fowler's 5-tine reversible Cultivator | Barnhurst. Field 12 C | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 2 8 | 1 10 | 182·2 | 8 | 1458 } 1414 | 209 } 458 | 215 } 399 | 11 | 15 | Trial stopped in consequence of bush melting in windlass gear, and causing break down. Coal doubtful. | | | | | |
| June 30 | .. | Weight {Traction Engine 9 9 1 2¼; 2 Windlasses 6 4 0 1¾} 15 13 1 16 (tons cwts qrs lbs) | Fowler's 4-furrow Balance Digger | Ditto ditto | 40 × 7½ | 702 | 14,780 | 21·0 | 4,926 | 3694 | 210 | 2·8 | 37·2 | 1 1 32 | 1 6½ | .. | 7½ | 1366 | 249 | 184 | 11 | 3½ | Indicator Gear has pipes only ⅛ diameter. | 7·4 | 1[illegible] | | [illegible] | [illegible] |
| .. | .. | | Ditto at one-third speed | Ditto ditto | .. | 702 | 13,700 | 19·5 | 4,567 | 3425 | 70 | ·95 | .. | .. | .. | .. | | | | | | | | | | | | |
| July 5 | I and I. V | Engine runs 2·51 revolutions per yard run of implement | Ditto ditto | Stafford. Field 14, Plot 14 | 40 × 6·9 | 682 | 17,032 | 24·9 | 5,677 | 4258 | 200 | 2·7 | 40·8 | .. | .. | 192·3 | | | | | | | | | | | | |
| .. | .. | Ditto ditto ditto | Ditto at half-speed | Ditto ditto | .. | 682 | 15,030 | 22·0 | 5,010 | 3757 | 100 | 1·35 | . | .. | .. | .. | | | | | | | | | | | | |
| July 6 | I. V. | Ditto working with long rope, Engine in next field | Ditto ditto | Stafford. Field 7, Plot 7 | 40 × 8 | 858 | 18,800 | 21·9 | 6,267 | 4700 | 180 | 2·4 | 40·5 | .. | .. | 208·8 | | | | | | | | | | | | |
| June 30 | III | Same tackle as above, worked with 10-Horse-power Double Cylinder Portable. Same sized cylinders and speed ratios as above, but smaller windlasses. Weight {Engine 4 16 3 22; 2 Windlasses 4 12 0 2[illegible]} (tons cwts qrs lbs) | Fowler's 5-tine Turning Cultivator | Barnhurst. Field 24 | 50 × 7½ | 941 | 22,710 | 24·1 | 7,570 | 5680 | 180 | 2·4 | 49·0 | .. | .. | 195·5 | | | | | | | | | | | | |
| .. | .. | | Fowler's 4-furrow Balance Plough. | Ditto ditto | 40 × 8 | 803 | 17,300 | 21·5 | 5,770 | 4327 | 220 | 3·0 | 45·6 | | | | | | | | | | | | | | | |
| June 30, July 5 | .. | Same tackle with above Traction Engine | .. | Friction of Engine and light rope | .. | .. | 3,863 | .. | 1,288 | 966 | 200 | 2·7 | 9·25 | | | | | | | | | | | | | | | |
| July 6 | .. | Ditto ditto ditto | .. | Ditto with extra long light rope at Stafford | .. | .. | 4,010 | .. | 1,337 | 1008 | 200 | 2·7 | 9·6 | | | | | | | | | | | | | | | |
| June 28 | III. | E. Hayes' Portable Engine, with detached Windlass and Roundabout Tackle. Cylinder 10½" diameter × 16" stroke | Cultivator | Barnhurst. Field 12 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | Started work, but after numerous mishaps with tackle, was disqualified for competition. | | | | | |
| July 1 | IX. | Trials of Special Implements in Classes 9 and 6. Implements worked with Hayes' Roundabout Tackle Engine. Cylinder 10½" diameter, 16" stroke, runs 1·33 revolution per yard run of implement. | Fowler's 7-tine Cultivator with turning gear | Barnhurst. Field 16. Vetch and rye stubble. | 70 × 6½ | 1137 | 14,920 | 13·1 | 4,973 | 3730 | 110 | 2·8 | .. | | | | | | | | | | | | | | | |
| .. | .. | | Howard's 7-tine Cultivator | Ditto ditto | 73 × 6½ | 1140 | 17,130 | 15·0 | 5,710 | 4283 | .. | .. | | | | | | | | | | | | | | | | |
| .. | .. | | Ditto 5-tine Cultivator | Ditto ditto | 57½ × 6½ | 934 | 17,560 | 18·8 | 5,853 | 4390 | .. | .. | 44·0 | | | | | | | | | | | | | | | |
| .. | VI. | | Fowler's 4-furrow Balance Plough | Ditto ditto | 39½ × 7¾ | 763 | 11,697 | 15·3 | 3,899 | 2924 | .. | .. | | | | | | | | | | | | | | | | |
| .. | VI. | | Howard's 4-furrow ditto | Ditto ditto | 45¾ × 7½ | 839 | 11,758 | 14·0 | 3,919 | 2939 | .. | .. | | | | | | | | | | | | | | | | |
| July 1 | .. | Ditto Friction Experiments | Engine and Windlass only | Ditto ditto | .. | .. | 2,241 | .. | 747 | .. | .. | .. | | | | | | | | | | | | | | | | |
| .. | .. | Ditto ditto | Engine and Tackle hauling Fowler's 7-tine Cultivator, light | Ditto ditto | .. | .. | 4,850 | .. | 1,617 | 1213 | 110 | 2·8 | | | | | | | | | | | | | | | | |
| .. | .. | Ditto ditto | Ditto hauling Fowler's 4-furrow Plough, light | Ditto ditto | .. | .. | 5,403 | .. | 1,807 | 1340 | .. | .. | | | | | | | | | | | | | | | | |
| | | | | | | | | 18·3 Average. | | | | | | | | | | | | 115 | 5·1 | | | 7·2 | 161 | 7·1 | 9·[illegible] | |
| | | | | | | | | | | | | | | | | | | | | Average per acre. | | | | Average | | | | |

*To face page 521.*

the mouldboard at any required angle and height, by which great perfection in ploughing may be at any depth attained.

A frame of the kind above mentioned was next used, fitted with four ploughing bodies, and with revolving disc-coulters; price 80*l.* This, at 7 inches deep, made splendid work, and altogether was the most perfect ploughing of any. Another of the same kind of frame was tried, fitted with different shaped mouldboards, and made excellent work. Next came a somewhat similar frame, arranged to carry either four bodies to cut 10-inch, or five bodies to cut 9-inch furrows; price 87*l.* 10*s.* This, worked with Kent breasts, made good ploughing.

Messrs. Fowler lastly tried their 6-furrow balance-plough, price 95*l.*, which, by its excellent steerage, was as easily managed during progression as the smaller implements.

Messrs. Amies and Barford exhibited a new 3-furrow plough, price 40*l.*, including digging-breasts. Each half or set is made of two straight and parallel beams, working independently on the axle of the wheels. The two sets also are attached by chains, and work upon somewhat similar principles to that of Messrs. Howard's plough. This implement works steadily considering its light weight, but requires improvement in detail. We awarded the prize of 25*l.* to Messrs. Fowler for their 4-furrow plough (No. 6489).

Class VII. *Best Subsoiler, suitable for Steam-cultivation.*—Messrs. Fowler and Co. exhibited a subsoiler proper, with two subsoils and two ploughs (not convertible), price 100*l.* The first subsoil works in the furrow made by the last plough during the previous journey, and the second subsoil works behind the first plough, so that the wheel does not pass over a subsoiled furrow. Their second exhibit was a 3-tined knifer (price 60*l.*), capable of working 2 feet deep. The tines or knives, of great strength, are placed 1 foot apart, and will work in grass land without disturbing the surface much. They are also adapted to break up shelly rock or remove stones in arable land. We awarded the prize of 20*l.* to Messrs. Fowler and Co. for their subsoiler (No. 6511).

Class VIII. *Best Digger, suitable for Steam-cultivation.*—Messrs. Howard and Messrs. Fowler alone competed with their plough-frames (which have before received notice), fitted with digging-breasts in the place of the ordinary mouldboards. The work accomplished by both firms was of a similar character, the difference being due to the particular form of breast used. Messrs. Fowler worked two forms of breast, one having the upper prong 15 inches long, and the lower one *shorter* by an inch; the other having the upper prong $12\frac{1}{2}$ inches long, and the bottom one nearly 2 inches *longer.* This last 5-furrow digger was fitted with subsoils to follow in the furrows, and which worked to the depth of 14 inches. The price of this implement is 87*l.* 10*s.* Messrs. Howard's digger worked with four furrows, the breasts having prongs the same distance apart as those of Messrs. Fowler, the top prong being 12 inches and the bottom prong 2 inches longer, with a little more upward curve. This implement made very excellent work. We awarded the prize of 25*l.* to Messrs. Fowler and Co. for their 4-furrow digger (No. 6492).

Class IX. *Best Cultivator, suitable for Steam-cultivation.*—Messrs. Fowler began the trials in this Class with their 5-tine turning cultivator (price 60*l.*), which can also carry two extra tines, making the total width between the centres of these 5 feet 10 inches. This implement has been much improved in detail, and a considerable amount of unnecessary weight removed from it. The frame is carried on 4-feet wheels, with $5\frac{1}{4}$-inch tires, which in working need not follow on the cultivated land. The steerage is worked, as it is in all Messrs. Fowler's implements, by worm and cogwheel, which gives the steersman great power and command over his implement and unlimited range in turning. There being only one steerage-wheel and an ingenious method of attaching the rope, the implement turns very rapidly and without difficulty or fear of upsetting. The axle carrying the frame is cranked, by which means the whole of the tines are raised out of the soil when the implement is backed or turned. This implement worked with several different-shaped points, did excellent cultivating, and showed itself capable of dealing with any kind of soil. The tines are fixed in the frame with bolt and pin, and can be easily adjusted, but the depth of the whole can be regulated by the notches and clutch on a lever.

Messrs. Howard's 5-tined double-action cultivator (price 25*l.*) was next tried, working with 13-inch shares, with prongs on the top of these to break up the soil. It made fair work, and the bottom was very level and well cut. This implement is raised or lowered by set screws. The tines are so attached as to allow them to rock on the frame, so that the points taking the land may get a little more pitch than those which are being passed through the broken ground backwards.

Messrs. Barrows and Stewart brought forward a "Smith's," improved cultivator, with five tines, 3 feet 10 inches wide between the centres of the outside tines, price 17*l.* This broke up the soil and made good surface-work; but the floor was very unlevel and badly cut, the two front tines going several inches lower than the hinder ones.

Messrs. Howard next tried their 7-tine cultivator, 5 feet 8 inches wide from the centres of the outside tines. This is made on the same principle as their smaller implement before mentioned, all of wrought iron, and wheels 4 feet high. It was worked with 8-inch shares, and made fair work at 9 inches; leaving the surface rather flat, but the bottom level and good.

Mr. Edward Hayes exhibited a form of "Smith's" which worked very fairly with 5½-inch heart-shaped points, taking 3 feet 4 inches breadth from the centres of the outside tines; price 24*l.*

Messrs. Amies and Barford tried their "Smith's improved" cultivator, 3 feet 10 inches wide (price 21*l.*), with seven tines. The work produced was not good, each turn of the implement producing a ridge, and the floor was unlevel, as was the case in all the trials of this kind of implement. This unevenness of the floor, in which some of the tines have torn up the soil some 2 or 3 inches lower than the implement was intended to work, is objectionable, and must cause a great amount of unnecessary draught on the rope. When it has been decided at what depth cultivating should be done, the implement used should move the soil uniformly to that depth throughout. We awarded the prize of 25*l.* to Messrs. Fowler and Co. for their 5 (or 7) tined cultivator (No. 6503).

CLASS X. *Best Skim-Plough or Scarifier, suitable for Steam-cultivation.*—We had brought before us in this Class some of the cultivators previously noticed, fitted with broad shares to pare the surface. Messrs. Howard worked their 7-tined cultivator, which pared the soil to the depth of 3 inches uniformly and well. Messrs. Amies and Barford worked their 7-tine cultivator with 12-inch shares, which also made very good work. Messrs. Fowler worked their large 11-tined cultivator, which proved itself as effective as a parer as it was when worked as a cultivator; and to this implement (No. 6499) we awarded the prize of 20*l.*

CLASS XI. *Best Roller, suitable for Steam-cultivation.*—The exhibitors were Messrs. Fowler, Messrs. Cambridge and Parham, Mr. J. Williams, Messrs. Amies and Barford, Messrs. Howard, and Messrs. Sainty. The press-wheel roller of Messrs. Amies and Barford appeared to be best adapted for ordinary farm purposes, and the prize of 10*l.* was awarded to this firm for that implement (No. 2671).

CLASS XII. *Best Harrow, suitable for Steam-cultivation.*—Messrs. Howard first brought before our notice their set of three heavy harrows, with fifteen chisel-shaped tines each, taking 12 feet of ground. The harrows work independently, being attached at the ends to a bar, which is carried on a simple frame, with two wheels at each end, all being under steerage. Price 27*l.* 10*s.* These work backwards and forwards without turning: and the line of draught can be raised or lowered as required.

Messrs. Howard also tried a lighter set, made on the same principle, taking 10 feet 6 inches in width, price 22*l.* 10*s.* In these the nuts are simply fixed by small pieces of hoop-iron, to prevent them from becoming loose. Messrs. Howard showed us another set of four lighter harrows, price 20*l.*; with three extra barrows, as the last, to fit the same frame, 9*l.* extra.

Messrs. Fowler make three sizes of harrows to fit their frame. They brought to trial the medium-sized ones, containing 15 tines each, working 5 inches apart; the total width being 15 feet. This is a well-known set and capable of almost any kind of work, from light cultivating to light harrowing; but, looked upon as a harrow proper, its price, 85*l.*, appears rather high. We awarded the prize of 10*l.* to Messrs. J. and F. Howard for their harrows (No. 1185).

Class XIII. *Best Drill, suitable for Steam-cultivation.*—Mr. Hensman exhibited a very useful drill, 7 feet 4 inches wide, with 13 coulters and self-balancing box, which can be raised on either side when working on uneven land. A handle to raise the coulters and one to alter the gear are placed in the centre. A man walks behind and steers on either side. The coulters work on two bars, but are in too straight a line. The arrangements for turning require some little improvement. The price of this drill is 40*l.* 15*s.*

Messrs. Howard's drill clears 8 feet 3 inches, has 12 coulters and a set of harrows to follow; price complete 60*l.* It has a Priest and Woolnough's skid to carry the pivot-wheel on turning, which is under the command of the steersman. There is a platform for the attendant; to this the harrows are attached by a chain working on a bar, by which means they are brought more on the drilled land, and thus cover the whole of the ground drilled. These worked remarkably well and turned without difficulty; they can be lifted, if necessary, by the attendant. The drill can be worked by horses.

Messrs. Fowler and Co. brought two drills for trial, both of Mr. Coultas's make, fitted up by themselves with frame and other arrangements to carry two sets of harrows, one to precede and the other to follow the coulters. The front harrows are lifted by the steerage during the act of turning, and the others are raised by the attendant with the same handle and at the same time that he lifts the coulters. The steerage is on the same principle as that used in their other implements, with one wide wheel, and acted very efficiently. One of these drills was fitted as a combined corn, seed, and manure drill, and the other as an ordinary corn drill. The arrangements for carrying the harrows appeared to us to make these drills rather too ponderous and heavy. The former clears 7 feet 9 inches, price 95*l.*; the latter is 8 feet 6 inches wide, price 75*l.* The harrows follow exactly in the track of the coulters, and consequently the wheel-marks escape being harrowed.

Mr. Coultas's drill is similar to the preceding, but of a lighter build, with india-rubber tubes to convey corn to the coulters. It is fitted with Fowler's steerage, which can be removed when required for horse-power. It has a platform behind for the attendant, and the coulters are lifted by a handle and windlass. Price 55*l.* Width of drill 8 feet 6 inches. We divided the prize of 20*l.* equally between Messrs. J. and F. Howard for Article No. 1182, and Mr. Coultas for Article No. 570.

Class XIV. *Best Root or Stone Extractor, suitable for Steam-cultivation.*—Messrs. Fowler exhibited an immense iron claw, similar to the claw-anchors used in steam-cultivating. It is 2 feet 3 inches wide, 2 feet 5 inches long, and the size of the claws is $6\frac{1}{2}$ inches by 2 inches. This is actuated by a movable pulley, by which double the power exerted by the engine is obtained. We awarded the prize of 10*l.* to this implement (No. 6514).

CLASS XV. *Best Combination of any of the above Implements not qualified to compete in Classes I., II., or III.*—The offer of this prize only brought out one competitor, this being Mr. J. A. Williams, of Baydon, Wiltshire; his combination being a roller, cultivator, and set of three harrows, price 70*l.* The cultivator is suspended on the roller-shaft and by means of a lever is raised out of the ground when the implement commences to turn. The roller, about 2 tons weight, takes 8 feet of ground, and is followed by a cultivator; and the harrows, which take about 2 feet more in width, work on a bar carried on three wheels, which is to assist an attendant following in lifting. The harrow-bar is attached to the cultivator by chain (of too great a length); the roller has breaks for an attendant to use when travelling. During one journey of this implement it worked effectively; but the turning arrangements not having been matured in detail, some difficulty was found at the land's-end, and finally the arm to which the rope was attached became broken and put an end to the experiment. The prize not awarded.

CLASS XVI. *Best Implement or part of Tackle, suitable for Steam-cultivation, of any other description, not qualified to compete in the preceding Classes.*—In this Class we had eight exhibits, namely, six by Messrs. Fowler, consisting of one harrow-frame, two water-carts, two sleeping-vans, and one ditching-plough (an extraordinary implement), and two exhibits by Messrs. Howard, viz., their plough-frame, fitted with ridging bodies, and their small cultivator-frame fitted as a ridger and subsoiler. Messrs. Fowler's harrow-frame, fitted with two ridging bodies, worked very steadily and well, and would have made excellent work if fitted with proper shaped mouldboards; and Messrs. Howard's combined ridger and subsoiler showed itself in work to be a most useful implement for steam-cultivation. Between these two implements we divided the prize of 20*l.*, and we recommended Messrs. Fowler's ditching-plough as deserving a medal.

(Signed) JAMES W. KIMBER.
JOHN HICKEN.

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## *Remarks relating to the Table of Experiments* (Table III.) *on Ploughing Machinery.*

The observations made and facts collected are in some instances not as complete as could be wished. This arises partly from the ground actually worked by each implement not having been measured at once by the surveyor; partly from the imperfect manner in which some of the exhibitors complied with the very clear printed instructions issued by the Society with reference to the measurement of water and the preparations for the reception of the indicators; and partly from the extremely inclement weather and the badness of the water at Stafford.

In column 9 the power expended in working the land has been represented by the work which would be necessary to raise the earth disturbed the tabular number of feet, or by the foot-lbs. of indicated work per lb. of earth moved. A singular and unexpected fact appears deducible, namely, that the absolute work in foot-lbs. necessary to cultivate the land does not depend materially upon the speed at which it is worked; that is, that the coal and water consumed per acre, will be the same if the implement travels fast or slowly. In support of this, the following extract from the tables may be taken:—

*Indicated Work of Engine in ft.-lbs. per lb. of Earth moved.*

| | Foot-lbs. |
|---|---|
| Amies and Barford—full-speed .. .. .. .. .. | 12·6 |
| „ „ half-speed .. .. .. .. .. | 12·8 |
| Barrows and Stewart—full-speed .. .. .. | 11·4 |
| „ „ half-speed .. .. .. | 12·3 |
| „ „ full-speed .. .. .. | 10·0 |
| „ „ half-speed .. .. .. | 8·8 |
| Ravensthorpe Company—full-speed .. .. .. | 21·0 |
| „ „ half-speed .. .. | 22·0 |
| „ „ one-third speed .. | 19·5 |

In three cases the slower speed took the more power, and in two only rather less.

The Fisken high-speed hemp rope naturally attracted a good deal of attention. The work expended per acre by the various roundabout systems stands in the following order:—

| | Foot-lbs. |
|---|---|
| The Fisken high-speed system .. .. .. .. .. | 22·1 |
| Messrs. J. Fowler and Co. .. .. .. .. .. .. | 20·4 |
| Messrs. Howard .. .. .. .. .. .. .. .. | 16·7 |
| Messrs. Amies and Barford .. .. .. .. | 12·7 |
| Messrs. Barrows and Stewart .. .. .. .. | 11·5 |

The Fisken tackle worked Fowler's implements, and these undoubtedly moved the ground in a more thorough manner than any of the others; hence the greater power absorbed by the first two competitors, but the 10 per cent. extra force required by the high-speed system over Fowler may be fairly laid to the charge of the hemp rope. The figures above quoted also show that, in order to obtain a fair comparison between different systems of tackle, they should all be worked with the same implement under similar conditions of soil, in order to ascertain the useless resistance inherent in each. The above averages for roundabout tackle are taken from trials at both Barnhurst and Stafford. To approximate nearer to similar conditions, the averages from trials of diggers only at Stafford, worked by various systems, have been extracted, and it appears that the

| | |
|---|---|
| Average foot-lbs. of work per lb. earth moved by Fowler's various systems of tackle .. .. .. | = 21·8 |
| Average foot-lbs. of work per lb. earth moved by Howard's various systems .. .. .. .. .. .. | = 21·8 |
| Average foot-lbs. of work per lb. earth moved by Ravensthorpe (Fisken) tackle .. .. .. .. .. | = 22·9 |

Thus giving 5 per cent. advantage to the tackle of the first-named firms.

Comparing the resistance of ploughs, diggers, and cultivators respectively on light and heavy land, it is found on taking averages from all the trials that the

| | At Barnhurst. | | At Stafford. |
|---|---|---|---|
| Average foot-lbs. of work indicated per lb. of earth dug or ploughed .. .. .. .. | = 17·7 | .... | 21·7 |
| Average foot-lbs. of work indicated per lb. of earth cultivated .. .. .. .. .. | = 15·2 | .... | 20·3 |

thus showing that the change from light to heavy land increased the resistance 28 per cent., and that the diggers and ploughs consumed about 10 per cent. more power than the average of cultivators exhibited. It further appears from the diagrams that ploughing requires rather less power than digging.

From column 11 it will be seen that the strain on the wire-rope hauling the implement varied from over 4 tons in Messrs. Fowler's 20-horse set down to 1¼ ton in Messrs. Barrows and Stewart's roundabout. From the lightness of the strain on the rope and the small amount of power expended per acre by the latter firm, it is evident that the implements used did not move the land very efficiently, which was also the opinion of the Judges, derived from the appearance of the work. The Fisken high-speed rope working Messrs. Fowler's 5-tine cultivator ranks next in intensity of strain upon the wire rope, which amounted to over 2½ tons.

From a variety of causes it was found impracticable during the trials to determine the exact resistance of the high-speed hemp rope in the Ravensthorpe tackle, but it was ascertained that the extension of the hemp rope some 200 yards at Stafford did not add to its resistance very materially.

Column 17. The weight of the natural ground was taken in layers 6 inches deep, but the difference between the weights of the several layers was insignificant and quite irregular. The weight of earth moved is calculated from the average of numerous measurements of depth taken by the Judges, these gentlemen being unanimously of opinion that direct measurement was a much more accurate method than the one previously practised of calculating the depth from the weight of earth moved.

The observations on fuel, water, and lubrication are imperfect as regards Messrs. Fowler's 20 and 12-horse double-engine sets. This is much to be regretted, and arose from the want of acreage at Barnhurst, and want of time and the inclemency of the weather at Stafford. The high-speed rope took the most lubrication, but this system to be properly tested should be worked for a considerable number of hours at a stretch. Messrs. Howard consumed the most fuel per acre.

Referring to the averages of columns 20-23, and 25-28, it appears that

The average consumption of coal = 161 lbs. per acre.
" " water = 115 gallons per acre.
" " oil and tallow = 5·1 ozs. per acre.
" " water per lb. of coal = 7·2 lbs.
" " coal per mean indicated H.P. per hour, 7·1 lb.
" " weight of earth moved per lb. of coal = 9·3 tons.

(Signed) EASTONS AND ANDERSON, *Consulting Engineers.*

*August 1st*, 1871.

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## XXVII.—*Report of the Judges on the Trials of Traction-Engines at Wolverhampton.* By F. J. BRAMWELL, C.E., and JAMES EASTON, C.E.

THE Wolverhampton Meeting is the first occasion on which the Society has brought to trial this important class of steam-engines. For many years past such engines have appeared at the shows of the Society as articles of exhibition and sale, but they have never until this year come before the Society's Judges. Year by year when steam-ploughing has been tried, as at Leicester, many of the engines employed have, as is well known, been self-propelling, and, therefore, truly locomotives for road or for farm; but, nevertheless, they have been considered simply as ploughing steam-engines, and their merits have not been judged apart from those of the ploughing tackle which they drove.

There appeared no valid reason why locomotive engines should not be made suitable for moving agricultural machinery, whether threshing, ploughing by means of windlasses, or for other purposes for which the farmer requires motive power; and it was with the view of encouraging the manufacture of such engines that the Society determined this year to offer a prize, not for a mere locomotive, but for "the best agricultural locomotive engine applicable to the ordinary requirements of farming."

Before entering into a description of the nature of the engines which the exhibitors have brought forward to compete in this Class it may be as well to say a few words upon the history of common-road locomotion. It is now nearly forty years since Gurney (and there were probably others before him) exhibited his common-road steamer as a competitor with the stage-coach of the period. He was speedily followed by Ogle and Summers, by Maceroni, by Russell (whose engine, however, threw great discredit on the cause in consequence of its exploding), by Sir Charles Dance, and by Walter Hancock. It was this latter gentleman who, from about 1825 to 1835, did more than any of his predecessors or competitors to show the feasibility of using steam-power as a means of propulsion on common roads at higher speeds than those attainable by the best stage-coaches. For many months together his steam-carriages, competent to carry from 15 to 20 passengers, travelled regularly from the Bank to Paddington and back at the ordinary sixpenny fares then charged by the omnibuses, and besides the Paddington journey he very commonly used to come out from and return to his factory at Stratford, his carriages passing through Whitechapel, Leadenhall-street, Cornhill, and the busiest parts of the City of London. In his steam-coaches he exhibited a very large amount of ingenuity and of engineering knowledge. The boilers and engines he manufactured would compare favourably with the best productions of the present day—a great thing to say of a man who worked 35 or 40 years ago, when high-pressure light engines were so much less understood than they are now. The principal merit of his steam-carriage lay in the boiler. This was composed of a number of flat chambers which were ranged side by side, like books on a shelf, with a space, however, of about three-quarters of an inch between each two neighbouring chambers. The water and the steam were in the chambers. The pressure used was about 100 lbs., and evidently no shape could be more improper to resist that pressure, or even a tithe of that pressure, than the flat chambers. But Hancock had this happy idea: he raised bosses (hemispheres) all over the surface of his chambers, and the summits of the bosses of one chamber bore upon the summits of the bosses of the neighbouring chambers throughout the boiler, and thus each chamber, by means of its bosses, served as the abutment for the chamber on either side of it, and they served as the abutments for it. The final pressure, that of the outside chambers, was taken by two thick wrought-iron plates against the flat surfaces of which the bosses of the outer chambers bore. Outside the plates were girders which projected beyond the ends of the chambers so as to admit of tie-bolts passing from the girders of one plate to the girders of the other, thus holding together the two plates containing between them the chambers of which the boiler was composed. There were also two other bolts—one low down and the other high up—which passed through the whole of the chambers. Washers were introduced, so as to leave an annular space round the bolts, and this annular space formed at the bottom the water connection, and at the top the steam connection. The boilers thus constructed were made of iron not more than one-eighth of an inch thick, and they were absolutely safe at 100 lbs. They were placed immediately over a fire which played up between the chambers, the heat being compelled to pass up among the tortuous channels left between the bosses. These boilers were most rapid generators of steam, and they also were very free from "priming." This arose, however, very greatly from the fact of Hancock having soon discocovered that the best way to prevent a boiler from "priming" is to keep the steam at a high pressure in it, and it was with this object that he used an extremely small steam-pipe to supply his engines.

The engines of Hancock's steam-coaches were two-cylinder direct-acting inverted, communicating motion to the crank-shaft, which was at the bottom. On this crank-shaft there was a pulley shaped to take an ordinary chain, which chain worked another pulley on the axle of the driving-wheels. The chain-pulley upon the crank-shaft was provided with a clutch, so that the engine was thrown out of gear with the driving-wheels when it was required to run either for pumping or for blowing the fire, which was urged by a fan-blast. The driving-wheels were loose upon the axle, and were worked by clutches having a large amount of clearance. By this means, when easy curves were to be made on the road, one wheel was enabled to overrun the other to allow for the difference of travel between the wheel on the inner and that on the outer side of the circle. To make a very sharp turn, the clutch of the wheel that was intended to be on the inner side of the circle was thrown out of gear, and when this was effected the carriage would come round in its own length. The steering gear consisted of a chain-wheel fixed to the fore axle, with the chain passing over a small pulley on a vertical steering-spindle. There was a break for the steersman (to be pressed by his foot), which held the fore-wheels in any position in which he had put them, and which (except when he was in the very act of turning) saved his arm from the effects of the jar produced by the action of the road on the wheels. The waste steam was blown into a box before it was suffered to issue into the chimney. The chimney, however, was barely in sight; the fuel was coke: the steam escaped along with the products of combustion, and, except in case of very damp weather, was invisible. Thus there was no smoke and no steam, nor was there any noise of the waste steam; neither was any machinery to be seen. It is quite certain that in respect of quietude of travelling, and in the way of not being an annoyance to others upon the road, Hancock's coaches of thirty-five years ago far exceeded anything of the present day. These coaches of Hancock's commonly travelled 10 miles an hour, and have travelled 14. It may be asked why it was that, if they were so meritorious in an engineering point of view, they did not continue to run? This is a difficult question to answer. Mr. Hancock always endeavoured to show that they paid, but it is believed that he was a better engineer and inventor than he was a commercial man. Be this as it may, however, it is unhappily the case that after many years of effort he gave up the endeavour, and with him common-road locomotion practically ceased; railways began to be established throughout the country; the old coach speed of 12 miles an hour, or the fourteen miles per hour of common-road steamers, was not sufficient to satisfy the public, and the demand for something better than the stage-coach to travel on common roads died out, while the opposition of horsemen and of riders in horse-carriages continued. These persons naturally enough complained of the danger they were exposed to when some of their unreasoning animals took fright at machines, to the presence of which they had not been trained.

After Hancock ceased his efforts, common-road locomotion, as has already been said, was practically in abeyance for many years, and when it was revived it was revived in the traction-engine form to compete with the horse in drawing heavy loads, and not in that of the high-speed, light-loaded steam-carriage.

Another instance in which slow-going steam locomotion has been revived within the last few years, is in connection with steam-ploughing. The carrying out of this great improvement in agriculture has introduced steam-locomotives suitable not only for roads, but also fit to traverse the fields to be ploughed.

The attention of engineers and others has been directed to the subject, ingenious minds have been at work upon the matter afresh, and there are now many forms of locomotives, most of which, it is true, are intended for no greater speed than three or four miles an hour, but some of which are competent to perform from eight to ten miles.

Whether engines at these greater speeds will be suffered to run upon common roads is a question for the Legislature. At present they are forbidden to travel more than four miles an hour, and it is compulsory that they should be preceded by a man bearing a red flag to warn horsemen and others that such engines are coming. It is to be presumed that could it be shown the introduction of quick-going common-road steamers would really be a benefit to the community at large, the restrictions upon such steamers would be taken off, and persons who break-in horses would not consider their duties completed, nor the horses properly broken, until they had been made accustomed to the presence of such machines. That horses can be broken so as to be utterly regardless of locomotives is well known. Any one who has seen their behaviour at the railway stations, where they are used for shunting, must know that there they regard the noise of a locomotive with absolute indifference. As a matter of fact, by the time that Hancock had been running his steam-carriage two months upon the New Road, none of the omnibus horses paid the slightest attention to it, although at the commencement of his running they had frequently shied when he passed them.

Having made these few preliminary remarks upon part only of the history of common-road steam locomotion, and upon its present condition and its prospects, we will now proceed to report upon the matters more immediately connected with the Wolverhampton Show.

In the Report on the Engines tried at Oxford, the Judges alluded to the fact that the Society had left it to the exhibitors to determine what should be the dimensions of their engines; and the Judges in their report pointed out that while this was attended with the benefit of permitting each exhibitor to fully exercise his skill and judgment as to what were the proper dimensions and proportions for the nominal power of his engine, it left the customer in this difficulty, that in buying the nominal 4-horse engine of A, he might be buying either a larger or a smaller engine than the nominal 4-horse engine of B; and it was shown in the Report how the real horse-power, of 33,000 lbs. lifted one foot high, which engines could exert, had increased year by year in reference to the nominal power of such engines. It was stated that no purchaser would be contented without twice the nominal power, would not be surprised at thrice, would not object to four times, and that if he lived in the neighbourhood of a sea-port and had experience of the performances of marine engines, even as much as six times the nominal power might be looked for by him.

This year the Society has gone further in leaving to exhibitors full liberty to exercise their skill and judgment. They have not only given perfect freedom in respect of dimensions for a nominal horse-power, but they have also permitted the exhibitor to try the engines upon the dynamometer at any power he pleased not below the nominal, and to work at any pressure of steam he pleased, taking the precaution, however, to obtain from each exhibitor proper drawings of his boilers and a declaration of the steam-pressure at which he intended to work, and then ascertaining by proof that the boilers were competent to sustain double that pressure, and by calculation that they were safe at three times that pressure.

Furthermore, the proportions of the different parts being thus given by the exhibitor,enables the Judges in their report to tabulate them, so that the purchaser of an engine can see when he buys a certain nominal engine of A whether, taking heating surface and grate surface, as well as cylinder dimensions, into consideration, he is buying a more or less powerful machine than the engine of B of the same nominal power.

On this occasion, also, the Society have acceded to the advice offered to them by their engineers, and by the past and present Judges in former reports, and have caused the amount of water evaporated by each exhibitor when on trial at the brake to be recorded, the oil and tallow consumed also to be recorded; and further, they have directed each engine to be fitted with proper cocks for applying the indicators supplied by the Society, so as to enable the Judges to take indicator diagrams at the time the engines were being tried upon the brake.

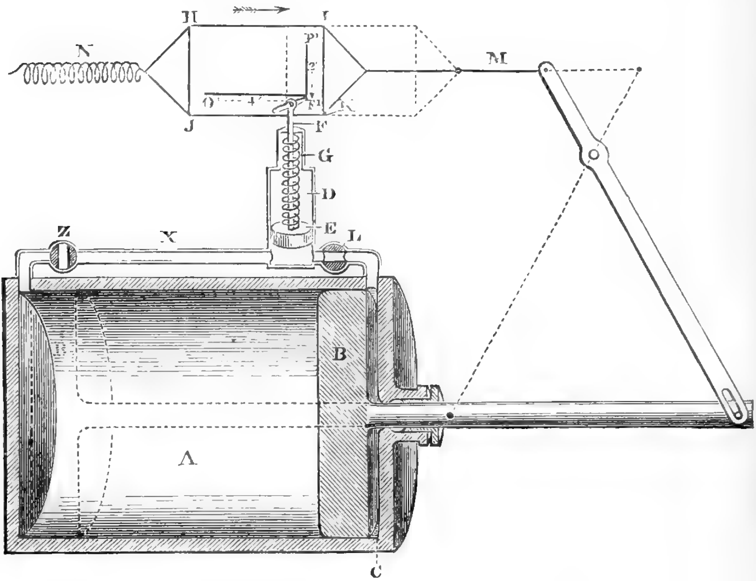
In the Oxford Report it was thought that it might be of interest to the readers of the Journal were the Judges to give a brief description of the nature and principles of the brake so long used by the Society for the purpose of ascertaining the performance of the engines offered for trial. It may now perhaps be well to give (also briefly) a description of the nature, the principles, and the uses of the steam-engine indicator, now for the first time employed by the Society.

*The Indicator.*—The steam-engine indicator was invented by the great James Watt. It is an implement by means of which an engine is caused to write on a piece of paper an accurate record of the performances that take place within the cylinder;

it is a record which, to the uninstructed eye, is unintelligible, but by engineers is looked upon as the most reliable statement they can have of the duty done by an engine, inasmuch as it tells at each and every part of the stroke of the piston what are the effective pressures tending to produce motion, and what are the back pressures tending to detract from those effective pressures.

We fear we must introduce a sketch here of an elementary indicator, as without it, probably, a verbal description would not be intelligible.

Fig. 1.—*Illustrating the Structure and mode of using the Steam-engine Indicator.*




Supposing "A," Fig. 1, to represent the cylinder of a horizontal steam-engine from which it is desired to obtain indicator diagrams, and supposing "B" to represent the piston of that engine now at the right-hand end of its stroke, "C" to be the clearance between the piston and the right-hand cover. Suppose further that "D" is the cylinder of the indicator, of, say, half an inch area; and suppose that "E" is its piston attached to the rod "F," having on it a spiral spring "G," and that in its normal condition the spring "G" holds the indicator-piston "E" at the place shown on the drawing, and that the top of the piston-rod "F" of the indicator carries a pencil at "F¹" which presses against a card or piece of paper "H, I, J, K," and let "L" be a cock by which the connection can be made when required between the end of the engine-cylinder "A" and the bottom of the indicator-cylinder "D"; assume also that the card "H, I, J, K" can be drawn backwards and forwards by the cord "M" being attached to some lever worked by the piston-rod, so that while the piston-rod moved through its whole stroke, say of 1 foot, the card "H, I, J, K" would move say 4 inches, and that as the piston-rod came back again through the foot, the card, by means of a spring "N," could be drawn the 4 inches back again.

In the condition supposed, it will be seen that the traverse of the card is one-third that of the piston, and is made rateable with its motion. Assume the card to have thus travelled while a pencil "$F^1$" is applied to its surface, it will draw upon the card a horizontal line 4 inches long from "$F^1$" to "$O^1$"; so far it will show nothing more than a proportion of the stroke of the engine.

Next, suppose that the string "M" is disconnected from the engine and that the card "H," &c. remains stationary, and then suppose that the cock "L" is turned so as to connect the underside of the cylinder "D" with the right-hand end of the engine cylinder "A." So soon as the slide-valve opens to admit steam to the right-hand end of the cylinder "A" to press the piston "B" towards the left-hand end, the same pressure of steam would clearly be exerted below the indicator piston "E." This piston being attached to the spring "G," would force that spring upwards rateably according to the pressure which came below it, and therefore the indicator piston-rod "F" and the pencil "$F^1$" would rise as shown by the line "$F^1$ $P^1$" to such a point upon the card as would represent the pressure per square inch of the steam in the engine cylinder.

Suppose, for example, that the indicator-spring were one which would collapse 1 inch for every 50 lbs. pressure per square inch applied to the piston, then if there were 100 lbs. steam applied, the pencil would rise 2 inches from "$F^1$" to "$P^1$."

Suppose the piston "B" to have completed its travel towards the left-hand end of the cylinder, and the slide-valve to have opened so as to allow the steam between the right-hand end and the piston to escape, then the indicator-piston "E" would return to its original position level with the line "$F^1$ $O^1$," with the exception of any little pressure that might remain in the cylinder in consequence of the steam not having perfectly escaped into the atmosphere; but leaving this out of the question, it would have returned to the point "$F^1$".

The card, therefore, used in the ways described would show two things: one, that a certain percentage of the whole stroke of the piston was indicated by the line "$F^1$, $O^1$"; the other, that the maximum pressure of the steam within the cylinder was indicated by the line "$F^1$, $P^1$"; but if this were all the indicator showed it would be but of little use, and it is not thus that the indicator is worked. The string "M" is kept in communication with the lever worked by the piston-rod at the same time that the cock "L" is open, so as to keep the indicator cylinder in communication with the engine cylinder. The effect of this is, that assuming the pressure to exert itself with great rapidity, the pencil "$F^1$" (see Fig. 2) would trace a vertical line "$F^1$, $P^1$" on the card "H, I, J, K;" and supposing the pressure to be maintained uniformly throughout the whole of the stroke, then as the point "$F^1$" would be maintained at the level "$P^1$" throughout the stroke, while the card travelled from right to left its 4 inches, the pencil would describe the top line "$P^1$, $Q^1$;" then the slide-valve being opened to allow the steam to escape, the pencil would make a sudden drop from "$Q^1$" to "$O^1$," and on the return journey of the card would trace the line "$O^1$" "$F^1$"; thus it would have described a parallelogram of which the horizontal line would represent a proportion of the stroke of the piston, and the vertical line would represent the pressure upon the piston; the area of that parallelogram would therefore represent pounds pressure into feet moved through by the piston in its stroke or half revolution of the engine. Now, as has been before explained in the Oxford Report, a horse-power is supposed to be 33,000 lbs. moved through 1 foot in a minute of time, or equal thereto, viz., 11,000 moved through 3 feet, or 1 lb. moved through 33,000 feet, &c.

Figs. 2-5.—*Indicator Diagrams.*

FIG. 2.

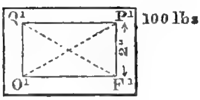



FIG. 3.

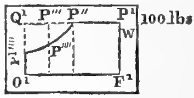



FIG. 4.

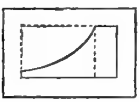
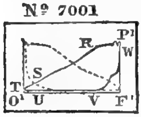


FIG. 5.
N° 7001




Supposing now, to take an example, that the lines "$F^1$, $O^1$" (see Fig. 2) represent 1 foot stroke of the piston, that that piston has an area, say of 100 square inches, that the line "$F^1$, $P^1$" represents 100 lbs. to the inch, then we shall have 100 lbs. $\times$ 1 foot $\times$ 100 inches area $=$ 10,000 as the work performed by the piston in its one stroke or half a revolution, and if this be doubled for the whole revolution, then we shall get 20,000 lbs. through 1 foot as the force exerted by the engine, and supposing the engine to be making 100 revolutions in a minute, then 2,000,000 lbs. through 1 foot would be the force exerted by the piston of such an engine in a minute of time; this, divided by 33,000, gives 60 and about two-thirds horse-power, as what is called the gross indicated horse-power of such an engine. Before, however, the available power that the crank-shaft will deliver for pumping, threshing, ploughing, or for other purposes can be considered, an allowance must be made off the gross indicated horse-power for the friction of the engine. The diagram shown in Fig. 2 is a mere elementary diagram, one that hardly ever occurs in practice, and if it does, is only justified by the desire to obtain the greatest possible power out of a given size of engine without regard to the highest economy. It will be seen that it supposes steam to have been admitted during the whole length of the stroke, and that no advantage whatever has been taken of the expansive use of the steam.

Diagram, Fig. 3, shows steam working expansively.

Assume, that, as in the former case, the pressure of the steam has been 100 lbs. above the atmosphere, and has raised the pencil from "$F^1$" to "$P^1$"—assume also that during half the length of the stroke of the engine that steam has been admitted to the cylinder, but at that point, viz. at "$P''$," all further inlet of steam has been stopped by the action of the slide,—the steam now in the cylinder begins to expand, and as it expands it loses pressure; by the time, therefore, the piston has got from "$P''$" to "$P,'''$" the steam will have lost pressure, so that the pencil will gradually have dropped along the curved line "$P''$ $P''''$," and by the time the piston has got to the end of the stroke "$Q^1$," the pressure will still further have diminished, say down to "$P^{1''''}$."

An inspection of this diagram will show, that although only half the steam was admitted that was admitted in the case of diagram 2; the area of the diagram is very much more than half of that of Fig. 2; as a matter of fact, it is about ·83 of that area, and thus a power of ·83 has been obtained (by using the steam expansively) for half the fuel that was required in the case of Fig. 2.

As a further illustration take Fig. 4, which is the diagram that would be made if the steam were cut off when the piston had moved one-fourth of the stroke. In this instance only one-fourth the steam would be required that was required for Fig. 2; but the total area of the diagram is about ·54 of that of Fig. 2, so that ·54 of the work is got for one-fourth of the steam.

The diagrams given here are theoretical ones, which very rarely occur in actual practice, and certainly not in the case of traction-engines, where the cylinders are fitted with only one slide worked by that which is called a "link motion."

Fig. 5 is a real diagram taken from the 10-horse engine, No. 7001, of Aveling and Porter, when working at 30-horse-power upon the brake.

Starting from the top point "$P^1$," the steam remanis at an uniform pressure to about the point "R." Here the slide, which has been gradually closing, is so nearly closed as to "wiredraw" the steam, as it is called, and to cause it to fall in pressure following the curved line; the closing being entirely effected, the expansion takes place as shown by the curved line "R, S." At "S," prior to the arrival of the piston at the end of the stroke, the steam is allowed to go into the atmosphere, and nearly suddenly drops from "S" to "T;" and it is at this moment that the waste-blast is heard in the chimney; when the piston reverses, there remains a slight pressure in the cylinder, which becomes less and less until by the time the piston gets to "U," the waste steam, with the exception of about 1 lb. to the inch has gone out of the cylinder; but this 1 lb. to the inch remains as a back pressure throughout the stroke, so that it keeps the line of the pencil 1 lb. above the line of no pressure, or the atmospheric line "$O^1$, $F^1$," until the closing of the connection with the blast-pipe by the movement of the slide, which occurs at the point "V," after which time the steam remaining in the cylinder is compressed, raising the indicator-pencil according to the curved lines "V, W."

In this instance, the effective work done by the engine is represented by the area contained within the irregular figure "$P^1$, R, S, T, U, V, W;" this is after allowing for the back pressure and the compression, which are contained between that figure and the lines "$O^1$ $F^1$ $P^1$."

We have now described how a diagram is taken from one end of the cylinder. To obtain it from the other, all that has to be done is to connect a pipe, as shown by "X" in Fig. 1, to the left-hand end of the cylinder "A," and then the diagram, having been obtained from the right-hand end, and the cock "L" shut, and the cock "Z" in the pipe "X" opened, a diagram from the left-hand end may be got on the same piece of paper, and would, if the engine were perfectly equal in performance at the two ends, be represented by the dotted line upon Fig. 5. The sum of these two areas will represent pounds pressure through the length of the stroke of the piston in a whole revolution, which, multiplied by the area of the piston and the number of revolutions per minute, will, as before, give the foot-lbs., which, being divided by 33,000, will give the gross indicated horse-power of such an engine.

The indicator described is that first invented by Watt, with a flat card reciprocating in front of the pencil, and with the piston connected directly by its rod to the pencil at "$F^1$". Since the day of Watt the indicator has been improved in construction, the flat card has been replaced by a piece of paper partaking of the character of that ordinarily employed in metallic memorandum books, which paper is wound round a cylinder caused to have a reciprocating revolution by means of a string and spring; and the pencil, instead of being directly attached to the end of the indicator piston-rod, is attached to a lever which multiplies the motion of that rod, so that the piston of this indicator has but a small stroke. The object of this last improvement is to get rid of the undulations arising from the momentum that takes place in the piston of the indicator when applied to engines working at high velocities. Formerly with Watt's indicator it was difficult to obtain steady diagrams from an engine working more than 50 revolutions; by the use of the improved indicator good diagrams can be obtained up to 200 revolutions, but above this they begin to partake of the undulatory character of the diagrams from the old indicators.

*Entries for Trial.*—Originally there were 13 engines entered for trial in Class XVII., viz., 4 by Aveling and Porter, 1 of Ashby, Jeffery, and Luke, 1 by Tuxford and Sons, 2 by Burrell, 1 by Maude and Walker, 1 by Howard, 1 by the Perseverance Iron Works (Robey and Co.), and 2 by Ransomes, Sims, and Head. These last two entries related, however, in fact, to only one engine, but one appearing in two characters, the first with india-rubber tyres, and the second with iron tyres. Aveling and Porter did not bring their 12-horse engine to the trial yard, Messrs. Ashby, Jeffery, and Luke, and Messrs. Maude and Walker were not ready, and Messrs. Robey kept their engine at Lincoln. Thus the 12 engines were reduced to 8, one of which, however, —that of Ransomes, Sims, and Head—counted for two entries, making 9 entries. These 9 entries may be divided into 5 distinct groups: first, the locomotive type of boiler, with iron driving and steering wheels. Of this type were Aveling and Porter's 10-horse, No. 7001; their 6-horse, No. 7002; Burrell's 8-horse, No. 3660; and Tuxford's 10-horse, No. 2677. Second, the locomotive type with iron wheels containing india-rubber between the outer and inner tyre. Of this only one was exhibited, viz.: Aveling and Porter's 6-horse-power, No. 7003. Third, the Howard safety boiler, 10-horse-power, No. 1170, mounted on ordinary iron driving and steering wheels. Fourth, the Thomson vertical pot-boiler, with indiarubber tyres to both the driving and steering wheels. Of these two were exhibited, viz., Ransomes, Sims, and Head's 8-horse-power, No. 2149, and

Burrell's 8-horse-power, No. 3661. Fifth, Thomson's vertical pot-boiler with iron wheels. Of this type Ransomes, Sims, and Head exhibited one engine, No. 2150.

Reverting to the entire liberty left to exhibitors as to the proportions of their engines for a nominal horse-power, it may be well to compare those proportions with some standard, and the one we propose to take is that employed at the Bury Show for single-cylinder engines, viz., 10 circular inches of piston area for each horse-power. The strokes of the various engines differed so little among themselves, none being under 10 inches, and none over 1 foot, that there is no impropriety in assuming that the feet run per minute of piston might be the same in all the engines, the difference in the length of the strokes being corrected by a corresponding difference in the number of revolutions. This being so, and the boilers being suitably proportioned, the relative number of circular inches given by exhibitors to a nominal horse-power would represent the relative value of the engines in point of utmost power to a customer.

*Aveling and Porter's 10-Horse-power Engine.*—The first engine we will describe, as it was the first which was tried upon the brake, is Aveling and Porter's 10-horse-power engine, No. 7001, price 390*l.* The boiler of this engine is of the ordinary portable engine or locomotive type, having a fire-box, barrel smoke-box; and funnel, this latter by-the-by was cast iron, which the makers' insist is much more durable than the ordinary wrought-iron construction. The area of the fire-grate is $6\frac{1}{2}$ feet; there are 53 tubes, $2\frac{1}{4}$ external diameter, giving a collective area of $169\frac{1}{2}$ feet, which, with the fire-box area, $35\frac{1}{4}$ feet, makes up a total heating surface of $204\frac{3}{5}$ feet. The collective area for draft through the ferrules of the tubes is ·75 foot. The engine is a single one; the cylinder is 1 foot stroke by 10 inches bore = 100 circular inches area, thus giving the exact Bury standard of 10 circular inches for each nominal horse-power. The cylinder is mounted on the fore end of the boiler. It is contained in and forms part of a casting, which is at once steam-chest, slide-jacket, steam-jacket, and cylinder. The steam on its way to the steam-chest passes through the jacket round the cylinder, which jacket is thus always open to the boiler. The regulator and throttle-valves are between the steam-chest and the slide-jacket. Within the barrel of the boiler a cast-iron baffle-plate is placed over the steam outlets, with the view of preventing "priming." The crank-shaft is of the bent construction, and is mounted in brasses carried in wrought-iron plummer-blocks. These are supported on bracket-plates. The outer bracket-plate of each plummer-block is formed by continuing the fire-box side upwards (and, as will be seen immediately after, these same sides are prolonged backwards to support the second motion-shaft), the inner bracket-plates for the crank-shaft plummer-blocks rise from the top of the fire-box to which they are riveted. On the left-hand end of the crank-shaft is a fly-wheel driving pulley, from which power can be taken for threshing, &c., and the shaft itself is prolonged beyond the pulley to receive a coupling for an universal joint-shaft to drive a windlass for ploughing. On the right-hand end of the crank-shaft is a pinion, which gears into a spur-wheel on the second motion-shaft. This shaft extends across the back of the fire-box, and is carried in bushes bolted to the bracket-plates, which, as already mentioned, are the same plates as those that are carried up to support the crank-shaft, they being caused to extend behind the fire-box far enough to receive the second-motion shaft-bushes. The spur-pinion on the right-hand end of the second-motion shaft gears into a spur-wheel, which runs loose upon the axle of the driving-wheels, and carries in itself two bevel-pinions, which gear into two bevel-wheels, the left-hand one keyed fast on the driving axle, the right-hand one attached to the right-hand driving-wheel boss, which runs loose upon the axle. The left-hand driving-wheel is also loose upon the axle, but can be attached thereto by a pin, which slides through its boss and fits into one of four recesses provided in the break-wheel, which is keyed fast on the driving-axle, at the left-hand side of the fire-box.

Those who are conversant with some of the traction-engines that have been made of late years, and, still more, those who are conversant with cotton-spinning machinery, will see that the driving power is applied to the two wheels by means of what is now, and properly, called a compensating motion, but which in cotton-spinning machinery is known as the "Jack-in-the-Box." While going along a straight road the bevel-pinions act as mere fixed drivers to the right and left-hand bevel-wheels, and have no motion of rotation round their own axes; but should the steering require the engine to make a curve, so that the wheel on the outer side must traverse a greater space than the wheel on the inner side of the curve, then the pinions begin to revolve about their axes to such an extent as to compensate for this difference of motion. Several makers have applied the compensating motion to traction-engines before, but they have been tempted to abandon it, because if one wheel gets into a slippery hole while the other remains on comparatively firm ground, there is a liability that the energy of the engine would be spent in driving the wheel in the slippery hole, instead of the wheel upon the firm ground. Mr. Aveling, however, says he finds the convenience for general work in this compensating arrangement so great, that he prefers to use it, putting in spikes to the wheel which may be in the hole, and thus giving an abutment for the motion to work upon.

Further on, when we relate the trials which took place upon the high road it will be found that the use of the jack-in-the-box did give occasion under the most severe load for one wheel to run round while the other stood still. We should recommend to the ingenuity of Messrs. Aveling and Porter, and to that of the other exhibitors, the solution of the problem how, without complication or expense, to arrange a motion by which the jack-in-the-box might at will be thrown out of gear, so as temporarily to drive the wheel by a rigid connection.

It may be as well here to state that the driving-wheels, which are 6 feet in diameter, and 1 foot 6 inches wide, have cast-iron rims, made with a sort of cellular pattern, to work upon the road, and are each provided with seven pairs of holes, to receive either spikes or the pins by which pieces of angle-iron, called paddles, are bolted across the faces of the wheels. The steering-wheels have also cast-iron rims, with a fillet upon them to prevent their slipping sideways when traversing "side-long" ground. They are carried on a fixed wrought axle attached to the under-side of a wooden bed. A perch-pin passes through the axle, through this bed, and through a wrought bracket formed on the bottom of the smoke-box and barrel. The lower end of the pin is stayed in the ordinary way, as in portable engines, by a stay-rod, which extends back to the front of the fire-box. To the outer ends of the wooden bed two chains are attached, which are led away to an axle carried in brackets at the front of the fire-box, around which they are wrapped in contrary directions. On the right hand of the axle there is a worm-wheel, driven by a worm-pinion, fixed on the lower end of an inclined shaft, the other end being within easy reach of the driver as he stands on the foot-plate of the engine behind the fire-box. He has also close to his hand the reversing handle, the steam-regulator, the ash-pan damper-handle, and the brake-handle. The feed-pump regulating cock is also close to him; and thus one man, or, in fact, one boy, can with the greatest ease not only fire but steer, and in every way control the action of the engine. The notch-bar, in which the spring-catch lever of the link motion is retained, is made to slide through a mortice in a bracket; and its position can be regulated by means of a hand-wheel, and a screw of sufficient range to move the notch-bar a distance a little more than the space between any two notches. Thus the desired point of expansion can be reached with the greatest nicety. It certainly did seem to us that the simplest way to have effected this would have been the direct application of a screw, as is now very frequently practised in locomotive engines, but Messrs. Aveling and Porter say that they find it is somewhat cheaper to provide the arrangement they have than the single screw and nut. The feed-pump is fastened on to the left-hand bracket, which carries the second-motion shaft, and is worked by a separate eccentric on the crank-shaft. The pump is always at work, and the amount of water is regulated by a cock in an overflow-pipe. When this cock is shut, the whole of the water goes into the boiler; when it is open the whole of the water returns to the tank. When travelling along a road with the tank full of water, in which state it contains 200 gallons, the feed-water is not heated, because the back-pressure of the steam is not sufficient to overcome the head of water. But when the engine is being used as a motive-power in a farm-yard, then a branch-pipe, which is led back to the tank from the waste steam-pipe heats the feed-water. The engine is provided with a governor, to make it self-regulating when acting as the driver of machinery.

The toothed gearing of this engine was, with the exception of the wheels in the jack-in-the-box, of malleable cast iron. Mr. Aveling explained that in engines supplied to a customer these wheels also would be of malleable cast iron, but that he had not had time to get a set annealed.

The first trial to which engines in this class were subjected was an ordinary dynamometer trial, by which for years past engines exhibited at the Society's Shows have been tested.

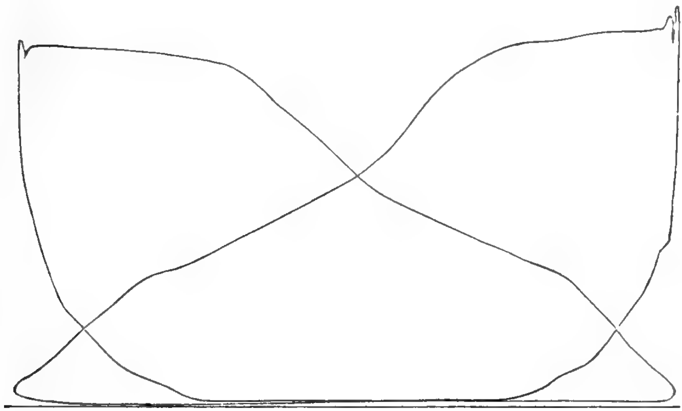
Aveling and Porter's 10-horse-power engine, No. 7001, which we have described, was, in accordance with the liberty granted, declared at 115 lbs. pressure of steam and at 30-horse-power, and was supplied with the usual 14 lbs. of coal for each horse-power; and with this quantity she ran at the declared revolutions—viz., 120 a minute—for 3 hours 44 minutes and 35 seconds mechanical time, showing a consumption of 3·73 lbs. of coal per horse-power per hour. This is not up to the very highest standard of economy that has been attained with Portable Engines at previous shows: but then those engines were working only at their nominal power; they were provided with double slides to their cylinders, and were in the charge of numerous attendants; while with respect to the engines in Class XVII. this year the power at which they were worked in all cases exceeded their nominal—in this instance, three times—the only expansion was that obtained by the use of the link-motion upon a single slide, and they were worked in each case by one attendant only.

Looking at these facts, we consider the performance of this engine, in developing a horse-power for 3·73 lbs. of coal per hour, extremely satisfactory.

The indicated horse-power, as ascertained from diagrams taken during the run (a copy of which is given in Fig. 6), amounted to 35 horse-power, giving a consumption of only 3·2 lbs. of coal per gross indicated horse-power per hour. The evaporation was 7·62 lbs. of water for 1 lb. of coal. The average temperature of the feed was 175°. The oil and tallow used were 1 lb. 12¼ ozs., being at the rate of 2½ ozs. per actual horse-power per day of 10 hours.

It is very gratifying, indeed, to be able to record at last the indicated horse-power of engines while being tried on the brake, because it gives one the means of comparing their performance with that of engines employed for other purposes, such as for driving machinery or for propelling vessels. In these cases, testing by the dynamometer-brake is not, and, in fact, could not be applied; the power, therefore, which is reported is invariably, in the case of marine engines, the gross indicated horse-power, and the consumption of fuel is referred to this gross indicated horse-power; and certainly, now that the com-

Fig. 6.—*Indicator Diagram of Messrs. Aveling and Porter's* 10-*Horse-power Locomotive, No.* 7001.



parison can be made, the agricultural engineers may be well satisfied to find their non-condensing engines working down to, if not below, the average consumption of extremely good condensing engines in the navy. No doubt this excellent result is largely due to the fact of the exhibitor being permitted to work at a really high pressure. It cannot be too constantly urged upon engineers and upon users of engines that the employment of a low pressure in non-condensing engines is an extremely wasteful thing; yet, clear as this is or should be to an engineer, the users of engines certainly do not recognise the truth of the proposition, as one may hear a man boasting, "I have got an extremely good engine (a non-condensing one): she will drive the whole of her work with 30 lbs. steam;" never reflecting that when he is using steam at only 30 lbs. above atmospheric pressure in a non-condensing engine, one-third of the whole of the fuel is consumed in getting the steam up to the atmospheric pressure; while if he were to use the steam at 120 lbs. to the inch, only one-ninth of the fuel would be so wasted.

Before proceeding to relate the next trial to which this and the other engines in Class XVII. were subjected, it will be well probably to describe those other engines, and to state their performances on the brake.

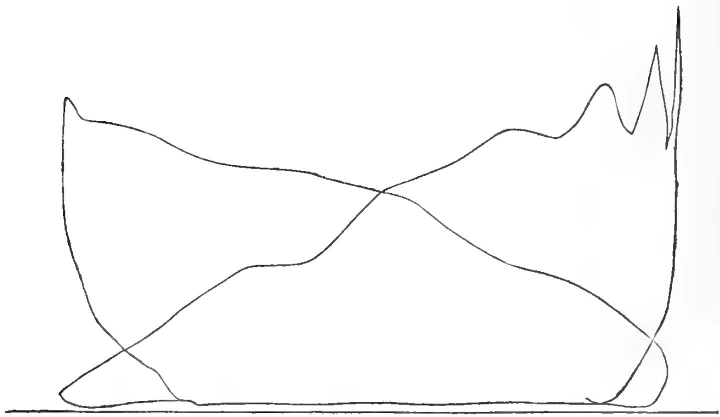
*Aveling and Porter's* 6-*Horse-power, No.* 7002, *Price* 300*l.*—This engine is generally similar to their engine No. 7001, already described. The principal points of difference are that the steering-wheels are wood; that the driving-wheels, which are 5 feet diameter and 10 inches wide, have wrought-iron tyres, with strips of wrought iron riveted on angleways; that the feed-pump regulation is made by a cock in the suction-pipe; that the reversing-handle is not provided with a screw adjustment, and that there is not any brake. The boiler of this engine contains 28 tubes, of 2½ inches outside diameter. The fire-grate has an area of 4·33 feet, and there is a total heating surface of 106 feet and a flue-area of ·534 foot. The diameter of the cylinder is

$7\frac{3}{4}$ inches, and the length of the stroke 10 inches. This diameter of $7\frac{3}{4}$ inches gives an area of 60 circular inches, thus allowing the Bury standard of just 10 such inches to each horse-power.

During the trial on the brake this engine was worked at 160 revolutions per minute at 115 lbs. pressure of steam, and at 18-horse-power, being three times its nominal; and it consumed 4·42 lbs. of coal per horse-power per hour. It evaporated 7·46 lbs. of water per lb. of coal. The average temperature of the feed-water was 183°. The oil and tallow consumed were 1 lb. 15 oz., being at the rate of $5\frac{1}{2}$ ozs. per actual horse-power per day of 10 hours.

The indicator diagram, of which Fig. 7 is a copy, showed that 20·5 horse-

Fig. 7.—*Indicator Diagram of Messrs. Aveling nd Porter's* 6-*Horse-power Locomotive, No.* 7002.

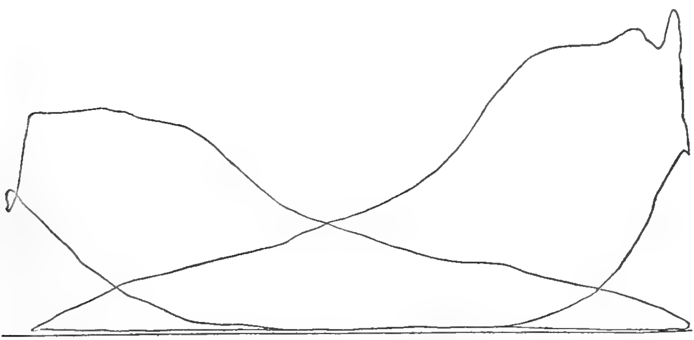


power were developed, equivalent to a consumption of 3·9 lbs. of coal per gross indicated horse-power per hour.

*Burrell's 8-Horse-power Locomotive.*—The next engine in Group 1 is that of Mr. Charles Burrell, No. 3660, 8-horse-power, price 370*l.* This is an engine of the locomotive type. The fire-box has an area of grate of 3·9 feet. There are thirty-three $2\frac{1}{4}$-in. outside-diameter tubes in the boiler, giving, with the fire-box, a total heating surface of 145·33 feet. The flue area through the ferrules of the tubes is ·63 foot. The cylinder is a single one, of 12 inches length of stroke, and 9 inches diameter = 81 circular inches, or $10\frac{1}{8}$ inches per horse-power. This engine was declared to work at 16-horse-power, at 120 lbs. pressure, and at 150 revolutions. The cylinder is fixed upon the fire-box end of the boiler. It is cast in one with the steam-chest, on which is mounted the adjustable safety-valve; there is a another valve upon the barrel of the boiler. The cylinder is steam-jacketed on one side only. The crank-shaft is a forged and not a bent shaft, and is supported on a saddle-casting bolted on the front of the boiler. At the right-hand end of the crank-shaft there is a fly band wheel for delivering power to a threshing or other machine; and adjoining that wheel, on its inner side, and also at the left-hand end of the crank-shaft, there are sliding pinions to be put into gear (when travelling), with spur-wheels carried upon the second-motion shaft. The pinion on the fly-wheel side is for the quick speed, and that on the left-hand side is for the slow speed. The second-motion shaft carries loose on it at each end two pulleys to take pitched driving-chains. These two pulleys are coupled up to the second-motion shaft by clutches, the handles of which extend forward of the smoke-box, so as to be within reach of the steersman (who, in the case of this engine, is in front, and has nothing to do with the firing or stopping and starting of the engine). These tooth-wheels work two pitched chains, made of wrought iron, case-hardened, with ¾-inch steel pins, which take directly on to other tooth-wheels attached to the inner side of the driving-wheels. These driving-wheels are 5 feet 6 inches diameter, 14 inches wide, and have cast-iron tyres, on which are riveted bands placed angleways. The wheels are provided with holes to take iron paddles or wood blocks, eight on each wheel. The main axle is carried in two cast brackets, bolted on to the sides of the fire-box, across the front of which the axle passes. Each of these brackets contains a volute spring, on which the engine is supported. The steering-wheels have cast-iron rims with projecting ribs, and a wrought-iron axle below a cast-iron bed, on which is a semicircle taking the steering-chain. This is a flat-link chain, passing over a toothed pulley at the bottom of the upright steering-spindle; this spindle is carried in a column, and is surmounted by a worm-wheel driven by a worm-pinion on the hand-wheel shaft. The feed-pump is immediately below the left-hand end of the crank-shaft, and is worked by a separate eccentric. The regulation of the feed is made by a cock in the suction-pipe; the handle of this cock, and that of the ashpan-damper, the reversing-handle, and the steam-handle, are all brought within reach of the fireman, who stands in a portion partitioned off the coal-box, which is carried on the main traction-iron. This engine is not fitted with a brake. The water, 160 gallons, is contained in a tank suspended below the barrel of the boiler. The water is not heated by the waste steam, although a little condensation from the waste steam gets into the tank. There is a heating-pipe from the boiler to blow into the tank when the steam is high. This engine consumed 5·02 lbs. of coal per horse-power per hour, and evaporated 7·36 lbs. of water per 1 lb. of coal, and consumed 1 lb. 2 ozs. of oil, being at the rate of 4 ozs. per horse-power per day of 10 hours.

The indicator diagrams, of which the figure below is a copy, show that

Fig. 8.—*Indicator Diagram of Messrs. Burrell's* 8-*Horse-power Locomotive, No.* 3660.

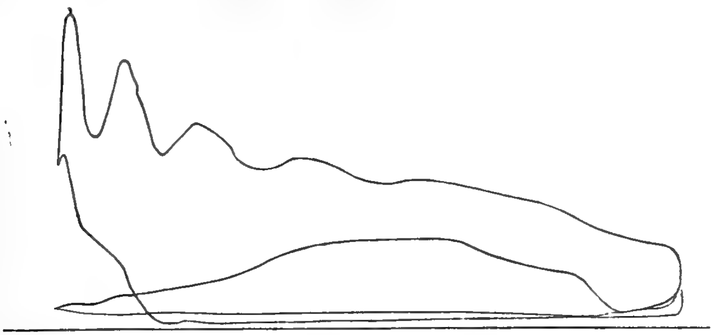


19·15 gross indicated horse-power were obtained by a consumption of 4·19 lbs. of coal per gross indicated horse-power per hour. It will be seen, on an examination of these diagrams, that the slide was not well set, and that much more power was developed at the crank end than at the back end of the cylinder.

*Tuxford and Sons'* 10-*Horse-power Engine.*—The fourth and last engine in Group 1 was Tuxford and Sons', No. 2677, 10-horse-power, price, 390*l*. This is an engine of the locomotive type of boiler, with a single cylinder 12 inches length of stroke and 9 inches diameter of bore, giving an area of 81 circular inches, or only 8·1 inches per horse-power, instead of the 10 inches of the Bury standard. The area of the fire-grate is 4·23 feet; the heating surface of the fire-box, 21·41 feet; and of the tubes, 132·75 feet—together, 154·16. The flue area, through the tubes, is ·6 foot. The cylinder, which is steam-jacketed, is placed upon the barrel of the boiler at the smoke-box end. The crank-shaft is over the fire-box, carried in plummer-blocks, fixed to a saddle-casting bolted on to the top of the fire-box. It should be stated that, unlike the other engines of the locomotive type, this engine runs fire-box first, but as in all previous instances the terms right and left have been used when the spectator is supposed to stand at the fire-box end and to look towards the funnel, the same positions will be assumed in the case of this engine. At the left-hand end of the crank-shaft is a fly-wheel driving-pulley, and at the right-hand end is a clutch, which can be slidden into gear (when the engine is required to travel) with a wheel having teeth to receive a pitch-chain. This chain drives a larger-toothed wheel loose on the right-hand end of the second-motion shaft, which is supported in a wrought-iron framing—hereafter to be described—and extends across the engine under the barrel of the boiler, and on the fire-box side of the driving-wheels, which in the case of this engine are near the smoke-box. The chain-wheel on the second-motion shaft contains two bevel pinions for a jack-in-the-box motion; it drives at its right-hand side a bevel-pinion loose on the second-motion shaft, and attached to a spur-pinion which gears into a spur-wheel, keyed on the boss of the right-hand driving-wheel; and on its left-hand side it gears with a bevel pinion keyed on the second-motion shaft, at the left-hand end of which is a spur pinion, to gear into a spur wheel keyed on the boss of the left-hand driving-wheel. From this it will be seen that the jack-in-the-box principle is applied, not directly to the driving-wheels themselves, as in the case of Aveling and Porter's engines, but to the second-motion shaft. The driving-wheels, as will have appeared from the foregoing, are loose upon the main axle: they are 5 feet in diameter and 1 foot 4 inches wide; their rims are made of wrought iron, and on the rims bands of iron are riveted diagonally at intervals. The engine has a single slide, worked by a link motion. The feed-pump is worked off its own eccentric. The reversing-handle, steam-regulator, and the regulator for the amount of feed water are brought within the control of the fireman. At what would ordinarily be the back of the fire-box, but which, having regard to the way in which this engine journeys, is in this case the front, there is an enclosed space for the fireman, the steersman, and the fuel. The two fore-wheels are each carried on a short pin, projecting from the under end of a vertical plunger. This plunger works in guides upon the sides of the inclosure where the fireman stands. The upper parts of the plungers enter cast-iron boxes, in which are volute springs. At the lower ends of the plungers there are lever arms, to which rods are attached, and are led away to levers placed upon the bottom end of the steering-spindle. This is vertical, is carried in a suitable casting, and is surmounted by a worm-wheel, driven by a worm-pinion on the steering-wheel spindle. Below the barrel of the boiler there are a pair of side frames; these are hinged at one end to a bracket on the fire-box, and at the other, or smoke-box end, work between guides, and are provided with rods entering into boxes in which are placed india-rubber springs; thus both the driving and steering wheels are spring-mounted. The left-side driving-wheel is fitted with a break. The steering-wheels have a projecting rib to prevent the engine sliding in "side-long" ground. The water-tank is in the form of a smoke-box, and is placed where the smoke-box is usually situated. It contains within it a real smoke-box, which in this case is a very small one, just of sufficient size to admit of access being obtained to the tubes. From the top of this smoke-box a funnel rises through the water-tank, above which it is continued by a chimney of the ordinary construction. By this arrangement it is intended to absorb a certain portion of the waste heat for heating the feed water. There is also, with the same object, a branch in the exhaust-pipe. This engine was declared to work at 20-horse-power, or double its nominal, at 165 revolutions, and at 120 lbs. pressure. It consumed 5·95 lbs. of coal per brake horse-power per hour. The water evaporated was 7·28 lbs. for one pound of coal. The oil used was 11½ ozs., equal to 2½ ozs. per real horse-power per day of 10 hours.

The indicator diagram, of which a copy is given below, shows that 23·55-

Fig. 9.—*Indicator Diagram of Messrs. Tuxford and Son's 10-Horse-power Locomotive, No. 2677.*

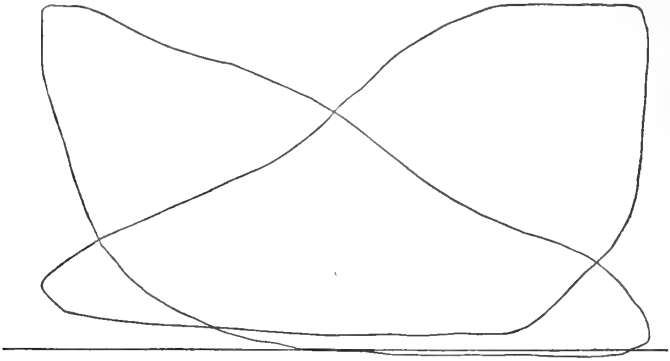


horse-power was developed. The consumption of coal was therefore 5·06 lbs. per gross indicated horse-power.

If anything were wanted to confirm the engineers and judges in their view of the desirability of taking indicator diagrams, it would be afforded by the instance of this engine. An examination of the diagrams thus taken will show, that while one end of the cylinder was developing 17·91-horse-power, the other end was developing only 5·64. Had the maker taken diagrams before he exhibited the engine, it is certain that he would have altered his slide so as to have corrected this error; and had he done so he would undoubtedly have obtained a far better result upon the trial.

*Aveling and Porter's 6-Horse-power*, Group 2.—Locomotive engines with indiarubber internal tyres.—The only engine in this group was Aveling and Porter's 6-horse-power, No. 7003, price 340*l.*, which is precisely similar to No. 7002, with the exception that the driving-wheels are fitted with Mr. William Bridges Adams's indiarubber spring inner tyres. The outer tyres of the wheels are 11 inches wide. Upon the interior of these tyres are riveted two angle-irons, with their vertical limbs inwards, leaving a space of 7 inches. Between these two angle-irons is placed a layer of indiarubber an inch and a-half thick, within which is the inner tyre of the wheel, formed of a T bar, with a 4-inch web and a 6-inch table to bear on the indiarubber. There is no connection of any kind, beyond frictional connection, between the inner tyre and the indiarubber, or between the indiarubber and the outer tyre. No. 7003 was tried upon the break at 15-horse-power, and consumed 4·42 lbs. coal per horse-power per hour. It evaporated 7·76 lbs. of water per lb. of coal consumed. The indicator diagram, of which a copy is given below, shows

Fig. 10.—*Indicator Diagram of Messrs. Aveling and Porter's 6-Horse-power Locomotive, with Internal Indiarubber Tyres, No.* 7003.



the gross indicated horse-power to be 17·6, and the consumption of coal therefore to be 3·77 lbs. per hour for each such horse-power. The oil and tallow used were 2 lbs. 10½ ozs.; but this large quantity was entirely due to a bearing having been suffered to become hot; and as the run could not be stopped to cool the bearing, excessive lubrication had to be kept up. The temperature of the feed water averaged about 130°.

*Howard's* 10-*Horse-power, with Safety Boiler.*—The 3rd Group, that of the Howard Safety Boiler, with rigid iron wheels, comprised only one entry, viz. Messrs. J. and F. Howard, of Bedford, No. 1170, price 410*l.* This is a 10-horse-power engine, single cylinder, having a length of stroke of 1 foot, and a diameter of cylinder 10 inches, giving the exact Bury standard of 10 circular inches per horse-power.

This engine is provided with one of Howard's safety boilers, and was declared to work at 180 lbs. pressure. This boiler consists of five vertical rows of tubes. The centre three rows are each composed of a nearly vertical pipe of a D shape when viewed in plan, having the flat side of the D towards the front side of the engine. From this flat side, six nearly horizontal pipes, 9 inches in diameter outside and 5 feet long, extend towards the front of the engine. The two outer sections are also made of D pipes and horizontal pipes, but in their case the horizontal pipes are only 7 inches outside diameter, and just touch each other as they lie one above the other; while with the three inner sections there is a space of 1 inch between the pipes. There is a brass connecting-pipe which joins to one another the forward end of the horizontal pipes nearest but one to the bottom of the boiler, and which serves for a feed connection. At the hinder end there is a somewhat similar connection for the steam. All these pipes are contained within a waggon-shaped casing. The spaces, such as they are, between the pipes of the outer rows are filled with fire-brick. At the bottom of the casing a fireplace is provided, and below that the ash-pan. Thus it will be seen that the fire plays up among the rows of tubes. It is not, however, permitted to go straight up through them, as there are cast-iron bars put in, which cause it to pass in a tortuous direction in ascending. The upper part of the case is made double, to withstand the heat, and the chimney is mounted upon the middle of the top of the case. The upper horizontal tubes are, it is to be presumed, simply used as steam-chests, and as dryers and super-heaters. We do not see, however, how they can act very efficiently in this latter capacity, as each tube is a *cul-de-sac*, and there is nothing, therefore, to cause steam which has just been delivered from the water in the D tubes to go into these upper tubes on its way to the steam outlet except when variations of pressure take place. It seems to us that, leaving out of the question the law of the diffusion of gases, the same steam that was first in the upper D tubes must remain there for an indefinite period. The water is in the lower tubes only. Within each of these lower tubes there is a circulating tube, which extends from the D tube to near the end of the horizontal tube. These circulating tubes have slits along the whole of the upper surface, and two slits at the sides near their ends. There is also in the D tubes a baffling-plate to prevent "priming," placed just above the mouth of each of the circulating tubes. It will be seen that there is nothing in this boiler larger than the 9-inch cylindrical tubes, and as these are made $\frac{3}{8}$ths of an inch thick, the boiler is competent to withstand great pressure. It was, as already said, worked as high as 180 lbs., and no doubt was quite safe at 600 lbs. The area of fire-grate was 6 feet, the total heating surface in the boiler, taking only, as regards the two outside rows of tubes, their semi-circumference, towards the fire, was 276 feet, of which probably 184 feet may be taken as boiling surface, and 92 feet as drying or super-heating surface.

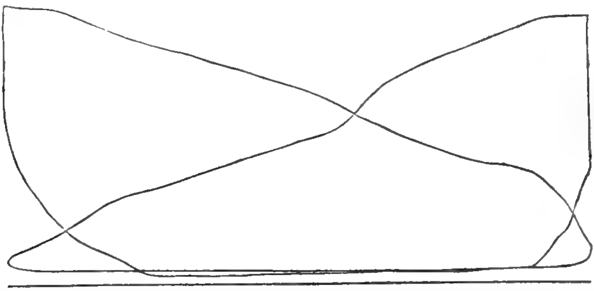
This boiler is carried on a plain wrought-iron frame made of angle iron, and 10 inches deep; this is swelled out at the front end into a circular form, and contains within it the circular frame which carries the single steering-wheel. This frame is provided with friction rollers to take both the downward and sideway pressures. It is surrounded with a grooved pulley, in which lies a wire rope, which is carried alongside the frame towards the hinder end of the engine, where it terminates in a pitch chain, carried on a studded pulley driven by a worm wheel and pinion, the pinion being on the bottom of a vertical spindle having a single cross handle at the top for the purpose of steering. At the hinder end the frame carries a plate-iron box. The right-hand side of this box forms the framing for the single horizontal cylinder. This drives a crank-shaft just behind the waggon-shaped fire-box. On the left hand of this shaft is a fly-band wheel, which, however, works between the driving-wheel and the side of the boiler casing, and is most inconveniently placed for putting on a strap; in fact, it appears as though it could not be got on without unlacing it. No governor was provided to regulate the engine when acting as a prime mover for farm machinery. At the right-hand end the crank-shaft carries a pinion, which gears into a wheel running on a stud, and having a pinion attached to it, which gears into a spur-wheel fixed upon the driving-axle. The driving-wheels are 5 feet 6 inches diameter, and 15 inches wide, and are made with wrought-iron tyres, having plates riveted on them angleways. These wheels are both loose upon the shaft, but can be coupled to it by pins, which in the case of the right-hand wheel fit into holes in the spur-wheel, and, in the case of the left-hand wheel, fit into holes in a hauling-pulley, which is keyed on to the shaft, and is of use to draw the engine out of positions of difficulty by means of a rope attached to a tree or some other fixed object, and wound round about this pulley. The tank is below the foot-plate. There is no means of heating the feed-water from the waste steam. The feed-pump is worked off a separate eccentric. The reversing and stopping and starting handles are within reach of the driver, as is also the regulating cock of the feed-pump. There is not any provision, except that already mentioned, for throwing either of the driving-wheels out of gear when making a sharp curve. There is not any brake to this engine. As has already been said, the steering power is brought to the hinder part of the engine. This is done in the case of Aveling and Porter's engines, but there the boiler is of such a shape that the fireman, if he be steering, can see over the boiler, and has a perfect view of the road he has to travel; but in the engine of Messrs. Howard, the enormous size of the waggon-shaped case of their safety boiler renders it absolutely impossible for the driver to see over it, and the most he could hope to do would be to obtain a glimpse round the sides of the case. We do not think it possible to safely steer the engine with the provision made for it.

On coming into the yard, the ground being rather soft, the engine made itself a hole, and it required many hours of labour to extricate it and put it in position for the brake. When this was at length done, the boiler was proved, but it turned out to leak so much that the maximum proof could not be attained. We, however, having no doubt of the safety of the boiler allowed the engine to go to work, but the coupling for the universal shaft provided by the exhibitors broke. The Society then lent one of their couplings, which did not, however, fit the shaft, but with this the engine was again put to work. It made only a few revolutions when the band fly-wheel, which was a disc-wheel, suddenly and spontaneously burst asunder, and the halves fell down, luckily injuring no one. On putting the halves together, it appeared that the wheel had been suffering from a large amount of strain, due to the contraction of the central part of the disc. This was shown by the fact that when the outer edges of the wheel were together, there was a space of from three-sixteenths to a quarter of an inch in the central part of the disc.

Under the before-mentioned condition of things, it was of course impossible to allow the engine to compete; but Messrs. Howard's representative and the Judges thought it would be very desirable to be in possession of the information to be obtained from a brake trial with so novel a form of boiler, and it was therefore arranged that Messrs. Howard's men should repair the boiler, and that a new fly-wheel should be supplied. This was done, and on Wednesday, 5th July, the brake trial was made. The engine was declared to run at 30-horse-power and 150 revolutions a minute, and, as before stated, at 180 lbs. pressure.

It consumed 5·48 lbs. of coal per horse-power per hour. The indicator Diagram, given below, shows that 34·26 horse power were developed, giving

Fig. 11.—*Indicator Diagram of Messrs. J. and F. Howard's* 10-*Horse-power Locomotive, with Safety Boiler, No.* 1170.



4·797 lbs. of coal per gross indicated horse-power per hour, the oil and tallow used were 1 lb. 8 ozs., being at the rate of 3·1 oz. per actual horse-power per day of ten hours. The water evaporated was 5·48 lbs. per 1 lb. of coals, as nearly as could be ascertained, for owing to the behaviour of the boiler it was by no means easy to be sure to a few gallons what the water evaporated really was. So long as no steam was being drawn from the boiler the water was tranquil in the gauge; but the moment the engine commenced to work, the water rushed through the gauge with great velocity, and no humouring of the reversing-handle or steam-cock would render the water quiescent. It was from this cause that it was impossible to leave off with the same amount of water as was in the gauge before starting. On the completion of the preliminary run the water was out of sight, and on the completion of the final run it was also out of sight. We felt that so much time had been consumed upon the trial of this engine, that we should not be justified in working the preliminary run over again, with the hope that when it was done the water might be in sight, and with the still further hope that on the completion of the final trial the water might also be in sight. In order to test the facility with which the water could be put in motion through the gauge, we ordered the small blast-cock to be turned on while the engine was standing, and the draught of this small quantity of steam on the boiler was sufficient to cause the water to circulate in the gauge, and it was not until the blast-cock was half shut that the water would remain stationary. We found that the engine could not be run in the least expansion with the regulator open, as on attempting to do so the boiler primed excessively.

If the description which has been given of the boiler has been intelligible in the absence of a sketch, it will be seen, that if the water-level happen to be coincident with the centre of one of the rows of nearly horizontal tubes, then, so far as regards that particular row of tubes, there is a very fair amount of surface for the delivery of the steam-bubbles generated in them; but even then the lower rows would be compelled to discharge the whole of their steam, mingled with the current of water set up by the circulating tubes into the D pipes; and assuming, as is quite possible, the water-level to be at such a height as to be between some two rows of horizontal tubes, then the whole of the steam would have to escape from the water surface to be found in the three large and two small D-shaped tubes, being about an aggregate area of 2½ feet; while the area of water surface in a locomotive boiler of similar power may be taken as 25 feet, or ten times as much. This circumstance is quite sufficient to account for the furious rushing of water through the water-gauge.

*Ransomes, Sims, and Head's 8-Horse-power Farm Steamer.*—The first engine in Group 4, was the 8-horse-power, No. 2149, of Messrs. Ransomes, Sims, and Head, price 750*l.* This engine, the "Sutherland," is of the "pot-boiler" and indiarubber-tyre construction, the invention of Mr. R. W. Thomson of Edinburgh. Probably most of the readers of this Report are by this time acquainted with the construction of the "pot-boiler." Nevertheless, it may be well briefly to describe it here. It consists of a plain vertical cylinder, containing at its lower end an internal cylinder of lesser diameter, forming the fire-box. In the centre of the crown plate of the fire-box there is a circular opening, about 1 foot 1½ inch diameter, to which is jointed the neck of the copper pot. Below the neck, the pot swells out into a spherical form, and is of such size as nearly to fill the fire-box, leaving, however, a space of about 1½ inch all round between itself and the inside of the fire-box. Up this space the products of combustion pass, and they make their escape from the fire-box through 36 vertical tubes 1⅞-inch bore, 3 feet 10½ inches in length, which are inserted in the crown plate of the fire-box in the space left between its sides and the neck of the pot. These tubes extend through the upper part of the cylindrical case of the boiler to the top tube-plate; they are surmounted by a short cylindrical casing or drum, from which rises the funnel. At the ordinary working height of the water, about 1 foot 6 inches of the tubes are immersed in the water, while 2 feet 3½ inches of the upper part of the tubes aer in the steam space, thus drying and superheating the steam. The grate area is 5·25 square feet; the total heating surface up to the level of the ordinary water-line is 80·5 feet; the flue area through the tubes ·66 of a foot. The ash-pan is hinged at the back end, and is provided with a hinged bottom door at the front. The pan and the door are each upheld by chains, and by means of these chains the pan and the door can be shaken and the ashes cleared out. There is an iron-wire grate in the base of the funnel to arrest the escape of ignited fuel.

The mode in which the joint between the pot and the boiler is made is a bold one, and, so far as we know, up to the day of "Pot Boilers," no such joint had ever been attempted before in a similar or even in an analogous place in a boiler. The copper pot has a brass neck riveted and braized to it, which is turned to fit the central opening in the crown of the fire-box, the sides of which opening are formed by a flanging upwards of the crown plate, this opening is bored to take the turned neck of the pot. On the top of the neck of the pot there is secured by eighteen ¾-inch stud bolts (with close-ended brass nuts) a gun-metal flange; this is faced and overlies the thickness of the turned-up crown plate round about the hole. The top of this thickness is also faced, and is bevelled inwards, and into the sink thus formed an indiarubber ring is put, upon which the brass ring bears, being kept hard down upon it by the pressure of the steam.

The pot boiler is carried on a wrought-iron frame extending fore and aft, but more fore than aft. The ends of the frame are upheld by two wrought-iron inclined stays or truss rods, the upper ends of which are attached to two studs secured to the boiler case. At the hinder part, and immediately behind the boiler, this wrought-iron frame carries four raking wrought standards on which the steam cylinders, two in number, are supported, each of these cylinders is 10 inches length of stroke, and 6 inches diameter, giving 72 circular inches as the collective area of the two cylinders, or 9 circular inches per nominal horse-power, being one-tenth less than the Bury standard for single-cylinder engines, but being exactly up to the Bury standard for double-cylinder engines. Why double-cylinder engines should have had 1 circular inch less area per nominal horse-power than single engines at this Bury meeting was not revealed to the world at large, nor even to the then judges, and we do not pretend to be able to solve the mystery. Certain, however, it is that that was the then standard, and that Messrs. Ransomes, Sims, and Head, have conformed exactly to it. The cylinders are placed fore and aft of the engine, and are fitted with guides and connecting rods working down to a crank-shaft, situated about 3 feet 10½ inches from the ground. This crank-shaft is a forged one, and carries between the two throws the four eccentrics for the link motions, and an eccentric to work horizontally the feed-pump, placed on the left-hand side of the frame. The links of the link motion are solid, working in gun-metal blocks, which oscillate in beds provided in the slide rods. The cylinders are not steam-jacketed. The whole of the framing of the engines is wrought iron, and is admirable for its excellence of proportion and for the finish of its workmanship. The crank-shaft continues to the back part of the engine, where it carries a band fly-wheel 4 feet 6 inches diameter by 7 inches wide, for giving motion to threshing and other machinery. When the engine is used for farmyard purposes, it is regulated by a governor. This is of the horizontal construction, and is actuated by a spring instead of by gravity. Upon the crank-shaft is a pair of pinions cast together, which can be placed between, or can be slidden into gear with, either one of two wheels keyed on the second-motion shaft, thus giving either the fast or slow speed for travelling. The second-motion shaft is immediately below the crank-shaft, and carries at its forward end a bevel pinion which gears into a bevel wheel upon the third-motion shaft. This lies across the engine, and has at each end a pinion sliding upon it. These pinions gear into internal spur-wheels attached to the insides of the driving-wheels. The pinions can be slidden in or out of gear by handles within reach of the steersman, who sits in the front part of the carriage, and they are taken in or out as may be required in turning sharp curves. The driving-wheels are 5 feet diameter over the indiarubber, are made of wrought-iron discs, and a wrought-iron flanged rim, containing between the flanges indiarubber tyres 1 foot

Fig. 12.—*Indicator Diagram of the forward cylinder of Messrs. Ransomes, Sims, and Head's* 8-*Horse-power Farm Steamer, No.* 2149.

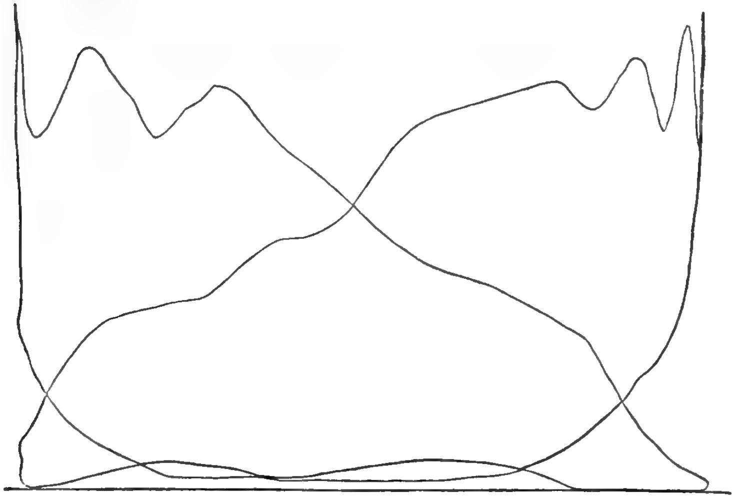


Fig. 13.—*Indicator Diagram of the after cylinder of Messrs. Ransomes, Sims, and Head's* 8-*Horse-power Farm Steamer, No.* 2149.

$3\frac{1}{4}$ inches wide by $4\frac{1}{2}$ inches thick. These tyres are surrounded by a chain of steel shoes; each shoe is as long as the width of the wheel and is 5 inches wide. The shoes are turned up at their ends, and the turned-up ends are connected to one another by steel links and pins, thus making an endless chain round about the indiarubber tyre. At the front end of the engine is the single steering-wheel. This is 3 feet 6 inches in diameter, 1 foot $3\frac{1}{2}$ inches wide, and is similar in construction, and is provided with a similar tyre and chain to those of the driving-wheels. The steering wheel is carried in a large wrought-iron fork, the spindle of which extends upwards through a strong casting, and is surmounted by a spur-wheel driven by a pinion, carried on a projecting bracket, which pinion is driven by another spur-wheel deriving its motion from a pinion attached to the steering-wheel which is carried on, but is not connected to the shaft of the fork. The driving-seat is very like that of a reaping-machine and is carried on springs. To the hand of the steersman are brought, as already stated, the two levers for throwing the pinions in and out of gear, and there are also brought the reversing and steering handles. The engine is ordinarily worked by two men. The fireman stands immediately behind the steersman, and has control over the feed-pump. There is a canopy over the fireman and steersman to protect them from the weather. The water-tank is placed in front of the driving-wheels, and extends forward to beyond the steering-wheel. It is recessed out to leave room for this wheel, so that the tank in plan view is not unlike that of an ordinary locomotive tender having a central opening and two horns. When full the tank contains 375 gallons of water. The coal-boxes are immediately above the sides of the tanks and hold 12 cwts. of coal. The engine is provided with a useful lift-hand pump, to which a hose can be attached so as to draw from any source of water that may be met with in travelling along the road.

The whole of the toothed gearing of this engine was of malleable cast iron.

The working parts were all encased in a species of wrought-iron cupboard with doors on three of the sides, allowing of convenient access. For engines travelling along a high road we think this casing of the machinery to be useful, as rendering the machine less likely to frighten horses. There was not any brake.

This engine was declared at 24-horse-power, at 115 lbs. steam, and 160 revolutions. The coals consumed were 4·95 lbs. per horse-power per hour, and the water evaporated was 6·72 lbs. per lb. of coal; 2 lbs. 12 ozs. of oil were used during the run, = 6·5 ozs. per actual horse-power per day of 10 hours. The indicator diagrams, taken from both cylinders, of which a copy is given in Figs. 12 and 13, show that the gross indicated horse-power developed was 29·26. The consumption of coals per hour for each such horse-power was 4·2 lbs.

*Burrell's 8-Horse-power, Thomson's Patent.*—The second engine in this Group was Mr. Charles Burrell's 8-horse-power "Pot Boiler," with indiarubber tyres, No. 3661. Price 635*l.* The engine had two cylinders, each 10-inches stroke by 6 inches diameter, giving a collective area of 72 circular inches, or 9 circular inches for each horse-power. Thus, as in the "Sutherland," the Bury double-cylinder standard was followed. The cylinders were not steam-jacketed. The boiler was of precisely similar design to that of Messrs. Ransomes, Sims, and Head's engine "Sutherland," and of nearly identically the same dimensions. The area of the fire-box heating-surface was 38 feet; of the pot, 15·1 feet; and of the tubes, 67·75 feet—of which, however, 35·25 feet was in the steam—leaving as the aggregate heating-surface in contact with water, 85·5 feet. The area of the fire-grate was 5·41 feet. The flue area through the tubes was 0·75 foot.

The framing of the engine and the disposition of the two driving and one steering wheel were also similar to that of the "Sutherland." The tank, when full, contained 250 gallons. The tank was in the same position as that of the "Sutherland," but was arranged in a somewhat different manner with respect to the steering-wheel space.

The driving-wheels were 5 feet diameter outside the indiarubber tyre, which was $11\frac{1}{2}$ inches wide by $4\frac{1}{8}$ inches thick, and was surrounded by a chain of steel shoes, as in the "Sutherland." The steering-wheel was 3 feet 1 inch diameter over the indiarubber, which was $11\frac{1}{2}$ inches wide by 4 inches thick, and was protected by a chain of steel shoes.

The steering-wheel fork-spindle passed upwards through a boss, in a strong dome-shaped casting, and was worked by a worm wheel keyed on it, driven by a worm pinion on the horizontal steering-spindle.

There was not any canopy over the steersman and fireman.

The principal difference between this machine and the "Sutherland" lay in the arrangements of the engine and of the gearing. To speak nautically, the cylinders and crank-shaft, instead of being fore and aft, as in the "Sutherland," were placed athwartship. The cylinders were inverted, and gave motion to a two-throw wrought-iron crank-shaft, containing between the throws the four eccentrics for the link motion. These eccentrics were forged in the solid, with the shaft. At each end of the shaft there was a sliding pinion to gear into an internal spur-wheel, bolted on to the inner side of the driving-wheels. These pinions, when in gear, gave the quick speed for travelling. The crank-shaft, by means of a spur pinion and wheel, drove the second-motion shaft, which extended across the engine, and carried at its two ends two pinions, which could be slid into gear for the slow speed with the internal spur gear of the driving-wheels. These and the other two sliding pinions were controlled by levers, fixed on the ends of shafts which extended lengthways of the engine: those for the quick-speed pinions were solid, and lay within the shafts for the slow speed. These latter shafts were hollow. The four handles were conveniently placed two on each side of the driver, and there was an ingenious arrangement of stops by which the driver was secured against inadvertently endeavouring to put the one speed into gear before the other was taken out. It will be seen that this disposition of handles sufficed for throwing out one wheel when turning sharp curves, as well as for putting in and out the quick and slow gear. The reversing handle and steam handle were also brought within convenient reach of the steersman. There was not any break. The feed was controlled by the fireman by means of a cock in an overflow pipe. The feed-pump was worked off the second-motion shaft by an eccentric.

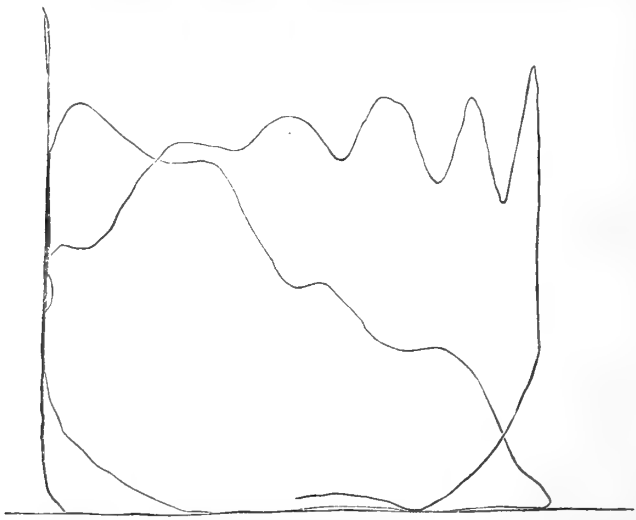
There was not any provision for heating the feed-water from the exhaust steam, but there was a heating-pipe to deliver surplus steam from the boiler into the tank.

There was a vertical governor, actuated by a spring as well as by gravity, to control the engine when working as a driver of farmyard machinery. When thus acting, recourse was had to a very original device for the purpose of obtaining motion for a band-wheel. It was as follows: the left-hand driving-wheel, having been got round to a particular position, was fixed there by a connection to the framing. When in this position, a hole in the inner, and a corresponding hole in the outer, disc of the wheel (these wheels being wrought-iron disc-wheels, as in the case of the "Sutherland") were brought into a line with the left-hand end of the crank-shaft. The pinion was slidden back on the shaft, exposing the outer end, with its two keys or driving-feathers. A piece of shaft a little longer than the width of the driving-wheel was then put through the holes in the left-hand wheel, and the end of this piece of shaft being provided with a suitable socket having two keyways, was passed on to the end of the crank-shaft. A bearing was then bolted on to the outer disc of the wheel, to support that end of the short spindle, and to keep it in position endways. On the end of the short spindle projecting beyond this bearing a band-wheel was placed to deliver off power by a strap, or an universal joint could be attached to drive direct. The bearing which supported the outer end of the short shaft was not bolted directly to the outer disc of the left-hand driving-wheel, but by means of trunnions was carried in a bracket, which was itself bolted to the disc. The inside of the socket was made rounding. These precautions were taken to allow for any irregularity in the position of the outer bearing of the short shaft. As we have said, this device was very ingenious, and by its adoption Mr. Burrell succeeded in keeping his engines athwartships, and in dispensing with the bevel gear employed in the "Sutherland." We fear, however, that the driving-pulley of Mr. Burrell's engine was brought into a somewhat inconvenient position, about 3 feet $4\frac{1}{2}$ inches from the ground, and that the contrivance for supporting the outer end of the short shaft would not be very satisfactory in practice. On the whole, we prefer the manner in which Messrs. Ransomes, Sims, and Head solved the very difficult problem of taking off power for farm-yard purposes from an arrangement of engine such as that employed in these two "pot boilers." The whole of the working parts of this engine were enclosed in a manner very similar to that employed in the "Sutherland."

This engine was declared to work at 24-horse-power on the brake, at 150 revolutions, and at 130 lbs. pressure of steam. It consumed 6·233 lbs. of coal for each horse-power, and evaporated 5·95 lbs. of water for 1 lb. of coal. The steaming during the trial was very irregular.

Although the exhibitor fitted indicator cocks to both cylinders, he had not provided a lever for each, and as it was impossible to change the lever from one cylinder to the other while the engine was running upon the brake, we were compelled to be content with a diagram from the right-hand cylinder only, which shows the gross indicated horse-power to be 31·4. The consumption of coals, therefore, for each such horse-power was 4·62 lbs.

Fig. 14.—*Indicator Diagram of the right-hand cylinder of Burrell's 8-Horse-power Thomson's Patent Locomotive, No.* 3661.



The oil and tallow used during the trial were 10 ozs., being at the rate of 1·85 oz. per actual horse-power per day of 10 hours.

*Ransomes, Sims, and Head's 8-Horse-power, with Iron Wheels.*—Group 5 contained only one entry, viz. Messrs. Ransomes, Sims, and Head's (No. 2150) 8-horse-power "pot boiler."

This, as before stated, was the same engine (the "Sutherland") as the entry No. 2149, but with cast-iron wheels in lieu of the indiarubber wheels, and with a difference in price of 250*l.* in consequence.

The driving-wheels, which were hollow cast iron disc-wheels, were 5 feet diameter by 1′ 7⅜″ wide.

The steering-wheel was of cast-iron, the same construction as that of the driving-wheels, and was of the same dimensions as the indiarubber steering-wheel of the "Sutherland."

There was, of course, no object to be attained in re-trying the "Sutherland" on the brake, under the guise of No. 2150, and thus there is no record to make of this entry as regards brake trials; but it figured in a very interesting manner in a trial on the high road, to be hereafter mentioned.

## General Remarks on Trials in the Yard.

Having now described the various engines, we wish to say a few words on the evaporative duty of the boilers, on the desirability of steam-jacketing the engine cylinders, and on brakes on the driving-wheels.

We were somewhat disappointed in finding the low evaporative duty of the boilers. In the best instance it was only 7·76 lbs. of water per 1 lb. of coal; we had expected, at least, 1 lb. more of evaporation. Last year, at Oxford, from the old boiler of the Society as much was obtained in one instance as 9·35 lbs. of water per 1 lb. of coal; and we had hoped that as good results would have been reached with the locomotive type of boiler in the traction-engine of Aveling and Porter, and of other exhibitors. In Aveling and Porter's engine, No. 7001, during the trial on the brake, the average temperature of the feed-water was from 170 to 180 degrees. This may be the right time to remark upon the fact that when the feed-water is heated by actual contact with the waste steam, so that the steam which heats it becomes condensed and mingles with the water, no greater amount of *cold* feed-water is evaporated by the boiler than would have been evaporated had the water not been heated; in fact, a slightly less amount is evaporated. A little reflection will make this clear. Although the feed-water may be heated, as in this case, 110 degrees above the temperature at which it was supplied from the Society's tank, yet that heat is obtained from steam which becomes condensed and mingles with the water, and has itself to be re-evaporated, and thus just so much more water from the steam has to be evaporated as would be equal to the saving in evaporating the feed-water by heating it, if the total of the latent and sensible heat of the steam in the boiler (say at 115 lbs.) were equal to the total latent and sensible and heat of the exhaust steam; but as the total heat of the boiler steam is greater than that of the exhaust steam, it follows that the fuel has to supply the difference, and that therefore it has not so many units of heat left to evaporate cold feed-water, and that thus a little less water is evaporated than would have been had not the exhaust mingled with it to heat it.

The benefit of this process, therefore, appears in the diminished coal required to produce the horse-power; but it does not appear in any extra amount of *cold* feed-water evaporated, thus differing from those cases where the feed-water is heated by passing through a pipe jacketed by steam. When this is done, the steam which heats the feed-water does not mingle with it, and does not add to its quantity, and therefore, with feed-water thus heated, there is a greater evaporation per lb. of coal than there is from cold feed-water; while in feed-water heated by actual contact with waste steam there is no greater evaporation.

We have felt it necessary to comment upon this point at some little length, because we know that among the exhibitors, and indeed among other engineers, there were those who were inclined, on first consideration, to hold that if the heating of feed-water be the means of obtaining an economy in the production of power, it obtains that economy by a higher evaporative duty, and that that duty should be shown in the amount of feed-water evaporated, forgetting that this would only become apparent if the cold feed-water, *after* having been augmented by the condensed steam, could be measured, and that it cannot become apparent if the cold feed-water alone be taken into account.

On finding the poor evaporative results, we became anxious to ascertain the temperature of the products of combustion as they issued from the boiler; but no provision had been made for this, and there was not time to drill holes into the smoke-box to introduce a thermometer. Some rude attempts were made to obtain comparative temperatures by holding a thermometer over the tops of the funnels; but evidently such attempts must be highly unsatisfactory so far as getting anything like an accurate result is concerned, because at that point the waste steam is mingled with the products of combustion and has cooled them, and the least priming makes, as might be expected and as we found, a most sensible reduction. We made further trials by lowering down the funnels pieces of lead attached to a wire—also a very insufficient mode of arriving at the truth. This being so, we feel it would be wrong to publish any of the results, and we will content ourselves with saying that the tests, rude as they were, made it quite clear there were great differences in the temperatures of the escaping gases from the various boilers, and that in the interests of the exhibitors and of engineering progress it is most desirable on the next occasion of the trials of engines by the Society that each exhibitor should be required to provide means for the insertion of a pyrometer in that part of his engine where the products of combustion have passed the last useful heat-absorbing surface, be it boiler or be it heater, and where they have not yet mingled with the waste steam.

*Steam-jacketing.*—One of the great difficulties in writing these Reports is, that they are addressed to two totally different classes of readers: the one, the manufacturers and exhibitors of the very machines to which the Report relates (a class to which it is almost an insult to offer anything in the nature of engineering criticism at all, and certainly anything bordering upon the elements of engineering); the other, the agriculturists who purchase and use these implements. The latter class of readers are not supposed to understand engineering as a science, and, in reporting for their information, one is bound therefore to enter into the consideration of engineering subjects in a manner which is necessarily elementary. This must be our apology for having devoted a page or two of this Report to the description of the steam-engine indicator, and of its mode of action. But we now wish to say a word or two upon the question of steam-jacketing engines; and we are about to take the liberty of saying it quite as much for the benefit of the manufacturers as for that of the purchasers. Although some of the engines were steam-jacketed, and some were so constructed as to superheat their steam to a point which might probably enable steam-jackets to be dispensed with, others were not jacketed although the steam was not superheated. Moreover, at previous trials of engines, the Judges have noticed that steam-jacketing was the exception, and that in some instances where the exhibitor has supplied jackets, he clearly did not appreciate their value.

Some few years ago, on the occasion of a trial of stationary engines from the Society's boiler, an exhibitor who had provided his engine with a steam-jacket did not use it, because he thought that as he could not return the condensed steam into that boiler, it would be a loss to him rather than a gain. We believe that very many engineers—not only those engaged in the manufacture of agricultural engines but engineers generally—do not appreciate the theory upon which the benefit of steam-jackets rests; and they share in the mistake of the greatest writer that probably we have ever had upon the steam-engine (we allude to Tredgold), who, clear as he was in almost every point connected with that subject, was, in respect of this particular of steam-jacketing, in error, and was led from that error to condemn James Watt's practice of the steam-jacket as a mistake. For Tredgold, not appreciating the theory of the steam-jacket, held that it was a mere contrivance for keeping the cylinder warm; and that, although it did this, it did it by the waste of more steam than would have been wasted in the unjacketed cylinders; the excess being (in Tredgold's judgment) that due to the extra size of the jacket over and above that of the cylinder which it enveloped.

After so great a writer as Tredgold had fallen into this error, and had condemned Watt, no engineer need be ashamed to confess that he does not see how a steam-jacket may be an advantage. We think, therefore, we may be pardoned if we say a few words in order to explain the paradox of the steam-jacket, although quite aware that while we are doing it the bulk of the engineering readers of these lines do not want any information upon the subject. We must, therefore, be taken as simply addressing ourselves to those engineers who may not have studied the question, and to that section of our readers who, not being engineers, nevertheless take an interest in engineering science.

The steam-jacket is of especial use in the expansive engine, and the greater the amount of expansion the greater is the need for and the use of the steam-jacket.

Assume the case of an expansive (say non-condensing) engine without a steam-jacket. The piston has been making a stroke towards, say, the right-hand end of the cylinder; and in making that stroke the pressure of the exhaust-steam on that side of the piston has been 1 or 2 lbs. above the atmosphere, and the temperature therefore practically that of boiling water.

The metal of the cylinder sides has, so far as its interior skin is concerned, been cooled down to the temperature of the exhaust steam. In this condition of things, steam, say at 105 lbs. to the inch above the atmosphere, and at a temperature of 343 degrees (about), is admitted from the boiler, and it comes into a chamber the walls of which are 131 degrees lower than itself. A quantity of steam sufficient to supply the heat to heat up the walls of the chamber must therefore be at once condensed; this is done, and the condensed steam remains in the form of water in the cylinder until the slide-valve by its motion has shut off the communication with the boiler; the steam in the cylinder then begins to expand and the pressure to be reduced. The water arising from the steam which was first condensed is now in contact with the walls of the chamber heated to a temperature due to 105 lbs., while the pressure in the cylinder has diminished from 105 lbs. gradually down to say $7\frac{1}{2}$ lbs. above the atmosphere; the inevitable result of this is, that the water which was first condensed becomes re-evaporated and turned into steam to be used in the cylinder. It may be said that, if this is so, its power, which was lost in the act of condensation, will be brought back again by its re-evaporation. But it must be recollected that its power was lost when it was 105 lbs. steam, and that while it is being re-evaporated at all sorts of intermediate pressures down to $7\frac{1}{2}$ lbs., the difference in effect will of course be very great. This may be made clear to the eye by constructing two diagrams. Fig. 15 shows a diagram from an expansive engine with a non-jacketed cylinder; the black lines

Fig. 15.—*Indicator Diagram from an Expansive Engine with a Non-Jacketed Cylinder.*

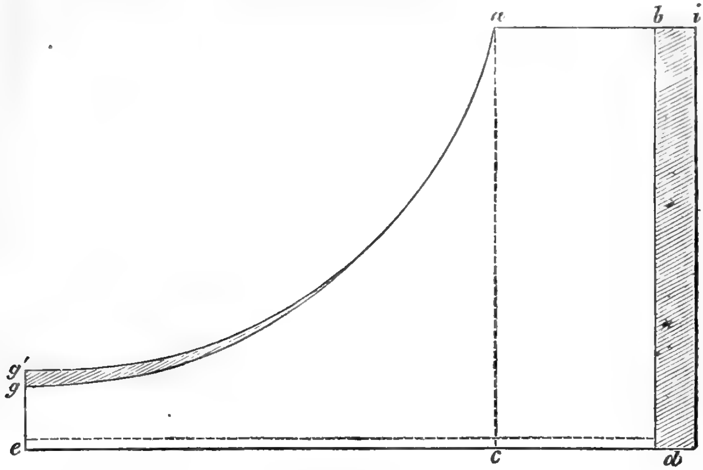
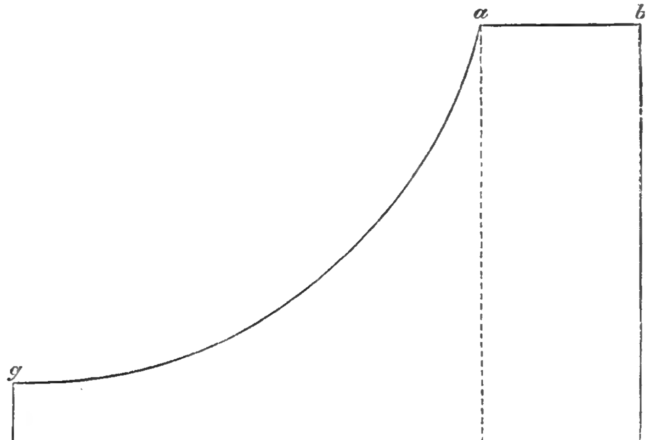



Fig. 16.—*Indicator Diagram from an Expansive Engine with a Jacketed Cylinder.*




the curve given by the indicator, and they would appear to represent that while no greater quantity of steam than was equal to the space contained in the parallelogram *a b c d*, namely, one-fourth of the stroke of the engine by 105 lbs. high, had been consumed, the work performed had been as much as was equal to the area contained by the black lines, less, say 2 lbs., average back pressure, as indicated by the space between the bottom line and the dotted line immediately above; in fact, it would be found, if this diagram were contrasted with one taken from a jacketed cylinder, that the area of the unjacketed diagram representing the work done would be greater than that of the jacketed. Fig. 16 shows a diagram taken from a jacketed cylinder; and if it be laid over the other diagram, it will be found that the expansion-curve $a\ g$ is lower than the expansion-curve $a\ g^1$ of Fig. 15; that is to say, that the height $g\ e$ of Fig. 16 is less than the height of $g^1\ g\ e$ of Fig. 15.

It may be said, therefore, that the unjacketed engine of diagram, Fig. 15, made a greater use of the amount of steam that came into the cylinder than had the jacketed engine, Fig. 16; but the fact is, while in Fig. 16 the parallelogram $a\ b\ c\ d$ truly represents the quantity of 105 lbs. steam which comes into that cylinder, the parallogram $a\ b\ c\ d$ of the diagram, Fig. 15, does not represent it, because it does not show the quantity of 105 lbs. steam which came into the cylinder and was condensed in heating up the walls of that cylinder; and in order to make diagram Fig. 15 correct, there should be added to it a portion as $b\ d\ h\ i$, to show the steam condensed on its entering the cylinder. If this were done, it would be ascertained that that steam ought to have produced, if utilized, the whole of the area $i\ a\ g^1\ e\ h$, instead of the area $b\ a\ g^1\ e\ d$. The rise in the diagram of Fig. 15, from $g$ to $g^1$, represents of course the re-evaporation of the condensed steam. Now it is upon these facts that the utility of jacketed cylinders is based, and it will be seen to consist in the prevention of the condensation of high steam in the cylinder, and its re-evaporation in that cylinder as low steam. The loss which takes place upon the outside of the jacket is one which may be materially diminished by proper cleading, and is a mere loss by conduction and radiation from the surface, about such as would take place from the surface of the cylinder itself. It must follow from what has been said here upon steam-jacketing, that to be of use the steam in the jacket should be at all times as high as the very highest steam employed in the cylinder; in fact, it has often been proposed in large engines to jacket the cylinders with steam from an especial boiler kept at a higher pressure. If these facts were borne in mind, we should see no more attempts at abortive jacketing, by surrounding the cylinder with steam upon the engine side of the throttle-valve, that is, with steam attenuated by wire-drawing below the boiler pressure, nor with the exhaust steam from the engine; nor if the very powerful effect of cooling-surface were borne in mind, and the fact that the temperature of steam must vary with its pressure, should we see instances in portable engines of waste steam-pipes carried from the cylinder when situated at the fire-box end towards the chimney *viâ* the interior of the barrel of the boiler, thus putting into the very atmosphere of 100 lbs. steam which is to work the engine a 2-inch or $2\frac{1}{2}$-inch pipe, containing steam at 2 lbs. above the atmosphere, and a few degrees only above boiling water.

*Brakes.*—We have one other general remark to make in relation to the engines that were brought to trial. Two of them only—viz., Messrs. Aveling and Porter's, No. 7001, and Messrs. Tuxford's 10-horse-power, No. 2677, were supplied with brakes. We are strongly of opinion that no traction-engine is really safe without the ability to apply brake power to the very supporting wheels of the engine itself. We are of course aware that, so long as the connection between the wheels and the engine, be it gearing or chains, is in good order and in gear with the driving-wheels, the power to control those wheels by reversing the engine is the best of all brakes; but assume the driving-wheels not to be in gear, by inadvertence, as happened in our experience; or assume the teeth to strip or the chain to break, as happened to another traction-engine at Wolverhampton this year (although that engine was not among those we tried), then if the engine be without a brake it is wholly uncontrollable, and may readily give rise to a fatal accident, as, unhappily, it did in the instance of the engine to which we have last referred.

## Trials at Barnhurst.

After the dynamometer, the next trial to which the traction-engines were to be subjected was that of drawing loads upon the "course," which for some weeks had been laid down at Barnhurst by the engineers of the Society.

The plan of Barnhurst Farm, Fig. 1, p. 481, and the Section on p. 562, Fig. 17, show this course:—The figures on the left-hand side of the course indicate the gradients. With the the sign + before them they indicate ascending gradients (having regard to the direction in which the engines were travelling), and with the sign – before them they indicate descending gradients. The figures on the right hand of the course indicate chains from the starting-point. The whole length of the course was a little over $1\frac{3}{4}$ mile—actually 144 chains. It will be seen that while the main part of the course was over field surface, a portion of it was over farm road, and a portion of it over a turnpike or parish road. On the afternoon of Saturday, the 1st of July, the engines were sent up to Barnhurst, for the purpose of taking a preliminary run round the course, in order that the exhibitors might be accustomed to it, and might know its quali-

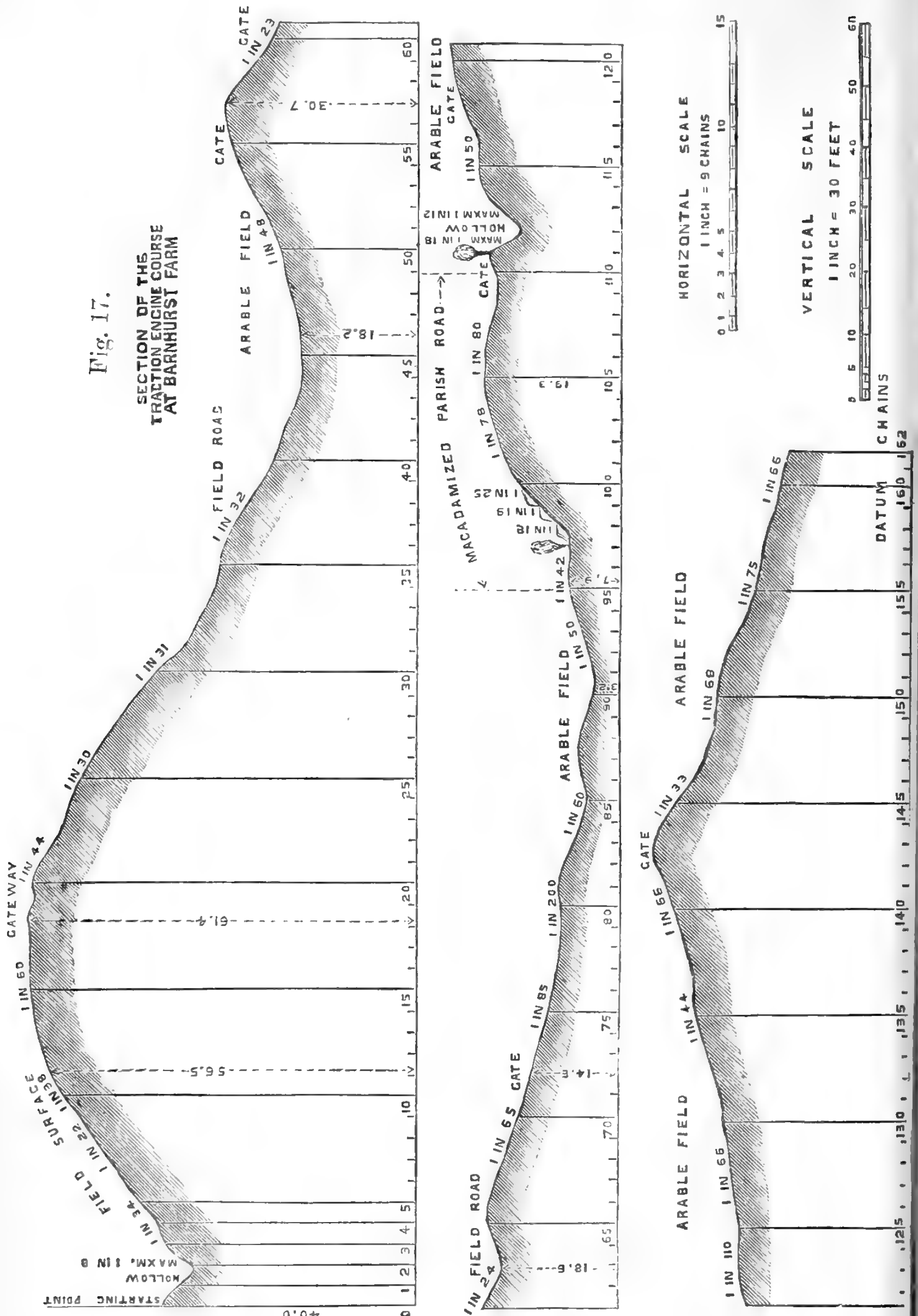


Fig. 17.
SECTION OF THE TRACTION ENGINE COURSE AT BARNHURST FARM
STARTING POINT
HOLLOW MAXM. 1 IN 8
FIELD
SURFACE
CATEWAY
FIELD ROAD
ARABLE FIELD
CATE
MACADAMIZED PARISH ROAD
HOLLOW MAXM. 1 IN 18 MAXM 1 IN 12
HORIZONTAL SCALE
1 INCH = 9 CHAINS
VERTICAL SCALE
1 INCH = 30 FEET
CHAINS
DATUM

ties and difficulties. The afternoon was fine, and there had not been any severe rain for a few days before the Saturday.

The engines that started were Ransomes, Sims, and Head's, 8-Horse-power Thomson's pot boiler, with indiarubber tyres ("Sutherland"), No. 2149; Aveling and Porter's 10-Horse-Power, No. 7001; ditto, 6-Horse-power, No. 7002; Burrell's 8-Horse-power locomotive, No. 3660; and Burrell's Thomson's pot-boiler, with indiarubber tyres, No. 3661. Unhappily Aveling and Porter's 6-Horse-power, No. 7003, with internal indiarubber tyres, had been taken by the Society to Stafford to assist in the work of the ploughing-field, and was not, therefore, at the disposition of the Judges for trial at Barnhurst.

Howard's engine, as has already been stated, was out of the competition, and Tuxford and Sons' engine, having only just completed its brake-trials in the Show-yard, did not arrive on the field in time for the run round.

The engines did not draw any load after them; the ground was in fair, even in good order, and it is, therefore, almost superfluous to say that all the engines performed well. The journey—1 mile 64 chains—was made in times varying from 29 minutes to 22 minutes in the first run, and, on the occasion of the second run, in times varying from 23 minutes to 15½ minutes. The numbers of the quickest and of the slowest engines are not given, as we had told the exhibitors that the run was for the mere purpose of enabling them to know the ground thoroughly well, and the exhibitors were not led to believe that this run would be regarded as a portion of the trial; we therefore think it not fair to the exhibitors to state the performances of the engines. It may be well to call attention here to the place near the 109th chain, marked "shunt." Those who laid out the ground thought that the way in which the traction-engines would deal with their trains at this point would be by running along the line beyond the gate of the field; that then each engine would leave its train, and would go round to take the tail of it; but, both in the preliminary run on Saturday and in the final runs which took place on Monday, the drivers of the traction-engines dealt with their trains as they would ordinarily deal with them—that is, they continued their direct course through the gate, and did not "shunt." After this preliminary run, the exhibitors were called upon to inform the Judges what load they wished to draw behind them at the trial over the course to take place on the Monday. This communication was to be kept a secret until the time of the trial, but there is no harm in divulging it now.

Lots were drawn for the order in which the engines were to run, and they came out as indicated in the following Table:—

| Exhibitor's Name. | No. of Article. | Nominal horse-power. | Load to be drawn as declared on the Saturday. | Load to be drawn as declared on the Monday. | Load actually drawn on the Monday. |
|---|---|---|---|---|---|
| | | | Tons. | Tons. | Tons. |
| Aveling and Porter | 7002 | 6 | 13 | $5\frac{1}{2}$ | $5\frac{1}{2}$ |
| Ransomes, Sims, and Head (Sutherland) .. .. .. | 2149 | 8 | 8 | 5 | Left its loaded waggon on the course. |
| Burrell's (Loco.) .. | 3660 | 8 | 8 | $7\frac{1}{2}$ | 7 |
| Tuxford .. .. | 390 | 10 | $7\frac{1}{2}$ | $7\frac{1}{2}$ | withdrew. |
| Burrell's (Pot-boiler) | 3661 | 8 | 10 | 5 | ditto. |
| Aveling and Porter | 7001 | 10 | $20\frac{1}{2}$ | 10 | 9 |

The loads declared are placed against the engine of each exhibitor in the above Table. The exhibitors all reserved to themselves the power of altering their load in the event of wet; and in the same Table there is a column showing the load for which they eventually declared on the Monday. The Sunday had been a day of almost unceasing heavy rain, so that, on the arrival at the trial-field on Monday morning, the ground was found to be thoroughly sodden, and on the Monday itself, and especially during part of the trial of Ransomes, Sims, and Head's pot-boiler and indiarubber-tyre engine, No. 2149, there were heavy storms of rain. Looking at the state of the ground, the exhibitors on Monday morning declared to reduce their loads down to the weights stated in the Table. It will be seen that two engines, namely, Messrs. Tuxford and Sons, No. 390, and Mr. Charles Burrell's Thomson Pot Boiler, No. 3616, did not start.

Mr. Barford, of Amies and Barford, early in the day, said that he was not concerned with Messrs. Tuxford's engine, except as an implement to drive his ploughing gear, that he had no efficient driver or stoker, and that (to use his own words) he was quite prepared to put up with any amount of indignity he might receive, but he really could not undertake to run the engine round the course; moreover, he wanted the engine at Stafford to drive his ploughing machinery there. Mr. Burrell at the outset of Monday morning intended to run his pot boiler with indiarubber tyres over the course; but when he saw the fate that befell Messrs. Ransomes, Sims, and Head's pot-boiler and indiarubber-tyre engine, he determined not to run his engine, as he said he had no reason to expect that his engine could do any better than Messrs. Ransome's, and it was manifestly idle for such engines to compete, the soil being in the condition in which it was.

*Aveling and Porter's 6-Horse-power Engine.*—The first engine that went round was Messrs. Aveling and Porter's 6-horse-power, No. 7002. This engine weighed at the time she started on the course, including water and coals, about 5 tons $4\frac{1}{2}$ cwts.

Steam was got up to the full working pressure of 122 lbs., and then the fire was raked out of the grate; 1½ cwt. of coals was issued to the engine, and 6 lbs. of wood; the fire was re-lit, and in 5½ minutes the steam was up to 120 lbs. The engine was started at 2h. 27m. 30s.; the load behind the engine was one waggon, weighing, including its own weight and that of the pig-iron with which it was freighted, 5½ tons. The engine was fired and steered by one boy.

Paddles were bolted on to the wheels. During the run the speed varied from 160 revolutions up-hill to 210 on more favourable parts of the road.

At 2h. 43m. the farm road was reached (at 63 chains on the sketch). There was a stoppage here of three minutes to take off the paddles. The engine then ran without any paddles to the gate on the high road (at 97 chains). Here there was a difficulty in getting the waggon out of the field, and the engine had to run ahead along the road, and to use a length of chain between it and the waggon. At 2h. 59m. the so-called shunt was reached. A stoppage again took place to put on the paddles and to attach a chain. At 3h. 3m. the engine was started, and got down into the hollow named by the exhibitors "Easton's Hollow" (at chain 112); there a longer chain was put on. The engine re-started at 3h. 7m., pulling its truck out of the hollow, and going on to the 107th chain, where the entrance to the last field is. This was a bad bit: a short stoppage took place there, but it was very short, as the engine re-started at 3h. 9m. The engine then went till 3h. 12m., when it entered a bad piece of ground in the last field; there again the chain was put on, and at 3h. 17m. the end of the course was reached, making a total of fifty-one minutes thirty seconds. On the arrival of the engine the coal remaining in the fire-box was carefully extracted, along with the ashes in the ash-pan, and was put into a closed iron box provided for the purpose. The coals consumed were 153 lbs., minus the weight of coals and ashes weighed back, together 26 lbs., leaving, if these be treated as of half the value of coals, 140 lbs. The water consumed was 114 gallons, being at the rate of 8·14 lbs. of water consumed per pound of coal. No doubt part of this apparent excess of evaporative duty over and above that which was obtained during the trial on the brake was due to priming.

*Ransomes, Sims, and Head's 8-Horse-power.*—The next engine which started was Ransomes, Sims, and Head's Pot Boiler, with indiarubber tyres, No. 2149, 8-horse-power. The engine at starting weighed about 10 tons 6½ cwts.; this included 2½ cwts. of coals and 255 gallons of water out of the 375 the tank holds when full; of this weight about 7 tons 9 cwts. was upon the driving-wheels, and 2 tons 17½ cwts. upon the steering-wheel. The fire was raked out as in the case of the other engine, and was re-lit from the 2½ cwts. of coals above mentioned and 8 lbs. of wood. At eight minutes after the re-lighting the engine was started in slow gear, with steam at 137 lbs.; planks had been previously placed under the wheels. At about 100 yards another plank was put under. By this time the spaces between the steel shoes round about the indiarubber were filled up with dirt, and the wheels ran round on the plank and could not start the load. At 3h. 13m. the engine was uncoupled from the load—a chain was used, but the snatch of the engine broke it. At this time the wheel frame was revolving slowly within side the indiarubber tyre. At 3h. 19m. a start was effected from the 18th chain, being the entrance of the second field. At 3h. 22m., while going down hill at the 19th chain, and upon a gradient of 1 in 44, the engine came into a soapy place and stopped; an effort was made to back the engine, but unsuccessfully, as the indiarubber tyres slipped round inside the steel shoes; the ground was then dug out behind the wheels, planks were introduced, and at 3h. 35m. the engine was backed. At 3h. 38m. it was re-started and put in fast gear. The reason given by Mr. Head, who was steering, was that in slow gear, owing to the engine's running so much more quickly, the boiler was liable to priming. There was then a good run round the farm as far as on to the road. At 3h. 46m., and at the 108th chain, water brought by one of Fowler's water-carts was taken in. At this time the water in the tank was about 1 inch below its glass, and it was filled up to $2\frac{1}{8}$ inches above the glass. Re-started at 3h. 59m., in slow gear; got into the field, but on going down hill into Easton's Hollow the water lay upon the ground, and the wheels slipped round on the ground, but the wheel did not on this occasion appear to slip within the rubber. Ashes were then put under the wheels, but the engine could not start, and screw-jacks had to be used; one wheel only was jacked up; the ground was dug out in front of the other, and wood was put under. These operations occupied 11 minutes, although there was plenty of assistance; for in addition to Mr. Head and the fireman, there were three labourers and one or two amateurs. A distinguished member of the House of Peers, noted for the interest he takes in mechanical matters, worked as hard as any man upon the ground, although suffering from a dislocated collar bone, which confined one arm in a sling.

At 4h. 21m. the engine started to climb, but without its load, the sides of Easton's Hollow; it got part of the way up when the wheels "whizzed" round upon the mire; more planks were put under, and then the engine moved a short distance until the whole slipped off the plank sideways. On this occasion particular note was taken, and it was found that the steel shoes were revolving upon the earth, and that the indiarubber was revolving within the steel shoes; but it could not be ascertained whether the wheel was revolving inside the indiarubber. A violent thunderstorm was going on at the time, and the wheel was working in a soft clay wash that, unhappily for the engine, made a lubricant with which the wheel was completely deluged. By dint of hard work the engine came out of the hole, leaving the waggon behind it. To add to the trouble, as soon as the engine had got upon comparatively dry ground, the cover of the delivery valve of the feed-pump started its joint, so as to blow very badly. The engine had to be thrown out of gear with the wheels, and at 4h. 30m. it was started to pump up the boiler. At 4h. 38m., the water being pumped up, a re-start was about to be made, but was delayed for a short time to allow Burrell's locomotive to pass. At 4h. 54m., this having been effected, the engine again went to work. At 5h. 3m. an attempt was made to pull the waggon out of the hole; this was done by means of a wire rope; but although the engine was on a level it could not pull the waggon, as the wheels slipped upon the ground, and the indiarubber slipped within the steel, and the frame of the wheel slipped slowly within the indiarubber. At 5h. 10m. (Mr. Head having determined to leave the waggon behind), the engine went on to the gap in the hedge between the 117th and 118th chains, which, as before stated, was a difficult piece of ground; and the engine found it so, for it could not surmount it, and screw-jacks had again to be resorted to. At 5h. 12m. it became necessary to send for more coals; $1\frac{1}{2}$ cwt. was received at 5h. 26m. At 5h. 32m. the screw-jacking was completed, planks and ashes were put under, and the engine was got through the gap, and was put into fast gear. At the 125th chain it stopped again, the wheel slipping very much, and the slow gear was put on. At 5h. 42m. the screw-jacks were again sent for; and the judge who was in charge, having other matters, to attend left the engine. While attending to other duties, he saw that at 6h. 40m. the engine had re-started; but at 6h. 42m., at about the 139th chain, the engine was stuck again. This was the last that the writer saw of it; but one of the assistant engineers reported that at 7h. 40m. it had again started, and, avoiding the bad piece of ground between the 140th chain and the lane, cut off a corner, got into the lane at 7h. 17m., and steamed down the lane.

It was felt that the trial was so entirely a failure that no useful result could have been arrived at from registering the consumption of coals and water, and they were not therefore recorded. We have given our report of the performance of this engine at Barnhurst in such detail that comment is almost unnecessary; those remarks, however, which we have to make, we think it will be better to defer until we come to speak of the trial with this engine on the high road on the following Saturday.

*Burrell's 8-Horse-power Locomotive.*—The next engine that went round was Burrell's 8-horse-power locomotive, No. 3660. The weight of this engine, on starting with 160 gallons of water in the tank and 3 cwts. of coal, was about 9 tons. The fire having been cleared out was re-lit from the above-mentioned coals and 8 lbs. of wood, and the engine started at 4h. 6m. P.M.; the load drawn behind it was, including the weight of the waggon and the freight, 7 tons. The consumption of coal was 167 lbs., or, if 20 lbs. of fire and ashes be allowed as half the value of coal, 157 lbs. The water consumed was 124 gallons, or equal to 7·9 lbs. of water to 1 lb. of coal. The time doing the run was 1 hour 2 minutes.

Messrs. Amies and Barford having withdrawn Tuxford and Sons' engine, the next that should have started was Burrell's Thomson's Pot Boiler, with indiarubber tyres, No. 3661; but Mr. Burrell, having seen the troubles into which the indiarubber tyres (No. 2149) had fallen, determined, as already stated (and we think wisely determined), not to attempt to run his indiarubber-tyred engine over the course.

*Aveling and Porter's 10-Horse-power.*—The last engine which started on this occasion was Aveling and Porter's 10-horse-power engine, No. 7001.

The weight of the engine, with 5 cwts. of coal and the tank full of water, was about 12 tons, of which $3\frac{1}{4}$ tons were on the steering-wheels, and $8\frac{3}{4}$ tons upon the driving-wheels. Mr. Aveling declared to draw behind him two waggons, the leading one weighing, including its freight, 4 tons, and the hinder weighing, including its freight, 6 tons, or 10 tons gross.

The fire having been raked out was re-lit with 10 lbs. of wood, and from the 5 cwts. of coals, and in six minutes was ready for the start, with steam at 127 lbs. the engine being managed by a steersman and a boy as fireman.

Started at 6h. 42m. At 6h. 43m. stopped to throw out half a ton weight from each of the waggons, making the gross load drawn 9 tons instead of 10. Re-started at 6h. 46m. with 130 lbs. of steam and the least expansion. The wheels were fitted with paddles and spikes. At 6h. 49m. the engine was making 216 revolutions; the steam was 120 lbs. On going down the slope at about the 22nd or 23rd chain, the engine made 280 revolutions. At 6h. 53m. the 33rd chain was reached. At this time a good deal of steam was blowing off at the safety-valve. At 6.56, while running alongside the channel that conveys the sewage from Wolverhampton to Barnhurst, say at about the 40th chain, the steersman very nearly put the engine into that channel; stopped about the fourth of a minute to rectify this. At 6h. 58m. came to the turn and gate (at the 58th chain), unshackled here, and put on about 9 feet of chain; backed and doubled the chain; then stopped and put the chain round the fore axle of the front waggon, and pulled through, just shaving clear of the gate post. Started off at 7h. 1m. 30s. At 7h. 2m. 30s. arrived at the road close by the Barnhurst, say at the 62nd chain. Stopped, and took off the paddles and spikes; 5 men, including bystanders, worked upon this. At 7h. 7m. 45s. they were all off, and the engine re-started. Steam at 125 lbs.; went well over the grass until about 7h. 14m., and near the 88th chain, when the wheel slipped, stopped, and put spikes on at 7h. 15m., with as many spikes on as could be inserted without sending the engine a little ahead during the fastening; but at 7h. 16m. stopped to put in the rest of the spikes; started at 7h. 16m. 45s. At 7h. 18m. 15s. arrived at the road at the 97th chain. Stopped to take the spikes off. Four men at work upon this. Re-started at 7h. 19m. 45s., and went up the road on an ascending gradient, varying, as will be seen, from 1 in 19 to 1 in 80, at 270 revolutions of the engine. At 7h. 22m. 30s. reached the 108th chain, and stopped to put the paddles on. At 7h. 31m. finished this; and at 7h. 32m. started, drawing the waggon by a chain. At 7h. 32m. got into Faston's Hollow; the chain broke and the engine went up, leaving the waggons behind. At 7h. 34m. came back, and 7h. 36m., by 50 feet of chain, got waggons nearly out; stopped, and came back, shortened chain, and re-started 7h. 37m. 45s. At the 117th chain, that is, at the gap, passed full charge through the gap in the hedge, and arrived at the end of the course at 7h. 47m., being 1 hour 5 minutes from the first start, or 1 hour 1 minute from the time when, the 1 ton having been thrown out, the real start was effected. The coals used were 233 lbs., less fire and ashes 25 lbs., if taken as equal to half coal; equals 220½ lbs. The water consumed was 217 gallons; being equal to 9.84 lbs. of water per lb. of coal. Although there were only occasional indications of priming, it is clear that this excess of apparent evaporation, over the evaporation when tried upon the brake, was due to priming, for it is quite certain that the fire was not being worked with more economical results. At a very early period of the run two teeth broke out of one of the wheels of the jack-in-the-box; but, as has been before explained, the wheels of the jack-in-the-box, except on turning curves, do not act as ordinary gearing, but as mere drivers. It was owing to this that the engine was enabled to go round the course.

Just before reaching home, namely, at about the 141st chain, two more teeth broke out, but the course was completed without accident. We felt this breakage was a serious matter, and one to be carefully weighed before we determined how far it ought to affect our award. We believe we have already said, that the whole of the gearing of this engine, with the exception of these wheels, was made of malleable cast iron. Prior to this accident taking place, namely, while the engine was being tried on the brake, Mr. Aveling had reported to us that he intended to supply such wheels to the jack-in-the-box motion; and the only reason why he had been compelled to allow it to come to the yard with ordinary cast-iron wheels was that he had found it impossible to get large wheels like these rendered malleable or annealed in time for the Show. While deploring this accident, we felt that it was an accident, and that it would have been a wrong thing to have withheld from Messrs. Aveling and Porter the prize they had so well won by the general excellence of the Article No. 7001, on account of the failure in a part which we had been previously warned was, as it were, a substitute for that which would be supplied to a customer, and which, although it gave way, did not prevent the engine completing the task assigned to it. We shall reserve our remarks upon the capabilities of traction of iron wheels, as we have those upon the powers of indiarubber, until we have recounted the trials on the high road.

## Trials on the Stafford High Road.

Lord Vernon, the President of the Royal Agricultural Society of England, is a member of the Select Committee of the House of Lords now considering the question of locomotion upon common roads; and at the suggestion of Lord Kinnaird, who is also a member of that committee, Lord Vernon and the Stewards determined to afford the Judges a further opportunity of testing the capabilities of traction-engines by a run of considerable length upon a high road. Instructions were accordingly given to the exhibitors, and on Thursday the 6th of July five locomotives started from the Show-yard at Wolverhampton to make the journey to Stafford, a distance of 16 miles, in the following order:—

| | No. |
|---|---|
| Ransomes, Sims, and Head's 8-horse-power Engine "Sutherland" .. .. .. .. .. .. .. | 2149 |
| Aveling's 10-horse-power Locomotive .. .. .. | 7001 |
| Aveling's 6-horse-power Locomotive .. .. .. | 7002 |
| Burrell's 8-horse-power Locomotive .. .. .. | 3660 |
| Burrell's 8-horse-power Pot Boiler .. .. .. .. | 3661 |

The Ransomes, Sims, and Head 8-horse-power engine "Sutherland," with Thomson's indiarubber tyres and pot boiler, left the Show-yard at 5h. 20m. A.M., drawing 12 tons behind it, made up of a waggon with its load, a threshing-machine, and a portable engine. Its own weight, with 300 gallons of water in the tank, and with 16 cwts. of coal, was about 10½ tons.

This engine arrived at Stafford at 9h. 48m., making the time occupied in the journey, including all stoppages, 4 hours 28 minutes.

During the journey there was a stoppage of 18 minutes, to take in from the canal 280 gallons of water; 5 minutes for the men to get breakfast; 2 minutes to allow a horse to pass; and 4 minutes to tighten the cylinder cover; making in all 29 minutes, so that the total time under weigh was 4 hours. The speed, therefore, was 4 miles per hour. The coals consumed were 6 cwt. 1 qr. 20 lbs.; the water 395 gallons, giving 5·48 pounds of water evaporated for a pound of coal, showing that there must have been very little priming during the journey. The ashes were dropped twice from the ash-pan during the run. They could not therefore be weighed back to go in reduction of the quantity of coals.

The average pressure of steam throughout the run was 121 lbs. The performances of the engine, as regards manageability, were everything that could be desired. Taking the useful load drawn of 12 tons, and the distance run 16 miles, the consumption of coal was 3·75 lbs. per ton per mile, and of water 2·05 gallons per ton per mile.

Aveling's 10-horse-power engine, No. 7001, left the Show-yard at 5h. 25m. A.M. Its weight, with 12 cwts. of coal and the tank full, containing 217 gallons, was about 12½ tons. It drew behind it 15 tons, composed of a waggon and load, of a portable engine, and of a threshing-machine. It arrived at Stafford at 10h. 58m., making the time of the journey 5 hours 33 minutes. On one occasion the engine had to be uncoupled from the load, and a chain to be used to pull the load over a soft place in the road. The delays were, that the feed-pump was stopped for a short time (supposed by a piece of waste), and that water was taken in at two places.

The quantity of water used was 466 gallons, equal to 6·81 lbs. of water per lb. of coal. The coal used was 6 cwts. 12 lbs., but there were 79 lbs. of ashes and unconsumed fire. As this, however, could not be ascertained in the case of all the engines, the Judges, for the purposes of comparison, record the difference between the coals taken in the bunkers and the coals weighed back. The speed appears to have been 3⅓ miles per hour when under way. The coals per ton per mile of useful load drawn was 2·85 lbs. The water consumed per ton per mile of useful load drawn was 1·94 gallons.

Aveling and Porter's 6-horse-power, No. 7002, left the Show-yard at 5h. 29m. A.M. The weight of the engine, with tank full, containing 105 gallons, and with 10 cwts. of coal, was about 5¼ tons. The load drawn was 9 tons, consisting of a waggon with its load, and one portable engine. The time occupied in reaching Stafford was 5 hours 13 minutes, including stoppages. The coals used were 4 cwts., without allowing for the ashes weighed back, amounting to 1 qr. 19 lbs.

Burrell's 8-horse-power locomotive engine, No. 3660, left the yard at 7h. 31m. The weight of the engine, with tank full, containing 150 gallons, and with 11 cwts. of coal was 9 tons. It drew behind it a load of 12 tons, namely a waggon, a portable engine, and an ordinary waggon or lorry. It arrived at Stafford in 6 hours 26 minutes. The stoppages were three times, to take in water. The coals consumed were 5 cwts. 4 lbs. The ashes were not recorded. Taking the useful load drawn, the consumption was 2·99 lbs. of coal per ton per mile.

Burrell's 8-horse-power pot boiler, with indiarubber tyres, No. 3661, left the Show-yard at Wolverhampton at 5h. 46m. A.M. The weight of the engine, with full tank of 250 gallons, and 11 cwts. of coals, was about 8 tons 17 cwts. The weight drawn was 12 tons, composed of one waggon with its load and one lorry with its load. The engine reached Stafford in 7 hours 11 minutes; but this requires explanation, as so far from this engine being the slowest of the lot, it was, when travelling, one of the very quickest; as is shown by the fact that at about the fifth mile it came up to Aveling and Porter's 10-horse-power engine, which had started 21 minutes before it, although in these 5 miles there was a stoppage to replace some of the pigs which had fallen off the lorry, and also to secure the ash-pan, which had become loose. At the first stopping-place there was a delay of 9 minutes to allow for Aveling's watering; then water was taken in by this Burrell engine, which consumed 13 minutes. There was then a stoppage of 17 minutes to allow the men to breakfast. Shortly after this a bad place in the road was passed, and the engine took its load over it without any difficulty, and without having to resort to the use of a chain. Between the eighth and seventh mile from Stafford the distance was done in 8 minutes, being at the rate of 7½ miles an hour; but the result of this speed was that a bearing got hot, and it became necessary to stop the engine to oil; 5 minutes were consumed in this. The engine then stopped at Penkridge to take in a second quantity of water. In this operation, owing to the engine being uncoupled from its load and going away to a watering-place different from that made use of by some of the other engines, 45 minutes were consumed. At 11h. 30m., when within one mile of Stafford, a linch-pin came out of the common-road lorry which formed part of the load of this engine. The wheel came off, and 13 minutes were occupied in endeavouring to rectify the matter. The result, however, was that the lorry had to be left behind. This took 4 tons from the load of the engine, leaving 8 for it to draw into Stafford. At 11h. 50m. a waggon was passed, which the waggoner had backed into a ditch in his desire to get out of the way of the preceding engine. A stoppage took place to assist in getting him out of the ditch; 33 minutes were occupied in this. A little water was taken in. The stoppages together amounted to 2 hours 15 minutes, making the actual running-time 4 hours 57 minutes. The coals consumed were 8 cwts. 1 qr. 22 lbs.; the ashes were shaken out upon the road, so that there were none taken back. This is a very large consumption of coal. No doubt a great deal of it was due to what was being burned while the engine was not running. It is impossible to make an accurate allowance for this, and therefore the economic duty of this engine upon the trial at Stafford cannot be ascertained. The water consumed was 579 gallons, being 6·12 lbs. of water evaporated for 1 lb. of coal. The ordinary working pressure during the run was from 120 lbs. to 160 lbs., but on two or three occasions the steam fell, and the engine was stopped for a minute or two until the pressure of 130 lbs. was obtained.

In addition to the five engines, the property of exhibitors, which made this journey to Stafford there was another Thomson engine, manufactured by Messrs. Ransomes, Sims, and Head, which performed the journey. This was the "Chenab," an engine very similar to the "Sutherland" as a whole, but differing in certain respects. The engines, not having to drive a band-wheel for farm purposes, are placed athwart the machine, thus dispensing with the bevel gear. The leading wheel was provided with a pair of elliptic steel springs, and the driving-wheels were 6 feet 11 inches in diameter. This engine towed behind it an omnibus of a very unusual appearance; it was carried on a single pair of indiarubber-tyred wheels placed in the centre. Its horizontal position was preserved by means of a long neck, containing at its outer end a nut, through which passed the vertical draft-pin of "Chenab." This pin was a screw, and by turning it the nut could be raised or lowered, so as to level the omnibus. The neck or draw bar of the omnibus was elastic. Not only was there accommodation within the omnibus for passengers, but on its roof, and protected by a canopy, there were four rows of seats, also for passengers. The sensation afforded by riding in the omnibus, although very peculiar, was by no means unpleasant. This engine, with its omnibus, is one of four which the Post-office authorities in India intend to employ to run on the high road between Chelum and Rawl Pindee. The "Chenab" was in charge of Lieutenant Crompton, who very kindly put it at the disposal of the Judges to accompany the competition engines on the run to Stafford. As much as 8 miles an hour was accomplished by "Chenab" on parts of the road; but it was suffering the whole time from a deficiency in steam.

On the arrival of all the engines at Stafford they drew up in the station-yard, where later in the day they were inspected by the President of the Society, by many Members of the Council, and by some Members of the Select Committee of the House of Lords on Common Road Locomotion.

Some of the engines that had steam up were worked to show their powers of starting, stopping, and turning, and the results were very satisfactory.

### Tettenhall Hill Trials.

It will be remembered that Messrs. Ransomes, Sims, and Head, under their entry No. 2150, had exhibited for competition in Class XVII. the "Sutherland" engine, with iron wheels. We felt that this afforded an opportunity for testing the merits of iron as against indiarubber, which might not be met with again, and we were thus most anxious to try article No. 2150.

To have gone through the full programme it would have been necessary to take this engine to Barnhurst to run her over the farm ground with her iron wheels; but the exhibitors wrote to the Judges, saying that, as those wheels were not provided with suitable paddles to enable them to cope with the state of the ground at Barnhurst, they desired the engine might be withdrawn from that part of the competition. We readily fell in with this view, because we are certain that had iron wheels of the small diameter of 5 feet, and without extremely well-devised paddles, been tried upon the Barnhurst ground, the trial could only have ended in disappointment. With respect to the highroad, however, the matter was very different; and in order to test the comparative merits of indiarubber and iron, we, on Saturday, the 8th of July, directed the "Sutherland" to be taken to a point on the road from Wolverhampton to Shrewsbury, about $2\frac{1}{2}$ miles from Wolverhampton, where the engineers of the Society had selected a piece of the road near Tettenhall, about 2000 feet in length, starting from and ending on a level, but being a continuous hill from the beginning to the end of the run, varying in gradient from 1 in 35 as a minimum to 1 in 18 as a maximum. The sketch of the road, Fig. 18, p. 572, will show precisely where the different gradients commenced and ended. The "Sutherland" drew behind it 26 tons, made up of three waggons and one portable engine. Its own weight was about 10 tons, making 36 tons in all. With this load the "Sutherland" went up the hill, 1900 feet in length, and of the various gradients mentioned, in 10 minutes 27 seconds; the steam was at 145 lbs., the engine was in slow gear and in the least expansion, but the steam-valve was only about half open. The average speed, it will be seen, was 2·11 miles per hour. The engine was perfectly successful in taking up this load. There was not the slightest difficulty or hitch of any kind or description. We then determined upon putting a greater load on the "Sutherland." Aveling and Porter's 10-horse-power engine was on the spot with steam up, and by the kindness of Mr. Aveling we were enabled to make use of this engine, not as a motor, but as a load to be drawn. Adding it to the train, brought up the load behind the "Sutherland" to 38 tons, or including its own weight, to 48 tons. This was re-started from the bottom of the hill with steam at 156 lbs. with the lowest expansion, and with the steam-valve half open. Up to the 400 feet mark upon a gradient of 1 in 35 the engine just drew the load, but about 450 feet the wheel began to slip, by the shoes round about the indiarubber tire slipping on the road. Stopped to take out of the train a portable engine, weighing 5 tons, leaving 33 tons of train load, or 43 tons of total load, to be taken on. At the 500 feet the wheels were just

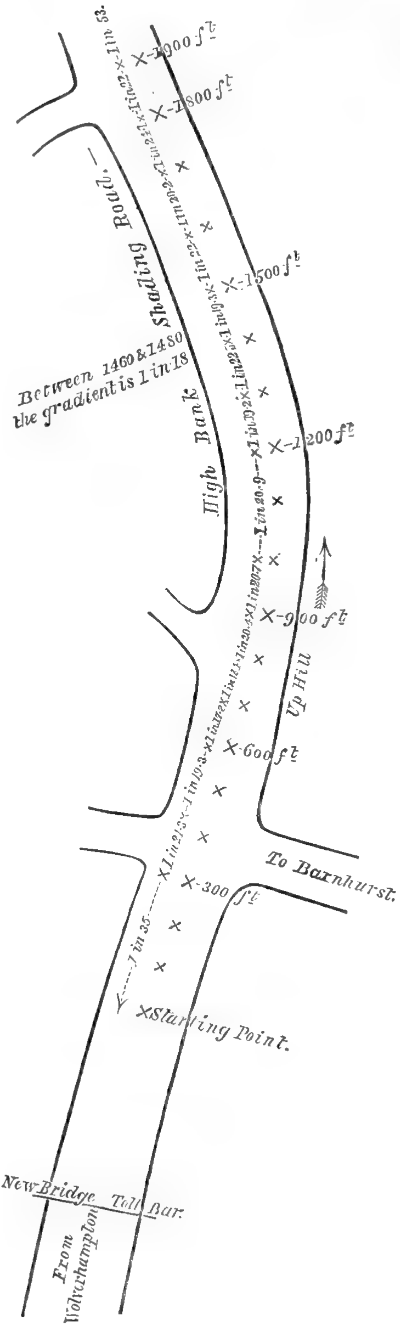



Fig. 18.—*Sketch-plan of Tettenhall Hill, showing the gradients of the part used as the Traction-Engine Trial-course.*

holding, but were much inclined to slip. The "Sutherland," however, succeeded in getting up the 1 in 20, but not without a good deal of slipping. When the 1 in 18 was reached it was clear that this load had fairly overpowered the indiarubber. The weight upon the driving-wheels of the "Sutherland" was 7½ tons, the gross load 43 tons, the inclination 1 in 20; making, therefore, 2·15 tons as the effect of gravity in drawing back the train: to this must be added the tractive force required to move 43 tons upon a level. We had no means of ascertaining this, as we were not provided with traction dynanometers of sufficient power; but referring to General Morin's experiments, and taking, as a fair mean applicable to the circumstances of the case, 1-35th as the tractive force required, then there must be added 1·23 ton, making 3·38 tons as the total tractive force exerted by the indiarubber wheels, the weight upon them having been 7½ tons, as before stated; so that the ratio of friction of the steel-shoed indiarubber-tyred wheels appears to be ·45, the load being taken as unity, or very close upon one-half of the insistant weight.

The "Sutherland" was then set to change its wheels for the iron wheels of article 2150. While this was being done, Aveling's 10-horse power engine being on the ground, it was thought a good opportunity to test the tractive force of that engine. Its wheels, as has been already stated, have cast-iron rims, convex, but with a sort of cellular pattern on them; their diameter is 6 feet and their width 1 foot 6 inches, of which, however, only the central portion bore upon the road, which was in good hard order. The load with which the engine started was, in waggons, &c., behind it, 26 tons; its own weight, 12 tons; together, 38 tons; steam, 120 lbs. When the 500 feet mark was reached the wheels were slipping badly, but were just driving; at 850 feet the slipping was excessive; the time occupied going between 600 and 800 feet was 1 min. 28 sec. The steam had fallen from 120 lbs., at which it started, to 100 lbs. After the 1000 feet mark was passed the wheels slipped very much, but they drove, and at about 1350 feet, as the wheels got more polished, the engine was brought all but to a stand by the wheels slipping. At about 1400 feet there was great slipping. Coals and ashes were put under the wheels, and in that way the 1600 feet was reached. Here the progress was brought to an end, the wheels going round with great violence. Here also was exhibited the disadvantage of the jack-in-the-box, for as soon as one wheel had turned a place for itself upon the road, so that it became more easy to drive than the other, the wheel which was less easy to drive stood absolutely still, and owing to the jack-in-the-box arrangement the whole energy of the engine was spent in "whizzing" round the wheel which was most easy to drive, for this a remedy was found in putting large stones under the easy-going wheel. We have already said that, in our opinion, the makers of locomotives for common roads should turn their attention to devising a ready means for putting the jack-in-the-box out of action; nothing can be better than its performance under circumstances of an easy load and a fair road. The power that it gives to turn, without disconnecting either driving-wheel, was well shown in the exhibition which took place at Stafford in the station-yard. It is true that the "Chenab" turned with great readiness, and in a very small circle; but to enable it to do so, it was necessary to throw the driving-gear out of action with the wheel upon the inner side of the circle. The engines, however, that were fitted with the jack-in-the-box arrangement required no such care, and could be made without any alteration whatever to turn circles, first to the one hand and then to the other. To revert to the trial. At this point (the 1600 feet) the breaks were put on the waggons, the engine was uncoupled and sent ahead, and a chain put on to see if by these means the load could be started; but it was without any effect, as the wheels fairly slipped round upon the road at 1675 feet from the bottom. The Judges found that both wheels were slipping together very nicely, jack-in-the-box not operating; but this arose from a cold chisel having been put in between the teeth: the chisel, however, could not be kept in. After almost superhuman exertions on the part of Mr. Aveling and his assistants by feeding coals and stones under the wheels, and by the use of chains, the 1900 feet mark was reached in 29 min. 57 sec. from the time of starting at the foot of the hill. The weight upon the driving-wheels of this engine was $8\frac{1}{2}$ tons, the gross load 38 tons, giving on an incline of 1 in 20, 1·9 ton as the resistance due to gravity; and (adopting the same traction on a level, as before, namely, 1-35th) 1·08 ton would be the force required on a level, or together 2·98 tons, showing the adhesion of the wheel upon the road to be ·35, as against the ·45 of the indiarubber; the insistant weight being unity in both cases. Although the steepest gradient passed by this engine was 1 in 18, 1 in 20 has been taken, inasmuch as the passing over the 1 in 18 was really due to the use of stones and coals, and matters of that kind, and not to the fair adhesion of the wheels.

By this time the "Sutherland" was fitted with its iron driving-wheels, which were 5 feet in diameter, 1 ft. $7\frac{3}{8}$ in. wide on the faces, which were rounding, and were perfectly plain. The load drawn behind the "Sutherland" was 18 tons 4 cwts.; adding its own load, 10 tons, gave 28 tons 4 cwts. as the gross load. The steam at starting was at 140 lbs. To save time, the start was not made from the very bottom of the hill; but by the time the 500 feet mark was reached, the wheels began to slip; stones were introduced at 590 feet, as the wheels were slipping freely. From here up to 1450 feet the travelling was good; from 600 to 1300 feet was reached in 5 minutes and 5 seconds.

At 1450 feet slipping again took place, and stones had to be used; at 1500 feet efforts were made by putting sacks under to get the wheels to bite, but such efforts were useless. A chain was then attached, but this would not do. It was then determined to take off the portable engine; with this reduced load of 13 tons nett behind the "Sutherland," or 23 tons 4 cwts. gross, including its weight, a start was made, but even with this load the wheels slipped a good deal; however, the summit was reached at last. It may be taken that the limit of adhesion of these cast-iron wheels, with a gross load of 23 tons 4 cwts., was reached upon an incline of 1 in 20: the resistance due to gravity would, therefore, be 1·17 tons; the resistance due to the traction upon a level ·66; together 1·83 tons. The insistant weight being $7\frac{1}{2}$ tons, the ratio of adhesion is ·244, in lieu of the ·35, with the cellular wheels of "Aveling," and the ·45 with the indiarubber wheels. It must be borne in mind, however, in comparing the iron wheel to the "Aveling" with the iron wheels of the "Sutherland," and then with the indiarubber wheels, that the "Aveling" wheels were 6 feet in diameter, while those of the "Sutherland" were only 5 feet.

The road trials appeared to show that, with a road in good order as this was (it should have been stated that it appeared to be formed of a mixture of flint, iron slag, and a little granite) the indiarubber tyres have a decided advantage over iron in tractive force; there is no doubt that they have the advantage of giving an elastic support to the whole machine. These advantages, however, are obtained at an addition to the first cost, in the case of such an engine as the "Sutherland," of 250*l.*, or fifty per cent. of the cost of the "Sutherland" with iron wheels, the price of the engine under these circumstances being 500*l.* Assuming the truth of the statements made by the advocates of the indiarubber tyre, that they may be used for years when protected with steel bands without appreciable wear, so that the cost of maintaining these tyres should not be a very heavy item, it nevertheless becomes a question how far their superiority in tractive force warrants a purchaser in going to the original greater outlay. This is a question which experience alone can authoritatively settle; but we are inclined to think that for road traction it may be worth the while of the proprietor to go to the expense of these tyres. It is, however, a question upon which we cannot, in the absence of longer experience, venture to pronounce a decided opinion. Our business was to award the prize in Class XVII., which was to be given "for the best agricultural locomotive engine applicable to the ordinary requirements of farming."

We had, therefore, to judge of the merits of the engines when used to replace portable engines, as a mere implement for driving farmyard machinery, of their merits when used as locomotives upon the high road, and of their merits when used as locomotives upon farm roads, or upon the surface of fields where there were no roads.

In this latter respect the indiarubber tyres most signally failed at Barnhurst. It is true that the weather had been to the very last degree unfavourable to the use of these tyres. The question then arose in our minds, "Is the Barnhurst course a fair one over which to put an agricultural engine; and would such engines be in practice required to be used on ground in the condition in which the Barnhurst course was?" Upon this point we thought it right to take the opinion of the practical agricultural Judges of this year, and they told us that a farmer must be able, when his root-crops were ready to be drawn off the field, to take them away, no matter in what weather. This had to be done in autumn, and very commonly in the midst of weather quite as bad as that which we have experienced, and with the soil in the same condition. Now, looking at the fact that as agricultural locomotives become improved, and come more and more into use, they will replace to a large extent the horses upon a farm, and a farmer will then find himself at the mercy, as it were, of these machines. Clearly, other things being equal, the most meritorious machine, therefore, is one which, under any circumstances of weather and of soil, can do its work; and, in fact, a fine-weather machine is practically useless to the farmer. It was upon these grounds we felt that the "Sutherland," notwithstanding the excellence of its workmanship and the superiority of its tractive force upon a high road, was out of competition in Class XVII. We must not be supposed, however, to lay down as a doctrine that the mere surface of the iron wheels will give adhesive force in soil such as that at Barnhurst. Upon pressure and motion being applied to the upper part of such a sodden soil, it becomes made into a lubricating paste or fluid, which renders adhesion of any surface, whether iron or indiarubber, practically impossible. It is in this state of things that the iron wheels, by their ability to use paddles (say to the number of eight round about a 6-feet wheel), have a great advantage, for the paddles cut into the surface, and the ground immediately behind the paddle that has just entered being compressed by the weight of the wheel upon it, cannot escape vertically, nor can it readily escape sideways; thus the paddle acts upon a block of soil some 3 feet long and the width of the wheel, and by pressing against this, it is enabled to find that foothold, if the term may be used, or that abutment or *point d'appui* which mere adhesion upon a surface cannot under these circumstances give. It may be that hereafter there will be exhibited engines provided with indiarubber tyres, and with the means of applying paddles when such engines are used upon farm land like Barnhurst. When these engines come for competition, we have no doubt the Judges who may then be in office will weigh their merits fairly; but there was no such provision made, nor, indeed, does one see how it could very easily be made upon wheels formed as those of the "Sutherland" were; and thus, when the "Sutherland" got upon the slippery, treacherous surface at Barnhurst it came to grief in the way that has been stated. Whether considered in point of economy of fuel as a driver of machinery, or of efficiency for traction upon a farm, Mr. Aveling's 10-horse-power engine, No. 7001, no doubt was far ahead of any of its competitors. We therefore awarded to Aveling's 10-horse-power engine, No. 7001, the prize of 50*l.* The only point on which it was surpassed was that of its adhesive powers upon a high road; here, no doubt, it was not equal to the Thomson system, and we felt that the merits of the indiarubber tyres were such as to justify our awarding a silver medal to that invention, as we did also to the invention of Mr. William Bridges Adams for his application of indiarubber between the internal and external tyres of the wheels. We much regret that the constant use the Royal Agricultural Society of England made of this latter engine at Stafford prevented our trying its tractive force upon the road. We believe that it would have turned out to be very high, judging from the reports made to us from Stafford.

These medals were awarded, with the approbation of the Stewards, as provided for by the rules of the Society.

Aveling and Porter's 6-horse-power, No. 7002, we highly commended, and Burrell's 8-horse-power locomotive, No. 3660, which appeared to us to be a very well-devised and well-made machine, we commended.

We believe we have now reported to the best of our ability upon the construction of the different engines which competed in Class XVII., upon the trials to which those engines were subjected, and upon the way in which they endured those trials; and we have stated the results so far as regards the prize-list.

We cannot conclude our Report without expressing our great pleasure at witnessing the thorough cordiality existing among all the exhibitors. The rivalry and competition were of the keenest; but, keen as they were, they never for one moment caused the least departure from the most perfect good humour, nor did they in any way give rise to selfishness. Each exhibitor was most ready to do all in his power to help a brother exhibitor and rival at a pinch, as we saw upon more than one occasion. Such conduct as this on the part of exhibitors most largely contributes to the comfort of all concerned, and especially to that of the Judges, and enables them to carry out their duties with untroubled minds.

We have to thank all the exhibitors for the ready way in which they carried out every direction given by us, and for the

DETAILED PARTICULARS OF CONSTRUCTION.

| 1. No. | 2. Name of Exhibitor. | 3. Nominal Power and Description of Engine. | 4. Price of Engine in £. | 5. Number of Cylinders. | 6. Diameter and Stroke of Piston. | 7. Boiler: Area of Fire-grate in Square Feet. | 8. Boiler: Area of Fire-grate per nominal Horse-Power in Square Feet. | 9. Heating Surface: Surface in Water-space above Grate-bars in Square Feet. | 10. Heating Surface: Superheating Surface in Steam Space. | 11. Heating Surface: Water-heating Surface per Square Foot of Grate Surface. | 12. Heating Surface: Water-heating Surface per nominal Horse-Power of Engine. | 13. Flue Area: Minimum Area through Tubes in Square Feet. | 14. Flue Area: Ratio of Minimum Flue Area to Grate Surface. | 15. Carriage: Diameter and Width of Driving-wheels. | 16. Carriage: Ratio of Revolution of Crank to Revolutions of Driving wheels. | 17. Carriage: Advance of Engine in Feet per Revolution of Crank. | 18. Content of Tank in Gallons. | 19. Weight of Engine in Working Order: Gross. | 20. Weight of Engine in Working Order: Load on Driving Wheels. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Diam. " " | | | | | | | | | ft. in. in. | | | | tons cwts | tons cwts |
| 7001 | Aveling and Porter | 10-Horse-power nominal, with Locomotive Boiler, and cast-iron rimmed Wheels, cylinder jacketed .. .. .. .. .. | 390 | 1 | 10 × 12 | 6·5 | ·65 | 204.4 | 0 | 31·4 | 20·4 | ·75 | ·11 | 6 0 × 18 | 17 to 1 | 1·1 | 217 | About 12 0 | 6¾ |
| 7002 | Aveling and Porter | 6-Horse-power nominal, with Locomotive Boiler and wrought-iron Wheels, cylinder jacketed | 300 | 1 | 7¾ × 10 | 4·33 | ·72 | 106 | 0 | 24·5 | 17·7 | ·53 | ·12 | 5 0 × 10 | 13·9 to 1 | 1·1 | 105 | 5 4½ | |
| 3660 | Charles Burrell .. | 8-horse-power nominal, with Locomotive Boiler, and cast iron rimmed Wheels, cylinder jacketed .. .. .. .. .. | 370 Average 43l. per Horse-power. | 1 | 9 × 12 | 3·9 | ·49 Average ·6 | 145·3 | 0 | 37·2 | 18·2 Average 17·9 | ·63 | ·16 | 5 6 × 14 | 12 to 1 / 16 to 1 | 1·4 / 1·08 | 160 | 9 0 | |
| | Tuxford and Sons .. | 10-Horse-power nominal, with Locomotive Boiler, and wrought-iron Wheels .. .. .. .. .. | 390 | 1 | 9 × 12 | 4·23 | ·42 | 154·2 | 0 | 36·5 | 15·4 | ·6 | ·14 | 5 6 × 16 | | | | | |
| 7003 | Aveling and Porter | 6-Horse-power, similar to 7002, but with B. Adams' Patent Elastic Tyred Wheels .. .. | 340 | 1 | 7¾ × 10 | 4·33 | ·72 | 106 | 0 | 24·5 | 17·7 | ·53 | ·12 | 5 0 × 11 | 13·9 to 1 | 1·1 | 105 | 5 4½ | |
| 4170 | J. and F. Howard | 10-Horse-power nominal, with Howard Safety Boiler, wrought-iron Wheels .. .. .. .. | 410 | 1 | 10 × 12 | 6·0 | ·6 | 184 | 92 | 30·7 | 18·4 | | | 5 6 × 15 | 21 to 1 | ·82 | 250 | | |
| 2149 | Ransome, Sims and Head | 8-Horse-power nominal, Head and Thomson's Patent, with pot Boiler, and India-rubber Tyres .. .. .. .. .. | 750 80l. | 2 | 6 × 10 | 5·25 | ·66 ·67 | 80·5 | 46 | 15·3 | 10·1 10·4 | ·66 | ·125 | 5 0 × 15½ | 9·3 to 1 / 18·4 to 1 | 1·7 / ·85 | 375 | 10 8½ | 7 11 |
| 3661 | Charles Burrell .. | 8-Horse-power nominal, Thomson's Patent, with pot Boiler, and India-rubber Tyres .. .. .. | 635 | 2 | 6 × 10 | 5·41 | ·68 | 85·5 | 35·2 | 15·8 | 10·7 | ·75 | ·14 | 5 0 × 11½ | 7·1 to 1 / 17·2 to 1 | 2·2 / ·91 | 250 | 8 17 | |
| 2150 | Ransome, Sims, and Head .. | 8-Horse-power, same Engine as 2149, but fitted with cast-iron smooth Wheels .. .. .. | 500 | 2 | 6 × 10 | 5·25 | ·66 | 80·5 | 46 | 15·3 | 10·1 | ·66 | ·125 | 5 0 × 17½ | 9·3 to 1 / 18·4 to 1 | 1·7 / ·85 | 375 | 10 8½ | 7 11 |
| | Averages .. | .. .. .. | | | | | ·61 | | | 27 | 16·1 | ·64 | ·13 | | | | | | |

TRIALS ON BRAKE FOR POWER AND ECONOMY, AND RESULTS OBTAINED.

| 1. No. | 2. Name of Exhibitor. | 21. Exhibitor's Declaration: Maximum Steam Pressure | 22. Exhibitor's Declaration: Revolutions per Minute. | 23. Exhibitor's Declaration: Actual Horse-Power to be worked on Brake. | 24. Preliminary Trial in getting up Steam: Fuel in Lbs. Coal. | 24. Preliminary Trial: Fuel in Lbs. Wood. | 25. Time occupied in Minutes. | 26. Actual duration of Trial in Minutes. | 27. Actual Average Revolution per Minute | 28. Indicated Horse Power at declared Speed | 29. Indicated Horse-Power at actual Speed. | 30. Ratio of Brake-Power to Indicated Power at same Speed | 31. Coal: Nett Coal Consumed in lbs. | 32. Coal: Coal burnt per Brake Horse-Power per Hour | 33. Coal: Coal burnt per Indicated Horse-Power per Hour. | 34. Coal: Coal burnt per actual Hour. | 35. Coal: Coal burnt per Square Foot Grate Surface per actual Hour. | 36. Water: Nett Water supplied and Evaporated in Gallons. | 37. Water: Temperature of Feed on entering Boiler in degrees Fahrenheit | 38. Water: Cold Water Evaporated per lb Coal. | 39. Water: Cold Water Evaporated per Indicated Horse-power per hour in lbs. | 40. Water: Cold Water Cubic Feet Evaporated per Hour | 41. Water: Weight of Steam used per Indicated Horse-Power per Hour | 42. Square Feet of Heating Surface per Indicated Horse-Power of Engine. | 43. Lard Fall used per Brake H.P. per day of ten Hours. | 44. Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | ozs. | |
| 7001 | Aveling and Porter | 115 | 120 | 30 | 68 | 10 | 60 | 201 | 134 | 35·0 | 39 | ·86 | 420 | 3·73 | 3·2 | 125·4 | 19·3 | 320·7 | 175 | 7·62 | 24·5 | 15·3 | 27·3 | 5·2 | 2½ | |
| 7002 | Aveling and Porter | 115 | 160 | 18 | 51 | 6 | | 162½ | 187 | 20·5 | 24 | ·88 | 252 | 4·42 | 3·9 | 93 | 21·5 | 188 | 183 | 7·46 | 29·0 | 11·1 | 32·5 | 4·4 | 5½ | |
| 3660 | Charles Burrell .. | 120 | 150 | 16 | 61 | 8 | 60 | 148 | 169½ | 19·15 | 21·7 | ·83 | 224 | 5·02 | 4·2 Average 4·0 | 91 | 23·3 | 165 | 160 | 7·36 Average 7·5 | 30·8 | 10·7 | 33·8 Average 32·7 | 6·7 Average 5·4 | 1 | |
| | Tuxford and Sons .. | 120 | 165 | 20 | | | | 125 | 186 | 23·5 | 26·5 | ·85 | 280 | 5·98 | 5.1 | 134 | 31·7 | 204 | 99 | 7·28 | 37·0 | 15·7 | 38·3 | 5·8 | 2½ | |
| 7003 | Aveling and Porter | 115 | 150 | 15 | 51 | 6 | | 153 | 186½ | 17·6 | 21·9 | ·85 | 210 | 4·42 | 3·77 | 82 | 19·1 | 163 | 140 | 7·76 | 29·2 | 10·2 | 31·4 | 4·8 | 8·9 | A hot bearing caused excessive use of oil. |
| 4170 | J. and F. Howard | 180 | 150 | 30 | | | | 147 | 156½ | 34·3 | 35·8 | ·87 | 420 | 5·48 | 4·8 | 171 | 28·5 | 286·7 | 60 | 5·48 | 32·7 | 18·7 | 32·7 | 5·1 | 3·1 | |
| 2149 | Ransome, Sims and Head | 115 | 160 | 24 | 76 | 8 | 57 | 161 | 168½ | 29·3 | 30·8 | ·82 | 336 | 4·95 | 4·2 4·4 | 125 | 23·8 | 226 | 60 | 6·72 6·4 | 27·4 | 14·5 | 27·4 27·8 | 2.6 2·7 | 6·5 | |
| 3661 | Charles Burrell .. | 130 | 150 | 24 | 83 | 8 | 90 | 138 | 146½ | 31·4 | 30·7 | ·76 | 336 | 6·23 | 4·6 | 146 | 27·0 | 200 | 60 | 5·95 | 28·3 | 14·0 | 28·3 | 2·8 | 1·85 | Driver too much occupied to attend to oiling. |
| 2150 | Ransome, Sims, and Head .. | Being same Engine as 2149, excepting wheels; this trial not repeated | | | | | | | | | | | | | | | | | | | | | | | | See trial 2149. |
| | Averages .. | | | | | | about 1 hr. | | | | | ·84 | | 5·03 | 4·22 | | 24·3 | | | 6·9 | 29·8 | | 31·5 | 4·7 | 4·3 | |

*Continued.*

TRIALS ON COURSE AT BARNHURST FARM, 1·8 Mile Long, July 3rd, 1871.

| 45. No. | 46. Name of Exhibitor. | 47. Load declared by Exhibitor July 3 | 48. Load taken round Course | 49. Time going round Course in Minutes. | 50. Coal, deducting half Ashes. | 51. Water in Gallons. | 52. Coal used per Ton per Mile. | 53. Water per Ton per Mile in Gallons. | 54. Water per lb Coal in lbs | 55. Mean Speed in Miles per Hour. | 56. Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7001 | Aveling and Porter .. .. | 10 | 9 | 65 | 220½ | 217 | 13·6 | 13·4 | 9·84 | 1·67 | Wheels fitted with paddles and spikes for running on ploughed land; these removed on roads; broke some teeth in jack-in-the-box gear. |
| 7002 | Aveling and Porter .. | 5½ | 5½ | 51½ | 140 | 114 | 14·1 | 11·5 | 8·14 | 2·1 | Wheels fitted with paddles. |
| 3660 | Charles Burrell .. .. | 7½ | 7 | 62 | 157 | 124 | 12·7 | 9·9 | 7·9 | 1·75 | |
| 2677 | Tuxford and Sons .. .. | 7½ | | | | | | | | | Withdrew from trial July 3. |
| 7003 | Aveling and Porter .. | | | | | | | | | | Detained by Stewards at Stafford. |
| 4170 | J. and F. Howard .. .. | | | | | | | | | | Disqualified after breakdowns in trial-yard. |
| 2149 | Ransome, Sims, and Head | 5 | Left waggon behind. | About 4 hours. | | Observations on stores impracticable. | | | | | Ran from 18th to 108th chain in 27′. Long delay, and finally left waggon in hollow at 113th chain. |
| 3661 | Charles Burrell .. .. | 5 | | | | | | | | | Withdrew from trial after failure of No. 2149. |
| 2150 | Ransome, Sims, and Head | | | | | | | | | | Allowed to withdraw from this trial. |
| .. | Averages .. .. .. | | | | | | 13·5 | 11·6 | 8·6 | 1·85 | |

TRIALS ON ROAD TO STAFFORD, 16 Miles Long, July 6.

| 45. No. | 46. Name of Exhibitor. | 57. Useful Load drawn, including Waggon. | 58. Gross Time on Journey. | 59. Stoppages. | 60. Nett Time Running | 61. Speed when Running in Miles per Hour. | 62. Coal used in Run, neglecting Ashes. | 63. Water in Gallons. | 64. Coal per Ton of useful Load per Mile. | 65. Water per Ton of useful Load per Mile | 66. Water per lb Coal | 67. Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7001 | Aveling and Porter | Tons 15 | Hrs. Min. 5 33 | About 45 | About Hrs. Min. 4 48 | 3¼ | 684 | 466 | In Pounds. 2·85 | In Gallons. 1·94 | In lbs. 6·8 | |
| 7002 | Aveling and Porter | 9 | 5 13 | | | | 448 | | 3·1 | | | |
| 3660 | Charles Burrell | 12 | 6 26 | | | | 564 | | 3·0 | | | |
| 2677 | Tuxford and Sons | | | | | | | | | | | Withdrawn previously. |
| 7003 | Aveling and Porter | | | | | | | | | | | Detained by Stewards for use at Stafford. |
| 4170 | J. and F. Howard | | | | | | | | | | | Out of competition. |
| 2149 | Ransome, Sims, and Head | 12 | 4 20 | 29 | 4 0 | 4 | 730 | 395 | 3·75 | 2·05 | 5·48 | |
| 3661 | Charles Burrell | 12 | 7 11 | Hrs. Min. 2 15 | 4 57 | 3½ | 946 | 579 | Could not be fairly ascertained. | | 6·12 | Most of the delay caused by irregularities in the ordinary road traffic. Really a fast engine. |
| 2150 | Ransome, Sims, and Head | | | | | | | | | | | |
| .. | Averages | | | | | About 3·5 | | | 3·2 | 2·0 | 6·1 | |

TRIALS ON TETTENHALL HILL, 1900 Feet Long, July 8.

| 45. No. | 46. Name of Exhibitor. | 68. Approximate Load Drawn | 69. Approximate Gross Load including Engine. | 70. Maximum Gradient fairly overcome | 71. Ratio of Grip of Wheels to Moving Weight. | 72. |
|---|---|---|---|---|---|---|
| 7001 | Aveling and Porter | Tons. 20 | Tons. 38 | 1 in 20 | ·35 | |
| 7002 | Aveling and Porter | | | | | |
| 3660 | Charles Burrell | | | | | |
| 2677 | Tuxford and Sons | | | | | |
| 7003 | Aveling and Porter | | | | | |
| 4170 | J. and F. Howard | | | | | |
| 2149 | Ransome, Sims, and Head | 33 | 43 | 1 in 20 | ·45 | |
| 3661 | Charles Burrell | | | | | |
| 2150 | Ransome, Sims, and Head | 13·4 | 23·4 | 1 in 20 | ·25 | |

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assistance they afforded us; and we trust that the result of the recent competition will be, as we in effect know it will be, to render the unsuccessful on this occasion most earnest in their endeavours to come to the front the next time, while we believe those who have succeeded will know that to do so again they must add to their efforts rather than rest upon the position they have already attained.

The Table which forms the Appendix to this Report require little explanation. In it are recorded the prices, leading dimensions, and proportions of the engines, the observations on the trials, and the results obtained.

The averages of several of the columns are added beneath them, and in those in which there are marked contrasts between the results obtained from the Locomotive, Thomson, and Howard types of engines respectively, the averages of each of those types are recorded at the sides of the columns.

(Signed) F. J. BRAMWELL.
JAMES EASTON.

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## XXVIII.—*Report of the Judges on the Trials of Hop Machinery and Miscellaneous Articles at Wolverhampton.*

### I. HOP MACHINERY.

ALTHOUGH very liberal prizes were offered by the Society for machines and implements connected with the cultivation and management of hops, the entries in these classes were not numerous. It is true that the total acreage of land planted with hops in the United Kingdom is comparatively small; but it must be understood that their cultivation absorbs a very large amount of capital and requires many peculiar and complicated machines; it is therefore most surprising that there was not a larger competition for these prizes, so judiciously offered by the Council. As, however, the announcement that these prizes had been offered was not made until November, 1870, there was not much time to invent and manufacture new and improved machines for the Wolverhampton Show, and there can be no doubt that when the year comes round in which these prizes occur again in their rotation, there will be keen competition for them, as several implement-makers who watched the trials this year saw that there is room for improvement and the exercise of inventive skill, and resolved to make themselves better acquainted with the mechanical requirements of hop-cultivation.

The trials of implements in the First Class, "for the best machine for the cultivation of hop-gardens to supersede manual labour," were held at Barnhurst, in the field where the steam-cultivators were tried. An impromptu hop-garden was marked out and measured, and the position of the "hills" was fixed by the marking-poles, tipped with small red flags, which had served to point out the course of the traction-engines. This arrangement presented a curious appearance, so that an eminent engineer inquired whether the "hop judges were going to have a bull-fight." There were three entries in this class, of which Messrs. Coleman and Morton's "Hop-cultivator" (No. 261), was the first to be tried.

This consists of an iron frame, in which seven tines or hoes are fixed; there are handles behind, with two small wheels in front, and a cranked axle, with lever, to regulate the depth. This may be said certainly to be a slight improvement upon the ordinary hop nidgett or skim, and is cheap at 4*l.* 10*s.* for the purpose of loosening the soil and getting up the weeds in spring and summer, but it is not in any way a machine adapted for the late autumn and winter cultivation of hop-gardens, to supersede manual labour. The same remarks apply in degree to Messrs. Weeks's iron nidgett (No. 3675). This is not so wide as Messrs. Coleman and Morton's cultivator, which covers all the ground in the "alley," and has only one wheel; while at 4*l.* it is not so reasonable in price. The "Patent Revolving Mouldboard American Plough" (Messrs. Mellards', Trent Foundry, No. 3012), or "disc" plough, as it is commonly called, being tried in this class, made remarkable work in the hop "alleys," bringing up soil that probably never saw the sun before. This is a plough in all its essential principles, and as such is not suited for hop-cultivation. Though the Judges, *quâ* "hop judges," could not give the prize to this plough, yet in their capacity of miscellaneous judges they successfully recommended the novel and striking application of the revolving disc to the Stewards, as worthy of a silver medal. The prize of 20*l.* was withheld in this first class of hop-machinery, and it is hoped that when this prize is again offered, there will be a grand competition of suitable digging-machines.

In the next Class, "for the best machine for washing the hop-plant to remove the aphis blight," the prize of 10*l.* was awarded to Messrs. Coleman and Morton for their "Hop-syringing Engine" (No. 262). The superiority of this machine over the others competing consists in its lighter draught in deep pulverized soil on account of its larger wheels, 32 inches in diameter, and the distance of the water-tank from the ground; in its remarkably easy working pump, whose capacious air-vessel causes it to work light, and at the same time gives it great propelling power. This pump is placed on the left side, convenient for working and for purposes of repair, in these respects contrasting favourably with the other washing-machines, whose pumps worked very hard, and, being in the centre of the tank, were difficult to get at. A brass strainer is screwed over the inlet of the pump, which is a great improvement. Messrs. Weeks's machine (No. 3669) is the same as is used generally in Kent: the pump works hard, and the small wheels make its draught considerable. The price of each of these machines is 9*l.*, fitted with two 3-ply $\frac{5}{8}$-hose, with branches, taps, rose, spray, and single jets complete. Besides being the better machine, mechanically speaking, Messrs. Coleman and Morton's is much the cheaper, considering its superior advantages. Mr. Read's machine (No. 7368) is nearly identical with that entered by Messrs. Weeks: the pump is perhaps more difficult to work. Mr. Read also showed some smaller apparatus for washing, fitted into pails, and syringes for hand use, which are more adapted for vineries or for very small hop-plantations. Several other engines, or rather large squirts of this description, were eloquently introduced to the notice of the Judges by various exhibitors, to whom it seemed to have just occurred that they might as well "go in" for the prizes for hop-washing machines. As it was found upon reference that many of these had not been entered for competition, they were of course not tried.

The prize of 10*l.* for the best Hop-presser was awarded to Messrs. Weeks for their entry (No. 2670). This is a very good machine, and, according to the opinion of the consulting engineer, is constructed upon proper principles. The hop-presser generally used in Kent, which took the first prize at the Show of the Royal Agricultural Society at Canterbury, and was exhibited by the side of this improved presser at Wolverhampton, is comparatively primitive in appearance and construction, and the improved presser has several points of novelty and ingenuity. The arrangement of the ratchet-lever gives, if necessary, far greater pressing force than is required merely to get the time-honoured maximum of 1½ cwt. into a "pocket," and is easily worked by one man. The process of weighing the pockets after they have been pressed is admirably and quickly effected by means of an iron lever working on one of the columns of the presser as a fulcrum. The shorter end of this lever has a hook to which the "pocket" to be weighed is attached, by affixing a handle, like that of a pail, to the iron (or wooden) hoop of the "bagging hole." A half-hundredweight, placed on the longer arm of the lever, indicates the usual weight of 1½ cwt. The lever may be lengthened or shortened, and heavier or lighter weights attached, according to the quantity required to be put into the "pocket." There is also an iron circular case which clasps the pocket tightly as it is filled, keeping it smooth and even, and preventing the "ribs" which disfigure pockets badly "trod" or pressed with the old machine.

In Class IV., "for any other improved implement or implements used in the cultivation or management of hops," Messrs. Weeks's Sulphurating Machine (No. 3671), price 12*l.* 12*s.*, was deemed worthy of the prize of 10*l.* The improvements in the machine are a great reduction in size and weight, an arrangement by which the sulphur sent out by the revolving blowing-fan can be guided upwards in different directions, and an improved regulator of the quantity of sulphur used. By this as little as 40 lbs. of sulphur can be distributed evenly over an acre of hops, which is most desirable, as in certain stages of the growth of the plant it is injurious to use sulphur in wholesale quantities.

Messrs. Weeks also showed a portable tank for creosoting the end of hop-poles, a hop-bine cutting machine, an improved fire-basket for drying hops in kilns, and several other machines and implements used in the cultivation and management of hops.

(Signed) CHARLES WHITEHEAD.
H. B. CALDWELL.

## II. MISCELLANEOUS ARTICLES.

The hands of the Judges in the Miscellaneous Department were tied by the 3rd and 4th Clauses in the "Instructions to the Judges," so that to find anything new in agricultural implements that was not included in the quinquennial trials was next to an impossibility. There were various so-called improvements, but those improvements were chiefly, if not totally, belonging to implements scheduled in other years' trials, and all the Judges can do is merely to report on what they think may be considered desirable improvements. At the head of their list they place a novelty (though it is not properly in this year's schedule), and this is "an American Revolving Mouldboard Plough" (so called by the Trent Foundry Company); it was, in the eyes of the Judges, worth much more than the Silver Medal, which was awarded for the "*Adaptation of the Revolving Mouldboard*" only. The fact is, the said plough is plough and cultivator combined, and far surpassed in its operations on the land at Barnhurst the smashing-up tools of Smith and of Fowler, and rendered harrows and drags unnecessary by leaving a ready-made seed-bed behind it. The Judges came to this opinion after trying it as a hop cultivator (for which it was entered), and they think also, that if made stronger and applied to steam, it will prove invaluable to farmers.

While on ploughs, we call attention to the new steerage on the double ploughs of G. W. Murray (Stand 48), though we doubt whether the movement of the wheel (furrow-wheel) might not be clogged, and be difficult to work on account of rust and dirt collecting on its axle. Want of trial of course prevents one judging of its merits; though with a good ploughman there is no doubt that it can make irregular work straight, and its advantages would be shown on stiff and strong soils where ploughs are constantly tilted out of work.

Then comes the Double-Furrow Turn-wrest Plough of Messrs. Ransomes and Sims, most ingeniously contrived and easily used, and, we think, for hill-side countries a most useful article of husbandry; and as turn-wrest ploughs are for turning the soil down-hill, there must be a lighter draught for these ploughs in such a country with respect to the work got out of them.

Next are the Double-Furrow Ploughs of Messrs. Howard, and also of Messrs. Hornsby, who are trying to make them lighter and handier for turning on the headlands, but while doing this they are making them lighter in draught, and losing the main qualification of the Pirie Ploughs, which is, the way in which they stick to their work. We think the slade of Messrs. Hornsby for the above-named turning very superior to a wheel, though it is, we suspect, a copy of the slade used years back on ploughs on the land-side.

The Thatching Machine of Messrs. Woods and Cocksedge (Stand 7), invented by the Rev. O. Reynolds, is recommended by its price, as compared with others shown before; but of course the thatch should be seen on the stack, and tested by the rough blasts of wintry winds. We must say, however, that the machine is of most simple construction.

In Stand 58 was a new attachment to the well known, and never yet beaten, Gardner's Turnip Cutter, for cutting the last piece of turnip, and it is a very simple and cheap addition.

A Patent Hand Chaff-cutter, for cutting 3 lengths of chaff, was shown in Stand 36 (Messrs. Southwell's); its work was very simply effected.

In Stand 76 was the self-acting Corn Screen of Mr. Robert Boby: the corn, being placed in the hopper, is allowed to run towards the screen in the common way of feeding, but an imitation breast water-wheel is turned by it, and the revolution of the said wheel works the screen, thereby dispensing with the man or boy who usually turns the crank. In Boby's machinery in motion (Stand 285, article 2248), is a Patent Combined Dressing Machine and screen for steam power, fitted with elevators for raising the grain to the hopper, and, when dressed, by another set of elevators into sacks, weighing it ready for market. It is an excellent contrivance for fixing in a barn, and making the corn really fit for market; a matter too little thought of since *finishing* threshing machines were brought to notice, which *finish* was never brought to perfection, and probably never will be, till the machines are fed through rollers; and it must be remembered that the higher the corn is dressed the better is the price at which it is sold; and the more tail-corn the more the pigs get; or at all events there is less outgoing for artificial food, or the taking with one hand and paying out with the other.

Then we find the Bullock Stalls of Mr. Willacy. There economy is the order of the day; and if one man and a boy, as he and his friends assert, can feed 100 bullocks on his system in 10 minutes, saving thereby what hardly one farmer in one thousand can calculate upon, his system must be good, for, though not entirely new, the cutting the roots and breaking the cake, and delivering them at the same time, is new. The railway and truck through the feeding-houses was in existence, and was shown at Lord Fortescue's, during the year that the Royal Agricultural Society of England held their meeting at Exeter; and, while writing of Exeter, let us not forget that there the rope traction was brought out by John Fowler for the purpose of under-draining, and, though then used and worked by horse-power, it has been the origin and rise of all our steam-ploughing or smashing up. Long may John Fowler be remembered by the agricultural world!!!

For those who like elevators for stacking their corn, Stand 243 must be noticed for its "Patent Slow Motion Automatic Folding Stacker," its recommendation being that it is easily folded up for putting away in a barn, and that is a recommendation for such unwieldy articles. Then there is a really good and economical article in the shape of a Broadcast Manure Distributor, the merits of which are greatly enhanced in a purchaser's view by its low price —12 guineas—and its very effective action with rough manures.

A Stile for footpaths by Morton and Co. (Stand 222) is cleverly designed, and where footpaths cross grass lands, especially in dairy countries, and gates are constantly left open, it is an advantage to a farmer in riding from field to field that, instead of a gate—the stile being made a trifle wider than those shown—he can lead his horse through, and no gate can be left open.

Then there is also a clever sheep-dipping apparatus by Hudspith (Stand 225) and at Stand 269 a Folding Balance Elevator by Tasker, which is recommended by its price.

At Stand 37 (Hunt and Pickering) we were detained by the number of articles (as in bygone days at Leicester), and found a great variety of cast-steel hoe-feet for horse-hoeing, which are most easily adjusted; and then we observed the lubricators and self-adjusting rod of the new Patent Two-horse Mowing Machine; but we could not find an engineer at the time to consult on the matter. It is worthy of notice and of trial, but must wait for its turn in the quinquennial trials.

Their new Commode for Invalids (Article 1034) is admirably arranged; but for common use, and for cottages, the self-acting commodes of Parker (Stand 131) are to be preferred.

Art. 6266. Horse-gear, by Denton, of Wolverhampton, made entirely of iron, with T-iron lever. The main wheel hangs on an adjustable steel centre, and is supposed much to reduce friction; it is of reasonable price, and appeared to be of excellent workmanship.

Art. 4829. This Improved Break for Waggons, by Ball and Son, is very powerful and easily put to work, and does not appear to be easily put out of order.

We much liked the new Self-raking Reaper of Messrs. Burgess and Key, which delivers the sheaves clear of the horses' track, and does away with the hands required, as heretofore, to clear the way.

The Potato-washers of Hancock and Co. (Stand 29) well repaid a visit, and the potatoes were turned out and beautifully cleaned for boiling, and though young potatoes were used, not a scratch of any kind appeared on them.

Art. 138. A new implement, called by S. Corbett and Son a Patent Hand Turnip-stripper, is a good machine, the strips answering all the purposes of pulping (falsely so called), and the hard work attending it, to say nothing of the time consumed in the process. The Iron Ridge Tile, price 2*s.* 6*d.*, in this Stand, is a very good contrivance for ventilation; and while on the subject of ventilation, we may mention that we visited, in a remote corner, the Stand 321 of Davis and Co., who showed excellent Thermometers for Stables and Orchard-houses, Hop-oasts, and Malt-kilns, by which masters can always detect the neglect of servants in regard to ventilation and the proper maximum and minimum of heat.

At Stand 324 a model of Railway Cattle-trucks was exhibited by Mr. Welch, ingeniously constructed to supply food and water to cattle, sheep, and horses, on long journeys by rail; and so as to supply a separate stall for each animal, if required. These especially commend themselves to all humane and thoughtful persons who know and deplore the tortures suffered by animals kept without food and water for many long hours in their transits by railway to and from distant fairs and markets.

Stand 111 contained a Drill for drilling Potatoes. We could not try it, but if it will do what the makers say it will, it must be highly useful where the said roots are grown on a large scale.

Art. 4489. New invention. Portable Roughing for Horse-shoes: can be easily attached, and may often save the necessity of taking off shoes to rough them, when perhaps there is only one night's or day's frost.

But we must draw this Report to a close, for there was nothing to be found that was really very new or peculiar. The term "Miscellaneous" was hard to explain to exhibitors, but they highly approved of the "stand" made by the new rules for agricultural implements, for the sheds were fast becoming what may fairly be called a fair for dolls and other things; and though we may be thought harsh with regard to the last expression, and while still admiring the *esprit* of the exhibitors, we must say there is too much brought to the meetings of purely non-agricultural implements, while there are also many things shown that can be made use of by agriculturists often to good purpose.

We can assure our readers that we visited every stand in spite of rain (and the slough of despond caused thereby), and many of them over and over again, though we heard whisperings to the contrary, and of inspections during storms of rain while we took shelter in exhibitors' offices. We now only ask forgiveness for these our supposed misdoings, and also of the Society for the scantiness of this our Report; though for a finish we must not forget the great Miscellanea which, being in this quinquennial year of trial, had their appointed judges, and on them we pass a cursory remark, having seen them in various difficult positions, which made us recall to our memory the meeting at Carlisle, when a "monster" there walked through every slough and over every hill-top without a struggle; but its "pattens" (so called) pressed the land down too much, and so it is hoped it will be noticed at this time next year how the racing-ground at Barnhurst looks.

May the great good already effected by the Society be increased year by year, for the benefit of the farming community; and with our best thanks to the Stewards and all the officials with whom we had to do, we say farewell.

(Signed) H. B. CALDWELL.
CHARLES WHITEHEAD.

## XXIX.—*Report on the Exhibition of Live Stock at Wolverhampton.* By JACOB WILSON, Senior Steward.

NEVER, perhaps, in the annals of the Society has a Country Meeting been held under greater difficulties than those which presented themselves at Wolverhampton. For several days, and even weeks, prior to the Show, and up to its conclusion, the elements were most unpropitious. A down-pour of rain falling upon low swampy ground, which had been but recently drained, had the very natural effect of plunging the surface to such an extent as to render locomotion not only disagreeable and difficult, but almost impossible, whilst such a state of things on more than one occasion prompted us to greet a friend with the familiar words of "Talpa,"—

> "Came you in boots, sir, or in boats,
> By land, sir, or by water?"

The choice of Wolverhampton as a site for the Royal Show of 1871 was from the first, and has been all along, severely criticised by a considerable portion of the public; but in arriving at this decision, by a very large majority, the Council were actuated both by an earnest desire to give the county of Staffordshire (the show never having been held in this county before) an opportunity of seeing by what means its agriculture could be benefited, and at the same time to maintain the interests of the Society itself.

But however necessary and desirable it may be to keep the coffers of the Society well and amply supplied, I am not of those who give priority to this feeling over the higher and more noble object for which the Society was instituted, viz., "the encouragement of the science and practice of agriculture," nor am I prepared to endorse the principle of maintaining a large funded property for the benefit of a *future* generation in preference to a more liberal, though reasonable, annual expenditure, in developing and furthering the agriculture of our *own* day.

In consequence of the disagreeable state of the weather and Show-yard, "a damper" seemed spread over the whole meeting: wet jackets and dirty feet did not tend to improve men's tempers, whilst small difficulties—which under more favourable circumstances would soon have disappeared—were readily multiplied into unpardonable sins, and therefore one was not surprised to hear complaints, loud and many, showered down upon the authorities of certain railway lines for their exorbitant charges for the delivery of stock into the Show-yard. In truth, there *was* some cause for these complaints, for on inquiry I found that one company was charging twice as much as another for such delivery; but in justice to them, I must say that on a proper representation being made, this matter was at once ordered to be rectified.

I am reluctant to pass over this question of "railway accommodation" without taking the opportunity of expressing my opinion that the weakest part of our Show-yard arrangements is that of "*railways.*" I am far from being an advocate of the principle that "a railway must be laid into the Show-yard under any circumstances," for we have many bright examples of most successful meetings where such accommodation has *not* been provided. Even at Wolverhampton, the most sceptical exhibitor could not complain of any want of expedition, or of facility in the delivery of his stock, but it was the *charges* to which exception was taken. The complaint at the General Meeting as to the want of facilities for passenger traffic was also not raised without sufficient cause; but, unfortunately, the Society is utterly helpless when pitted against a combination of powerful railway companies. This subject has on many occasions given the Council much anxiety, and every endeavour has been exerted to make the best possible terms for exhibitors and the general public who may visit our Royal show. I would express a hope, however, that our experience at Wolverhampton may not be thrown to the winds, but that a further attempt will be made to induce the various companies throughout the kingdom to grant more liberal terms to exhibitors as well as to the public. Without being invidious, I might point to the liberal manner in which the North-Eastern Railway Company treats the district through which it passes, and in which, I venture to say, there are annually held a greater number of agricultural gatherings than are to be found in any other part of England. Cannot some similar privileges be granted by all the railways in the kingdom, and may not the "Royal" share this liberality with local and county societies? Let us hope so; for when we consider the enormous risks and expenses in attending a Royal show for more than a week, I submit that exhibitors really deserve every encouragement and support that can possibly be accorded to them.

With the stock promptly and safely delivered into their respective stands on the Saturday evening, the great "Royal week" of the year was inaugurated on the following morning by Divine Service in the Show-yard, at which the Bishop of Lichfield preached a most appropriate sermon to the large congregation of herdsmen assembled. This Sunday service, happily commenced at the last Newcastle meeting and regularly continued ever since, is not the least interesting feature of our proceedings, and the large attendance of those for whom it is especially intended is sufficient evidence of its being fully appreciated.

In these days when our flocks and herds are exposed on all sides to diseases of a most fatal character, it is satisfactory to report that although each animal as it entered the yard underwent a searching veterinary examination, yet not a single instance of disease was detected; nor do I ever remember a show where the general health of the animals was so satisfactory throughout; of course we invariably hear of cases of "colds" and "gripes," which are usually the result of an overfeed of wet vetches, &c.; but it is due to the forage department to say that the control over the distribution of green food, as directed by the veterinary department, exercises a considerable and beneficial influence on the health of animals during the show.

The presence of distinguished foreigners, who bought largely of all kinds of stock, was a noteworthy feature of last year's meeting at Oxford. A similar notice is equally applicable to the recent Wolverhampton meeting, though the prices given were not so high as on the previous occasion. But if Oxford in 1870 was famous for the high prices then realized for shorthorns to be sent *to* America, I can claim for Wolverhampton in 1871 the honour of being the medium through which enormous prices have been given for young shorthorns to be brought to this country *from* America. The presence of those strangers to whom I have alluded is an indication that foreign countries look upon our annual Royal show as the legitimate emporium of all the best breeds of stock in this country, and hither they will continue to come. I shall hereafter have occasion to remark upon the effect produced upon the stock of this country by their frequent visits and purchases.

## Horses.

With catalogue in hand, I am led to commence by commenting upon the horses, as standing first upon the list. Taken as a whole, I am glad to observe the increasing interest taken by exhibitors in the horse department. Prior to the Manchester show our horse entries had dwindled down to a minimum, and were a disgrace to our national society. The *double* veterinary inspection, and the risk of losing a previous good reputation thereby, prevented the exhibition of even the *best* horses in the country. This difficulty has now been removed, and horses are only subjected to veterinary examination at the discretion of the Judges. To guard against the worst forms of hereditary disease, however, the opinion of the veterinary inspector is invariably taken in the case of stallions and brood mares, but with well-selected Judges, no such assistance is needed in the other classes. This arrangement is found to work well, and to render our horse show doubly popular and attractive. The agricultural classes, under the judicial eyes of Messrs. Barthropp, Wood, and Wright, numbered 98 animals, for which several additional prizes were given by the local committee. The entries were not numerous in most of the classes, nor was there any high degree of excellence visible throughout, with a few exceptions, to wit, Mr. Welcher's "Honest Tom," in Class 1; and Mr. Garrett's famous old Suffolk "Cupbearer," in Class 5. Nor must I omit to mention Mr. Linton's two-year-old filly in Class 27, and also that of Mr. Townley Parker in Class 28; and above all, Mr. Brierley's "Sensation," in Class 30, whose magnificent action and grand warhorse-like appearance earned many a cheer from the admiring public around the horse-ring. I shall, however, best consult the public taste by quoting the very excellent Report of this class furnished to me by the Judges, who say:—

The first class, Agricultural Horses, not Clydesdale or Suffolks, looked a grand lot of animals as they entered the ring, but on closer examination faults, which are too common amongst this class of horse, were to be found in several of them. It was very soon quite clear that the first and second prize horses would be the same as at Oxford last year, being far away better than the rest of the class. No. 3, Mr. Welcher's "Honest Tom," which took the first prize, has been so frequently a winner at the Royal and other shows, and his merits have been so often set forth, that it is unnecessary to describe him here further than to remark on his looking more fresh and active than last year; and we believe it will be long before a better animal of the sort will be found. No. 2, Mr. Manning's "Young Champion," has scarcely made so good a horse as he promised to do; he has good loins, is rather shaky on his fore legs, and is high on the rump; he is nevertheless a nice active horse. No. 6, the third prize, is a good-looking bay of 3 years-old, called "Le Bon," the property of Mr. C. Sharpley; he has a good back and fore legs, but is rather rough about the hocks; he should grow into a grand horse some day. No. 1, the Rev. John Hitchcock's iron grey "Lion," is a nice true-made horse, but is small and short; he got commended, and was selected for the Reserve Number. No. 4, Mr. Wynn's 7 years-old, "A 1," is a very fine stamp of horse, but his hind feet must always tell very much against him in a showyard. No. 7 is a good sort of horse, but his fore feet looked suspicious. A plain, common-looking 4 years-old completed the number of competitors in this class.

Class 2, for 2 years-old stallions, neither Clydesdale nor Suffolk, had eight entries, seven of which came up for judgment. No. 9, Mr. Corfield's "The Shropshire Friend," took the first prize, and is a compact bright bay colt, standing well on his legs, and is a good mover. No. 12, Mr. Ashcroft's "John Bull," is rather mare-headed, has long sides, a good loin, and is a smart sort of horse, and got the second prize. No. 16 got the third prize; he belongs to Mr. Street, is of a rich brown colour, has clean legs, and is a very nice one. No. 15, Mr. Perkin's "Young Prince," is the Reserve Number, and is a good-looking animal, but has not good action, and No. 13 has flat sides and lacks a ction, whilst No. 10 is far too high on the leg ever to make a good stamp of carthorse.

The Clydesdale stallions foaled before 1869 were a good lot, and we commended the whole class. No. 20, Mr. Tomlinson's "Young Lofty," is still very fresh and active, and carries his ten years very fairly; he has two remarkably good ends, but is rather flat in his middle; he had nevertheless an easy victory. No. 18, Lieut.-Col. R. Loyd Lindsay's "Prince Albert," is a very promising 3 years-old, and took the second prize; he has good short legs, and is very compact. The third prize went to a brown, rather leggy horse, with a white face and three white legs, belonging to Mr. Reed. Two other very useful horses completed this class. There was no entry for 2 years-old Clydesdale stallions.

Class 5, the Suffolk stallions, comprised seven entries, one of which, "Oxford Emperor," did not appear. The first prize went, after very little consideration to "Cupbearer," a horse belonging to Mr. R. Garrett, who gave over 400*l.* for him in 1869, when a Canadian gentleman tried to get him, rather than allow him to leave the country; he is a magnificent animal, with a handsome forehand, very deep shoulders and girth, a good loin, perhaps rather short back ribs, and very powerful hind quarters, and is as active as a pony. Mr. Badham's "Hercules," No. 23, is a smart, nice-topped horse; and Mr. Wilson's "Bismark," only 3 years-old, took the third prize; he is on a very large scale, with excellent fore legs and feet, and a good back; but he is too long on his hind legs to please those who go for symmetry; should he continue sound, he must grow into a wonderful fine horse, but we doubt his ever possessing the true character of the Suffolk horse, although he is well-bred on both sides. No. 28, "Harwich Emperor," now the property of the Stonetrough Colliery Company, in Cheshire, a former prizetaker at the "Royal," looked very fresh for a 10 years-old, but he has lost his form, and become flat-sided and over-topped; he was highly commended, and had the Reserve Number, being far better than either of the others. No. 24, Mr. Byford's "Volunteer," is a big, useful 4 years-old; but the Earl of Shrewsbury should get a better than "Young Colonel," who is small and plain.

Only three Suffolk stallions, foaled in 1869, were shown in Class 6. Lieut.-Col. Wilson's "Heir Apparent," who gained the first prize, is a very neat compact colt of good quality and fair size, has a capital back and fore legs; his hind ones are rather too straight, and he has not a pleasant head. Mr. Badham's "Emperor," No. 29, took the second prize, and promises to make a fine horse, but at present he is rather too long altogether to be looked on as the model of a Suffolk 2 years-old. Mr. Pigot shows a useful colt in "Patriot," No. 30, who got highly commended, and the Reserve Number. Mr. Grout's "Young Chester Emperor," although entered, did not appear.

Class 10, for Agricultural Mares not suitable to compete as Clydesdale or Suffolk, had fifteen entries, all of which were present, and were commended as a class. The first prize went to No. 67, Mr. Overman's "Diamond," a famous black mare, and a well-known prize winner in Yorkshire, &c. She is an animal of great power, on short legs, grand shoulders and fore legs, very active, and a sort of mare that any farmer might be proud to own. Mr. Crowe's second-prize mare, "Smart," No. 63, is well described by her name; she is as handsome as can well be, with power and quality, but her fore feet are too small, and look suspicious; she was, however, returned to us as sound, which we were glad of, as enabling us to give her a place in the prize list. The third prize went to a very nice mare, No. 68, belonging to Mr. Welcher, and the dam of "Honest Tom," whom we now like all the better for his mother's sake. She is 11 years-old, but looks very fresh and well. The 8 years-old, "Beauty," belonging to Mr. Lamb, was the Reserve Number, and was highly commended; she is a very excellent stamp of animal, but has a plainish head, and lacks the quality of Mr. Welcher's mare. No. 72, Mr. Lister's "Royal Duchess," commended, is a large-framed mare, with good style about her. The remainder call for no especial notice from us.

Class 11, Clydesdale Mares, make but a poor show, four only being entered. Mr. Statter's "Princess," No. 76, is by far the best of the lot. No. 77, Mr. Read's "Deborah," the second-prize mare, is rather plain, but will, when older, make a fine strong mare. No. 75, the Reserve Number, is still more plain, and we hope it is no treason to say that No. 74, the property of her Majesty the Queen, is no credit to the Royal stables.

Class 12 comprised five very good Suffolk Mares. No. 78, "Matchit," took the first prize, as she did the last year at Oxford, and at every show, with one exception, to which she has been sent. She is as perfect a specimen of the Suffolk mare as we have ever seen, and we suspect it will be a long time before we see her match. "Bury Empress," the property of Lieut.-Col. Wilson, took the second prize, and is a very handsome mare, with lots of quality, but scarcely so much substance as we should like to see; she is, moreover, rather too long in the back, and flat in her back ribs. Although there were but five mares shown in this class (consequently but two prizes to be awarded according to our instructions), we exercised the privilege granted to us of recommending a third prize to be given to Mr. H. Wolton's "Diamond," No. 80, who is too good to be passed over without a prize.

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No. 81 was highly commended, and obtained the Reserve Number, and Mr. Byford's "Pride," No. 79, was commended.

Class 27, Agricultural Fillies, neither Clydesdale nor Suffolk, had eight entries. No. 215, Mr. Linton's "Princess," is a grand filly by "Honest Tom," and a credit to her sire; she has, however, rather a plain head, and her fore legs are none of the best. No. 221, the second-prize filly, is very neat. No. 222, the third prize, "Darling," the property of Mr. Davis, is a big plain mare, and the same may be said of the Reserve Number, No. 216. The remainder are a very moderate lot.

The Clydesdale Fillies, Class 28, were a small lot. Mr. Parker's, No. 225, took the first prize, and is a good specimen of the breed. Her Majesty the Queen took the second prize with a very fine mare, as well as a high commendation, and the Reserve Number for No. 224, another clever one.

But one Suffolk filly, Mr. W. Thompson's "The Despised," appeared in Class 29; she is a very heavy mare, with good arms and legs, has the appearance of having a wonderful constitution; but she is so fat, that she has lost any activity she may ever have possessed. Here is a sad falling off in the number and quality of the animals we have in former years seen in this class.

Class 30, for Agricultural pairs of Geldings, or Mares. Six pairs entered the ring, and made a noble display. The first-prize horses are certainly a splendid pair, and equal to moving almost any weight. Mr. Statter's mares, No. 229, are very active and strong, and suitable alike for farm and heavy work. No. 232, Mr. Brierley's pair of greys, took the third prize, and they made a grand show; indeed, it is impossible to imagine a more noble-looking animal than "Sensation," being of great size, nice quality, and action like a Norfolk trotter; her companion and half-brother is, however, quite unworthy to be seen by her side, and must always be a great drawback to her when they are exhibited together. No. 231, the property of the Earl of Dartmouth, were highly commended, and obtained the Reserve Number. Here again "Thirley" is much better than his brother, "Bowler." The other pairs were of a common description, and by no means like prize animals.

Class 31, for pairs of 4 years-old Geldings or Mares. Mr. Statter was the only exhibitor; he sent one good one, and a very moderate one.

Class 32, for 3 years-old. Mr. Statter was again successful with No. 239, "Thumper" being a very good gelding; but "Maggie" is too long in the back and light in the girth. No. 238, Mr. Brierley's, second prize, are two grey geldings, named "Bobby" and "Flirt;" they are, however, no match, one being a very short-legged thick horse, and the other just the reverse.

Only one of the two 3 years-old Geldings entered in Class 33 was sent, at present belonging to Mr. E. Tongue; he is a very good thick stamp of horse, and worthy of a prize.

Class 34, 2 years-old Geldings. Mr. Derry showed a smart, active colt, No. 242; and Mr. Harris had a brown of good quality, but no particular sort about him, in No. 245; the other is a plain one, with long legs and short ribs.

Class 35, Mr. Statter showed a very unworthy representative of the "Stand Hall" stud in the yearling "Thumper."

In concluding this Report we think we may congratulate the Society upon the quality of the animals shown, and on their comparative freedom from unsoundness; it is nevertheless to be regretted that some of the classes were not better filled. It would be well if the Council of the Society would devise some more attractive programme with regard to agricultural horses, as we often see more animals exhibited at our local shows than we meet with at the "Royal." It is at these shows that the young farmer naturally looks to find the best specimens of the various kinds of farming stock; but as regards cart-horses, it by no means happens that he always finds the best.

The Hon. George E. Lascelles, with Messrs. Maynard and Bennett, as Judges of the Thoroughbred Hunting, Hackney, and Pony Classes, had a long and weary day—the latter portion under a heavy rain—in a ring adjoining that for agricultural horses. For once we had really something to look at amongst a large class of thoroughbred sires, many of which had already earned for themselves a world-wide reputation on the turf, and were a pleasing contrast to the walk-over exhibition by "Motley" at Plymouth. There can be no two opinions as to the qualifications of "Sincerity" for the first honours. He is, in my opinion, the beau-ideal of a *hunter sire;* and from what I have seen of his produce in the North during the present year, there is every reason to believe that, as a sire, "he is as good as he looks." However much approved was "Sincerity's" triumph, public comment and criticism were not wanting when the award went in favour of Mr. Lockhart's "Dick Turpin," as the best stallion for getting hackneys, the majority of the outsiders preferring the second-prize handsome chestnut of Mr. Mitchell, from Norfolk. This difference of opinion, however, arises simply from an incorrect interpretation of the word "hackney," as distinguished from the high-stepping "roadster." Mr. Roundell's pony stallion was a grand one, and won easily in his class. As a brood-mare for producing hunters, Mr. Miller's "Lady Emily" might be considered by many too light in bone for breeding a weight-carrier; but her quality is perfection itself; and when her grand "Carbineer" foal was seen capering by her side, there was ample proof of her high qualifications for breeding purposes. It was a treat, indeed, to watch Mr. Overman's clever "Jenny Lind," which was deservedly placed first in the hackney brood-mare class; whilst there were two or three very clever ponies in the succeeding classes. Amongst the young hunters there were several very promising animals, but nothing took my fancy so much as Mr. Armstrong's 3 years-old "Banker," and Mr. Moffat's "Luna," first in their respective classes, and come all the way from the sister counties of Cumberland and Westmorland. The latter is by the Newcastle Royal Prize sire "Laughing-Stock," which was ignored by the Judges on the present occasion; but I was much struck by the excellence of his stock as exhibited in several of the younger classes. Major Barlow carried all before him, in 4 years-old hunters, with his splendid browns "Tregothnan" and "Beckford;" whilst Mr. John B. Booth was as invincible as ever with his "Banner Bearer," which is not only a famous prize-winner, but a first-rate horse across country. Mr. Harvey Bayly's "Borderer"—a purchase last year from Mr. Booth—was second; nor would I despise the rich brown "Filbert" of Mr. Oswell, which, to my mind, is the stamp of horse to carry a heavy man through dirt. There was some difference of opinion as to the merits of Lord Coventry's "Bird-on-the-Wing" and Mr. Welfitt's "Loiterer," but it was impossible to deprive his Lordship's game-looking little black of the priority. Harness horses—as they always are out of Yorkshire and Cumberland—were a shabby lot; but there is always something attractive in an exhibition of roadsters, and I was glad to see the award go to Mr. Moffat's "Covet," a charming 4 years-old by "Laughing-Stock," and as full of quality as her sire. In this class Mr. Milward's "Hilton" appeared to me to deserve a higher position than a Reserve Number, for he is "a gentleman all over." I fancy I have seen the pony classes in former years better represented both in numbers and quality, if I except the wonderful little grey "Jumney," belonging to Mr. Bower, which was a source of great delight to the juvenile visitors around the horse-ring. I append a concise Report by the Judges in the above classes, which I am sure will be read with much interest.

Class 7. We commenced our duties with the class for stallions suitable for getting hunters, and had no difficulty in picking out the first-prize horse, No. 39, "Sincerity," by "Red Hart," dam by "Van Tromp," himself a horse that any 14-stone man might be proud to have in his stud of hunters. No. 33, "Blinkhoolie," was placed second, and is a horse certain to get hunters, especially from mares with substance. He is full of quality, action, and wire. No. 34, "Suffolk," a very neat-topped one, was placed third; and if he had liberty of action in his trot and walk, would be very nearly what is required as a hunter stallion. No. 37 was placed fourth, and he has proved himself the sire of good stock, as we had several good "Laughing-Stock" animals in the ring during the day.

Class 8. We considered No. 43 nearly the model of a hackney, and more likely to get horses that could carry a man safely and pleasantly on the road than the extraordinary high steppers which are often admired as roadster stallions, and which, though wonderful to behold, are far from pleasant to ride. No. 48 has really good and quick action, and as he is only 3 years old, will, with time, prove a valuable horse.

Class 9, No. 56, "Sir George," is as neat a little horse as often enters the ring, and shows himself in first-rate form. No. 58, placed second, is also of a useful stamp.

Class 13. In this class, mares with foal at foot, and barren mares served this spring, are exhibited together; and there is some difficulty in judging them in one class, the barren mares having so much advantage in condition. We were, however, able to find three really good mares with foals at foot, to which we gave the prizes. No. 83, first prize, is a beautiful mare, of both quality and size, with a good foal. No. 91, had more substance, and must be a good breeder if put to a thoroughbred horse: she had also a good foal with her. No. 93, third prize, a wiry mare, with great propelling powers;

requires to be put to a horse with good forehand. No. 94 was highly commended, and would no doubt have been placed higher if she had had a good foal with her.

Class 14. Small, and of no great excellence. No. 97 took first prize; a useful mare, with good substance and action; and No. 99, second prize, looking old, with a good loin and a good foal.

Class 15. There were some good ponies in this class. No. 103, a showy active mare, took first prize. No. 102, second prize, is a neat, well-bred pony, 4 years old,

Class 16. A large class, with many promising animals in it. No. 115 took first prize, a grand, well-furnished colt, which must make a hunter. No. 110, a good-looking brown, second prize. No. 119, a well-bred chestnut, third prize.

Class 17, No. 121, a chestnut filly by "Laughing-Stock," easily took first prize; and we thought her an extraordinary good one, which should make a "flyer." No. 126, perhaps a little light, second prize. No. 120, by "The Drake," a showy and useful filly, third prize.

Class 18. This was a good class, and the ring being very heavy with several suspicious-looking newly-filled-in drains across it, we were able to form some idea of a horse's power of getting across-country as far as galloping is concerned. No. 138 is a powerful, well-bred horse, and wonderfully furnished for his age. No. 137 is a little coarse, and not quite up in his withers, yet seemed very active, and went through the deep ground with perfect ease.

Class 19. In this class the four placed were all good horses, No. 145 being clearly the best for the weight—15 stone. No. 152 went like a hunter all over; and Nos. 149 and 150 also moved well.

Class 20. This class was hardly up to the mark, the first and second prizes being the only horses at all like hunters in it. We considered No. 163 the best, and he went through the deep ground with ease, though perhaps with too much resolution to be a perfect hunter. No. 157 is a neat horse, but carried his head in a most objectionable place for a show-hunter. The rest of the class were decidedly inferior.

Class 21. Only one entry of average merit.

Class 22 did not fill.

Class 23, No. 179, another "Laughing-Stock," and a very neat one, took first prize; No. 169, second prize; and No. 180, another "Laughing-Stock," and a clever cob, took third prize, in a good class.

Class 24. This was also a good class; and Nos. 193 and 188, first and second prizes, are really good hacks.

Class 25. A good class. No. 198, a cream-colour, with both substance and action, took first prize. No. 199, a good cob, second prize.

Class 26. This was an extraordinarily good class; and No. 212, a perfect little model of a horse, took first prize. He was well shown, and moved in first-rate form. No. 213 is also quite a prize-class pony, and has excellent action.

This brought us to the end of our duties, in a pouring rain; and I think we may safely say that the show in the classes before us was above the average, both in number of entries and in the quality of the horses exhibited.

## Cattle.

Except in 2 years-old and yearling heifers, the show of Shorthorns at Wolverhampton could not be considered up to the standard of former exhibitions. Many reasons account for this. Since 1868, the Canadians, Americans, and Australians have bought up most of the best yearling and 2 years-old bulls and heifers at good prices for exportation, consequently exhibitors have not those specimens to send forward as fully matured and developed animals. Moreover, the higher bred Shorthorns have in the same period become immensely advanced in value, whilst pure and *fashionable* pedigrees command such extreme prices, that selection is avoided and the *bad* with the *good* are left to grow together, like tares and wheat, till an auction is held which scatters them far and wide; but there can be no doubt that the *pure* stock of the country—though more may be bred—is hardly likely to be much improved in symmetry and quality, for there is an apparent coarseness in some of the more fashionable lines of blood. The old bulls were comparatively a poor class, and there was an absence of that massiveness and grandeur which one looks for in such animals. The first-prize bull, the famous old "Edgar," was a fine type of a good Shorthorn, and Cumberland may indeed be proud of him; the second prize, "Telemachus," was much younger and smaller, but neat, and lacking somewhat in masculine character about the head. The 2 years-old were a larger class and better; and several animals, rich in colour and fine in quality of flesh, were shown, though none of the specimens possessed any unusual merit beyond Mr. Linton's "Lord Irwin," which is very even and symmetrical, and was deservedly placed first in his class. The yearling bulls, as a whole, were scarcely equal to the last class, but still had some superior animals at their head—to wit, the first and second prizes in Colonel Towneley's "Baron Hubback 2nd," and Lord Sudeley's "Cherub," both immediately picked up for export, whilst Mr. Lamb's rich-handling "Ignoramus," a worthy grandson of "Edgar," was placed third. Beyond Messrs. Dudding's "British Flag," the Bull-calf Class does not call for much comment. The cows were decidedly inferior for "a Royal lot." The first prize, "Warrior's Plume," belonging to Mr. Beattie, of Dumfriesshire, was very sweet and feminine, with lovely head and fore quarters, short legs, and good quality of flesh, but evidently overdone with excessive feeding, and but recently calved. As a 2 or 3 years-old she must have been a good animal, being (like "Edgar") so full of true old shorthorn character. The 2 years-old heifers were indeed a grand lot, and the Judges had a difficult duty to perform in coming to a decision. Lady Pigot was placed first, with a rich-touching white, "Dame Swift," heavy in-calf; with Mr. How's "Vesper Queen," second; and Mr. Foljambe's "Concert" third. Not a few outsiders considered the latter worthy of a more prominent place, as she is very large in size, rich in colour, and full of flesh, without being coarse, but when walking she gets her back up too much.

As a class they were wonderfully even. The yearling heifers were equally well made up, but lacked quality. Mr. Outhwaite's first prize, "Lady Brough," was a credit to her owner's careful training, and she, along with several others, will in future grace an American home. Besides Mr. Foljambe's "Fleur de Lis," Colonel Towneley sent *four* in this class, but they were not equal to his "Butterflies" as of old, or to his Chester display. The heifer calves numbered 21 entries, amongst which were seen many very promising youngsters, the first prize going to a beautiful white 10 months-old, belonging to Mr. Garfit, and purchased from Mr. Cheyney's well-known herd. Lady Pigot once more came to the front with her roan "Victoria Victrix" as second; whilst Colonel Towneley, with two entries, fails to get more than a highly commended. The Judges gave an excellent report in detail, as follows:—

Before particularizing the prize animals, we cannot refrain from expressing the regret we felt on looking over the classes of aged bulls and cows, to find they so inadequately represented a fair sample and standard of the breed, and we are unable to account for the absence of better specimens. This remark, however, more especially applies to the cows, than which a weaker lot we never saw at a Royal show. When such is the case, it cannot well be otherwise than that differences of opinion as to the preponderance of merit in competition must exist; but we are also aware and do not hesitate to state, that a much greater influence in criticism is too frequently unduly exercised by the unfortunate "war-to-the-knife" prejudice to *lines of consanguinity!* It is incumbent on us to remark that our awards are made for the one only purpose of doing justice to the animals possessing the largest share of merit, and that our decisions are unanimous, as follows:—

Class 36. *Aged Bulls.*—First prize, roan, 8 years and 6 months-old: a large-framed bull, excellent quality, great length, good hair, having a well-covered level back, plenty of substance, his legs true and well placed.

Second prize, roan, 3 years and 2 months-old: good quality and character, a little wanting in length and substance, trifling weakness behind shoulders, and head and neck not masculine enough. This bull, having youth in his favour, is likely to improve and hold a better position.

Third prize, red, 3 years and 6 months-old: very good quality, rather too light-fleshed, but a useful bull on a fair-sized scale.

Fourth prize, white, 3 years and 7 months-old: good quality, great growth, rather low in loins, otherwise an evenly-formed well fleshed animal.

Reserve number, roan, 3 years and 10 months-old: fair quality and good back, harsh hair.

*Bulls above 2 and not exceeding 3 years.*—First prize, white, 2 years and 5 months-old: excellent quality and character, a massive well-fleshed animal of great growth and much promise.

Second prize, white, 2 years and 5 months-old: good quality, of great substance, with a level and evenly covered back, capital loins, not quite so good below.

Third prize, red, 2 years and 3 months-old: very good quality and size, rather thin in the chine, tail might have been better set on.

Fourth prize, red and white, 2 years and 10 months-old: fair quality, very good middle, deficient between hips and tail, rather small scale.

Reserve number, red, 2 years and 2 months-old: nice quality and substance.

*Yearling Bulls.*—First prize, red, 1 year and 4 months-old: very good quality and character, a level evenly made animal of great promise.

Second prize, red, 1 year and 3 months-old: excellent flesh with substance, not so true-made as the first prize.

Third prize, rich roan, 1 year and 2 months-old: quality surpassing all in the class, with good character, deficient in fore ribs, and rather so in substance, great flank and well let down in fore quarter.

Fourth prize, roan, 1 year and 2 months-old: good quality, thick well-covered frame, rather short in length of body, and tail not well set on; a compact useful animal.

Reserve number, roan, 1 year and 7 months-old: a mellow-fleshed animal of good size and character, but having the advantage of age over the others; he appeared to us too light in substance, upon rather long legs.

This class required very great consideration; we highly commended it.

*Bull Calves.*—First prize, red, with a little white, 10 months-old: good quality, an evenly-covered level back and good flanks, standing well on his legs.

Second prize, red and white, 7 months-old: fair quality, very good hair, and good hind quarters; shoulders prominent and not well placed; fore ribs rather flat.

Third prize, red, 9 months-old: medium quality, lengthy frame, nice hind-quarters, and good flanks; shoulders not well laid, and wanting in crops.

As a whole a very moderate class.

*Cows.*—First prize, roan, 5 years and 5 months-old: excellent quality and hair; somewhat short-drawn and lumpy in hind quarters, with rather light thighs, but her frame well covered all over and showing good character, with a very robust constitution.

Second prize, roan, 5 years and 8 months-old: good quality and character, large scale with plenty of substance, ribs not sufficiently arched, nor so well covered on the back as should be, with drooping quarters; nevertheless a stylish cow.

Third prize, red and white, 3 years and 4 months-old: good quality, a cow on very short legs, excellent bosom and fore quarter throughout; but her short very badly covered hind quarters, particularly from her hips to rump, and tail set on too high, with rather thick legs, prevented her taking a more prominent position.

Reserve number, red roan, 7 years and 5 months-old: very good quality, with an evenly made and well covered back, her fore quarter very light, and particularly thin through her plates, indicating weakness of constitution.

A very indifferent class.

*Heifers not exceeding 3 years-old.*—First prize, white, 2 years and 3 months-old, excellent quality, good hair and character, short but compact frame, well covered; a very nice animal, rather small.

Second prize, red, 2 years and 5 months-old: excellent quality, good hair, well-formed frame, with more length than the first-prize heifer, fore quarter not so deep, and somewhat small.

Third prize, roan, 2 years and 2 months-old: medium quality, harsh hair, flesh not mellow enough, standing on rather too long legs, great length, back wonderfully well covered, handsome outline, excepting only the setting on of the tail.

Reserve number, white, 2 years and 7 months-old: good quality, large scale, evenly covered, not maintaining the character of the prize heifers.

A very large and excellent class; we highly commended it.

*Yearling Heifers.*—First prize, roan, 1 year and 8 months-old: good quality, compact well-formed frame, combining great substance and character, not quite deep enough in fore quarter, but an excellent heifer.

Second prize, roan, 1 year and 10 months-old: medium quality, with rather harsh hair, fore ribs a little wanting, tail not handsomely set on, but a very good heifer, of great length, with a well-formed and covered back.

Third prize, red, 1 year and 10 months-old: very good quality, frame on large scale and well covered, a little low in back, horns showing want of character.

Fourth prize, roan, 1 year and 6 months-old: good quality and hair, a little light in fore quarter, and standing upon rather too long legs; a heifer requiring more time, but very promising.

A large and particularly good class, highly commended.

*Heifer Calves.*—First prize, white, 10 months-old: very good quality and character, a well-formed frame, showing great substance and early development.

Second prize, roan, 9 months-old: medium quality, great size, good form and appearance.

Reserve number, white, 9 months-old: good quality, excellent hair, rather low in back, but of great substance and character.

In this class we had very considerable difficulty, owing to the large number and great promise of these aspirants to fame.

We conclude our Report by observing that the heifer classes, including calves, were well represented, showing those characteristics of the true type of a Shorthorn—mellow quality, fine hair, great aptitude to grow flesh, with robust constitution, and good looks in a large degree; and the same remark will justly apply to many of the bulls, some of which we fully expect to see holding still higher distinction hereafter.

The show of Herefords was supremely satisfactory both in numbers and quality. It was feared that the numerous purchases of young stock of this breed which took place at Oxford last year, on behalf of the Colonies, would cause the collection at the "Royal" at Wolverhampton to be both meagre and inferior. But this was certainly not the case, as the entries numbered 86, and contained some splendid specimens of the breed, with great weight of flesh, combined with prime quality. Possessing as I do a great admiration for this breed of cattle, as considerable meat-producers, but having no special knowledge of their characteristics, I gladly leave a fuller description of the respective classes to be gathered from the Judges' Report, in which they say:—

We beg to report that the Herefords at this meeting show to great advantage; the Bull Classes were up to the average, and the females have never been surpassed if ever equalled at any previous show.

Class 44. Mr. Warren Evans took first prize with "Monaughty the 3rd," which is a grand, long, and massive bull, with heavy flesh and first-rate character. Mr. P. Turner's "Bachelor" took second honours. He is symmetrical, with substance, but his head is effeminate. He is the sire of "Rarity," "Plum," and "Provost," which fact is a "feather in his cap." "Theodore" had third prize and is a good animal. Mr. Walker's "Wonder," in store condition, was placed in reserve, and is a rare stamp for stock purposes.

Class 45. Mr. John Williams's "Royal Head," of fine symmetry and quality, was placed first, and the Earl of Southesk took second prize with "Ostorius," a big and good one. Mr. P. Turner's "Provost" had third prize, and he is a good animal, with great substance. Mr. Harding's "Noble Boy" was the reserve number. "Sir Oliver 3rd" was low in condition, but is a large and good stock animal.

Class 46. Mr. Richard Hill's "Pearldiver" headed this class. He is remarkably handsome, with a deep and rich touch and bloodlike character; his hind legs are a trifle too close and crooked. He is sold for Australia, as is also "Star of the West," who had second prize. Mr. Crane's "Prince George" took third prize, and Mr. Harding's "Tom Kinnersley" the reserve number.

This was a good class and generally commended.

Class 47. The straight and broad-backed "Alexander" took first prize. He is rich in colour and in flesh, and looks like making a grand animal. Mr. W. Taylor, of "The Oxford Lad" renown, was second on the list with "The Wolverhampton Boy," a growing calf of capital character; Mr. Edwards's "Albert" being the reserve number. "The Colonel," "Perfection," and "Vendome" all possess considerable merit, and there were other promising calves in this class.

Class 48 had six competitors, all possessing great merit, and were highly commended. Mr. Peren's "Ivington Rose," one of the best Hereford cows ever seen, headed this class. She appeared rather overfed for breeding purposes. Mr. Turner's "Livia" took second prize; and the third went to Mr. Tanner for his grand old cow "Queen."

Class 49. A better lot of breeding heifers never came together, and the class was generally commended. Mr. Turner had first prize with "Rarity," which is a "perfect gem." She was closely pressed by Mr. Harding's "Dahlia," placed second. Mr. Fenn's "Duchess of Bedford 6th," which had only just dropped a calf, took third prize.

Class 50 had sixteen competitors, and, with few exceptions, was characterized by more than average merit. The first-prize winner, Mr. Harding's "Lizzie Jeffreys," is a stylish and good heifer. Mr. P. Turner's "Plum" was second, and is evenly grown and handsome. Mr. Thomas's "Sunflower" had third prize. Mr. Arkwright's "Miss Hungerford," and was the reserve number, "Lady Oxford," in low condition, and Mr. Peter Davis's heifer, were all highly creditable specimens.

Class 51. Mr. Fenn's "Lady of the Tyne" was placed first, and is a model of beauty, substance, and character; she is in only moderate condition. Mr. Morris had second prize with "Madeleine," who is large and well furnished, and should make a grand cow. Mr. Thomas's "Rosalind," large and evenly moulded, with an indifferent touch, got the reserve number. Mr. Arkwright's heifer, without a name, Mr. Fenn's "Duchess of Bedford 7th," and Mr. Edward's "Dewdrop," all possess great merit. Some in this class were backward in condition and development, and they will probably appear to greater advantage at some future gathering.

The show of Devons was exceedingly small, and although the breed occupies a prominent position in the "Royal" prize list, the entries numbered only 47. Still this number sufficed to allow all the principal breeders to be represented, amongst the most successful of whom were Lord Falmouth, Messrs. Buller, Davy, Farthing, Taylor, and Smith. The Judges of Devons also judged the Norfolk and Suffolk Polls and the classes for other established breeds, and they report to me thus:—

In commencing with the Devons we consider, that though perhaps not so numerously represented in the show ring as other breeds, still they well maintained the reputation they have achieved, the several classes having in them specimens with unmistakeable evidences of the correct character and fashion so noticeable in this distinguished breed of cattle. While regarding Mr. James Davy's first prize bull, No. 503, in Class 53, as the "Premier" male of the Devons, if not of all breeds, and his first-prize yearling heifer, No. 529, in Class 58, in like manner head of the female classes of Devons, we much fear that with the former, from apparent overfeeding, his future usefulness is to a considerable extent limited, which, with so valuable an animal, is very much to be regretted.

Class 66. *Norfolk and Suffolk Polled Breeds* we consider were fairly represented; they are apparently animals of great size, with a fair proportion of meat to bone.

Class 69. *Other established Breeds.*—In this class we consider there were some good specimens, more particularly of the Longhorn, the moderately correct form of which, combined with large frames and fair quality of flesh, allowed them to take a fair position with other and more popular breeds.

Channel Island cattle are at all times an interesting feature of a showyard, as their beautiful deer-like appearance and gentle demeanour cause them to be greatly admired by the amateur farmer and general public. Since last year at Oxford, when much dissatisfaction existed at the breeds from the different Islands competing in the same class, a revision has taken place, and separate classes are now provided for Guernseys and Jerseys. But still exhibitors, from ignorance or some other inexplicable cause, appear to make erroneous entries, which it is presumed, with more experience, is a difficulty which will correct itself. I have great pleasure in appending the Report of the Judges, inasmuch as it is one always read with pleasure:—

In reporting on the classes submitted to our consideration, we would first observe that, owing to the recent determination of the Council to separate the Channel Isles' cattle under the distinct heads of Jersey and Guernsey, the work of judging has been much facilitated, and the dissatisfaction formerly existing among exhibitors in the mixed classes must have been put an end to.

### Jersey Cattle.

Class 60. *Bulls above* 1 *year-old.*—As a class this could only be termed very ordinary. Six specimens competed. No. 545, to which the first prize was awarded, was good in his frame, and as a 2 years-old, carried plenty of substance, but he was deficient in his head, which was too long and cowish. No. 546, which came in second, was better in his head than the former, and with good neck and shoulders, but he was flat-sided and wanting in depth about the flank. No. 543, the reserve number, possessed nothing remarkable beyond good condition.

Class 61. *Cows above* 3 *years-old.*—There were nine entries in this class, eight of which competed. The first prize was carried off by No. 554, a well-bred animal, with considerable merit. The second prize was awarded to No. 551, a well-shaped beast, but far behind No. 544 in richness of quality. No. 552 was placed as the reserve number, and highly commended. In the competition for second prize, No. 551 and 552 were considered almost equal; the symmetrical proportions of the former gained her the distinction. No. 556 was highly commended, and No. 548 and 550 received commendations.

Class 62. *Heifers in-milk or in-calf, not exceeding* 3 *years-old.*—Eleven were entered, nine of which competed. No. 564, a strong and well-made animal, carried the first prize. The second prize was adjudged to No. 560, not nearly so well-shaped a beast as the former, particularly in the hind quarters, though in some respects superior as regards richness of quality. The reserve went to No. 567, which was highly commended, and not far behind those obtaining prizes: this promises to be a useful animal. Commendations were awarded to Nos. 557, 559, and 568.

### Guernsey Cattle.

Class 63. *Bulls above* 1 *year-old.*—There were nine entries in this class, seven of which were exhibited. Of this number there were but four pure-bred Guernseys, two being of the Jersey breed, and one which did not resemble the breed of either island, but which impressed the Judges as being a cross-bred animal. Nos. 576 and 578, to which were respectively awarded the first and second prizes, were good and well-bred specimens. No. 577 came in for the reserve number.

Class 64. *Cows above* 3 *years-old.*—In this class seven out of the nine entries competed. The first prize was awarded to No. 584, the second prize to No. 585, and the reserve to 579, which was also highly commended. These were good and typical specimens of Guernsey cattle; but in this class, as in the last, some animals were entered which could not be called Guernseys, one of which especially would have stood among the best had she been entered in Class 61, with animals of her breed.

Class 65. *Heifers in-milk or in-calf, not exceeding* 3 *years-old.*—Eight were entered, six of which competed. The first prize went to No. 596, the second prize to No. 595, and the reserve to No. 593, which was also highly commended. With these exceptions, there was nothing exhibited in this class deserving of special notice.

In reference to Jersey and Guernsey cattle, it is evident that though there is no resemblance between the breeds, the distinction does not seem to be generally understood, proof of which was given in these classes. It would be well for exhibitors to be more careful, as the disqualification which ensues from error in their entries, deprives them of any good chance which they might otherwise have.

The Class for Dairy Cattle has always appeared to me one of very questionable utility. Milk is undoubtedly one of the most valuable elements of daily food, and its production is worthy of every support and encouragement; but when, as in this case, a prize is offered for a class in which are included every breed under the sun, from the high-bred Shorthorn to the more humble Ayrshire, judgment becomes a pure matter of chance and fancy. I rejoice to find the Judges speaking out so strongly on this point, and I trust that their remarks may have some effect in showing the difficulties of deciding in such a class, and in exposing that cruel and unnecessary practice of leaving cows unmilked for many hours prior to being judged, which is too common both in this country and in Scotland. The Judges say:—

Under the denomination of "dairy cattle" there were some excellent animals exhibited.

Class 72. *Pair of Heifers, in-milk, under* 3 *years and* 8 *months-old.*—Four pairs were entered, three of which competed. The first prize was awarded to No. 634 (Ayrshires), the second prize to No. 633 (Ayrshires), and the third prize to No. 635 (Shorthorns).

Class 73. *Pairs of Cows, over 3 years and 8 months-old, in-milk.*—Six pairs competed out of the eight which were entered. No. 637 (Ayrshires) took first prize, No. 638 (Ayrshires) the second prize, No. 642 (Cross-breds) the third prize, and No. 640 (Shorthorns) was placed as the reserve and highly commended; No. 644 (Cross-breds) received a commendation.

In judging these classes, the question arose whether the competition was intended for the largest production of milk, or for the milk which would produce the largest quantity and the richest quality of butter. No instructions being laid down in this particular, we adopted a middle course and gave consideration to both these points in making the awards; at the same time, in our opinion, it would seem advisable on future occasions that the special merits for which the competition is opened should be distinctly noted. There should also be a rule as to the milking of cattle. On the morning of their examination some of the animals exhibited came in the ring with full and distended udders, as though they had not been milked for eighteen hours, whilst others came in with udders comparatively empty. We would suggest that all the animals competing in these classes should be milked dry at the same time on the evening preceding the examination, in presence of a person appointed by the stewards, so that the following morning there should be uniformity in this respect. Again, that they should all be milked at the examination, and that the properties of the milk should be tested, due regard being paid to quantity and quality. We would further suggest that the date when the animals last calved should be stated in the entries, as the quality and quantity of milk are materially influenced by the length of time the animals have been in milk. No doubt other influences act upon these most essential points—food and management contribute their full share; but this is the part to be understood and carried out by exhibitors. On the other hand, the Judges having certain data to go by, would be better able to determine on the respective merits of the animals brought under their notice.

## Sheep.

The fine old breed of Leicesters, which has for so many years stood foremost in the "Royal" Catalogue, and been the basis of so many other breeds, was scarcely up to its usual form of general excellence or numbers. The old sheep certainly were noble specimens of their breed, but the shearling rams and ewes were many degrees short of former standards. The superiority of the old sheep over the young was observable throughout the sheep classes generally, which I imagine is attributable to the hot and dry summer of 1870, when lambs were much pinched for milk, and to the great scarcity of roots for feeding purposes during the past winter. My own experience tells me that these circumstances have had a very deteriorating effect on the produce of wool as well as of mutton during the spring of this year. Three separate reports of Leicesters by the Judges have been handed to me, but one may suffice for publication as being the only one containing any detail, and in it we are told:—

Class 74. *Shearling Rams.*—The first prize, exhibited by Mr. George Turner, jun., has a good head, well set on; a firm neck, good back and loin, with an excellent fleece of wool, and altogether is a very good shearling; the only fault to be found with him is a little softness in his handling. The second prize, shown by the Rev. George Inge, of Tamworth, has a good fore quarter, great girth, an excellent fleece, firm to the touch, and I may say, a very good sheep. The third prize, shown by the same owner, is a thick, well-grown sheep, with rather light fleece, and when turned loose walks badly. The highly commended and reserve number, shown by Mr. Sanday, is a neat, well-grown sheep, but not big enough to please the public. The commended shearling, shown by Mr. Turner, sen., is a good turning sheep, but not good enough to win in such company.

Class 75. The first prize aged ram is a two-shear, shown by the same gentleman that took first prize for shearlings, and a more complete type of a good Leicester I have seldom seen, many good judges pronouncing him to be faultless. The second prize, a three-shear, shown by Mr. Sanday, is a large-sized sheep with good wool and constitution; a little faulty about the shoulders, but a very useful sheep. The third prize, shown by Mr. Borton, is a very thick, well-formed sheep, but rather light in his fleece. We considered this an excellent class, and commended all but one. And I may add, that I have never seen a better lot of old sheep together.

Class 76. The Shearling Ewes consisted of only 3 pens. The first prize, shown by Mr. Hutchinson, were of good size and shape. Wool not quite perfect. The second prize, shown by Mr. Borton, were a useful pen. The third prize, shown by the Rev. George Inge, were not so good as his flock has before produced.

Following upon the magnificent show of Cotswolds at Oxford last year they cut but a poor figure on the present occasion, numbering only 36 entries. The absence of many of the famous old names of breeders in the Cotswold Hills is sadly to be regretted; but in Mr. Brown, of Norfolk, we have a liberal contributor, who won as he liked in the shearling ram class; whilst another new exhibitor, in Mr. Russell Swanwick, carried all before him in a very inferior class of young ewes. Of this breed the Judges say:—

Class 77 was fairly represented as to numbers, but with the exception of the prize sheep, was not of that high standing of merit we have sometimes seen at the Royal Shows. No. 715, the first prize, is firm-fleshed; of good fair character, but not quite perfect in his form of standing. No. 716 equal to No. 715 as to general character, but not so true in form before and behind the shoulder.

Class 78. Not so well represented in numbers as Class 77; but we consider No. 724, the first prize, to be of good general Cotswold character, with firm flesh and good wool. No. 728, the second prize, is also a good-fleshed sheep, but has not a good head.

Class 79 is only represented by five entries, and those far below the class as represented at Oxford last year.

Of Lincolns there was a very small entry, including the names of the well-known breeders, Messrs. Marshall, Dudding, and Gunnell; whilst of Ryland and other long-wools there were but nine competitors, and out of these Mr. Lynn's "Lincoln and Leicester" cross—grand sheep in themselves—were pre-eminent. Still I think it is a grave question for consideration, whether the Council should persevere year after year in offering prizes for such a class, unless the show be held in some locality demanding special notice towards this description of sheep. The Judges say of them:—

We thought the Lincoln Long-wool shearlings very good, and commended the whole class. The old sheep were a good class. The shearling ewes were a very good class, and we commended the whole of them. The Rylands were not a very good class, except the first and second prize sheep. The Ryland ewes had only one pen, which deserved the prize.

Oxfordshire Downs, like the Cotswolds, were a sad falling off from the Oxford Meeting of last year, when we saw them in all their native glory. The familiar names of Wallis, Howard, Treadwell, and Druce are amongst the exhibitors. The Judges say:—

Class 83 is represented by 26 entries, containing amongst them several sheep of good general outline; but they do not come to hand quite according to their appearance. No. 792, the first prize, is a neat-framed, good-fleshed animal of fair character, but somewhat deficient in the rump.

Class 84 is only represented by 8 entries. No. 807, the first prize, is an animal of very good, true form, of superior quality of flesh and wool, and decidedly the best specimen of an Oxford Down in any of the classes. The second and third prizes in this class are also of good quality of flesh and wool, but not so true in form as the first prize.

Class 85 is only represented by 3 entries, and those not calling for any particular comment.

The aristocratic Southdown—having for its patrons His Royal Highness the Prince of Wales, the Duke of Richmond, Lord Sondes, and other men of note—like many other breeds already described,—showed a falling off in quality as compared with former years; and the admirer of these beautiful creatures could not but regard, with regret and sorrow, the absence of any representative of the renowned and familiar Merton flock, which we trust, however, to see revived at no distant day. In describing this class the Judges say:—

The show of Shearling Southdowns was not so good as we have seen in former years, nor equal in numbers. The first prize was very even and level, but had not so much size as the second prize, which did not handle on his loin as he ought. The third prize and reserve number were fair specimens of the breed. In the class of any other age, the first prize was a good sheep; the second and third prizes were all true types of the Sussex Southdown. Taking this as a class, we considered it far superior to the shearlings. The reserve number was a well-formed animal, but not quite right in his wool. In the shearling ewes they were over an average, the first prize being a remarkably nice pen, showing the true character of what a Southdown ewe ought to be. The class was so good that we noticed them all.

In the very centre of their home-district, and with so tempting a prize-list as that conjointly arranged by the Council and the Local Committee, the Shropshire sheep came out in strong force—to the unprecedented number of 528 animals—though this was to a considerable extent composed of the numerous entries of ewes and lambs. This breed of sheep is rapidly extending its usefulness throughout the country, for to my mind there is no better "rent-paying" sheep in existence, and I rejoiced to see them forming the chief and prominent feature in the Wolverhampton Show-yard. They are annually improving as a class; and although the shearling rams were scarcely so good a lot as might have been expected, it was a treat, indeed, to behold the *twenty* selected by the Judges out of the aged ram class. But let the Judges speak for themselves. They say:—

Class 91. *Shearling Rams.*—There were 85 entries, and comparatively few of these animals were of an objectionable character. Some were not exhibited in a form to take prizes; but even amongst those there were some commendable specimens. Although we could not select one sheep of strikingly superior merit, they were, as a class, an improvement on last year.

Class 92. The *All-Aged Rams* were the most noticeable feature. In this class we found a large proportion of the animals of marked superiority, in illustration of which, 20 were either awarded prizes or received special commendations at our hands. We consider this the best class of Shropshires ever brought together in the Royal Show-yard, an opinion we feel sure all who have given them a careful inspection will admit. The first-prize sheep was not without a fault; although one of the heaviest carcases of mutton, with a heavy fleece of wool of superior quality, we considered him rather deficient in style.

Class 93. The *Shearling Ewes* were a good class, with few sheep of objectionable character amongst them. The first-prize pen were particularly good; and the character of the other prize pens, with four highly commended and eight commended lots, speak our views more fully than it is necessary to express in this Report.

Class 94. *Aged Ewes.*—In this class there were some very good sheep; some of them were in low condition, having only recently weaned their lambs. The second-prize pen were young ewes, more uniform in character, but lacking the condition of the first prize. No. 1027, the Reserve Number, contained some of the best animals in their class, but were wanting in uniformity.

Class 95. In *Ewe Lambs* there was a large entry, containing several fine specimens. The general class presented great uniformity; some of the lots were rather low in condition, nevertheless representing the true type of this popular breed.

Class 96. *Ram Lambs* were a numerous entry, several possessing great merit; and these, with the preceding class, are a sufficient guarantee that the breed will not depreciate in the hands of its present patrons.

In concluding our Report, we beg to express our satisfaction at the marked improvement noticeable in the present exhibition, the uniformity of type and character being more in accordance with our views than in any previous year. We must again call the attention of exhibitors to the fact that the grey tinge in the fleece was such an insuperable objection as to compel us to exclude some animals which in other respects would have commanded a prominent position in the prize-list; but a reference to the Report of last year will remind them of the strong point then raised on this question.

With reference to the above Report, I consider the breeders of this very useful sort of sheep are much indebted to the Judges at Wolverhampton (the same gentlemen who officiated at Oxford for the pains they took in framing their decisions, the anxiety they manifested to enforce by their awards the doctrine laid down in their former Report for the guidance of Shropshire breeders, and for their remarks upon the several classes brought before them. Here, perhaps, I ought to stop. I admire the breed of sheep as being well adapted to the Midlands, but I cannot lay claim to any practical knowledge of them, and it may not be safe to add to the Report of the Judges; but I cannot resist the temptation to say what I think may strike others as it did me,—that there is still the same reason as heretofore for urging upon breeders the importance of keeping in view the characteristics of good Shropshires, as indicated by the Report of the Judges, so as to attain to something like the uniformity of the Southdown, whilst retaining a far greater weight of wool and mutton. It was obvious that the Judges had their difficulties; for, in spite of their anxiety to stamp by their awards the type of animal they wanted, they must have felt constrained to relax the rule they had laid down for themselves when, after placing their *First* and *Third* Prize Shearling Rams, they had no alternative but to select the animal they did for the *First* All-aged Prize, and to take two pens of young and old ewes, so unlike each other, as *First* in their respective classes. No objection could have been raised if they had adhered to the line they had laid down, and after placing Mrs. Beach's shearling ewes *First*—about which there could be no doubt—they had given the same position to the aged ewes from the same flock; for there can be no stronger proof of the practicability of attaining the uniformity in Shropshire sheep that breeders have so repeatedly been urged to strive for than is shewn by the animals exhibited by this lady. Her shearling and old rams, the shearling and aged ewes, the ram and ewe lambs, are all precisely of the same character. The Judges, however, very properly marked their appreciation of the type by awarding to Mrs. Beach the cup, as the winner of the greatest number of Shropshire prizes; and even if they had gone further than they did, they would still have satisfied the other exhibitors and have confirmed by their decisions the views they expressed in their Oxford Report. I have dwelt thus long on the above subject, inasmuch as I consider that the importance of Shropshire sheep to the tenant-farmers of England, and the prominent position they occupied in the Wolverhampton Show-yard, demanded more than an ordinary recognition at my hands.

Amongst the Hampshire and other Short-wools, I need scarcely say that Mr. Rawlence, as usual, held his own against all comers; whilst in showing the great improvement observable in this breed the Judges write thus:—

The Hampshires were short in numbers but good in quality. They were of great size, and a great improvement upon former years, most of the animals shown being good of the sort. The first and second prize ewes were two remarkably good pens. Only two Dorset sheep were shown, but they were of the right sort as regards quality, size, and horn.

Mountain sheep furnished but a poor entry in any of the classes, and as several of them were disqualified for improper shearing, the competition was limited to very few. It was pleasing to observe the Cheviots, from their native hills in Northumberland, competing with others from Wales; and as Wales is to entertain "the Royal" of 1872, I trust we shall see a bumper entry of this valuable breed of sheep at Cardiff next July.

One word on the important subject of the inspection of shearing, which has wrought such an improvement in our sheep classes since 1863. The Report of the Inspectors is most valuable and encouraging, and I gladly give it in full, in the hope that it may have the effect of inducing other Societies to follow the example of "the Royal" in this matter, and thus tend to remove a "crying evil" too visible in nearly every show-yard in the kingdom. It is a singular circumstance that the only sheep disqualified were in the Mountain classes. The Inspectors say:—

We have to report that the sheep in Class 74, No. 653, in Class 104, Nos. 1084, 1085, 1086, and in Class 105, Nos. 1088, 1089, were not in accordance with your conditions, we therefore recommended them to be disqualified.

We were quite satisfied that the shearing of the sheep disqualified was most unfairly done—in fact, a great deal of old wool was left on the sheep; and we were glad to find that the stewards of the show acted on the recommendation of the inspectors. We had a few doubtful cases among the Cotswolds, Lincolns, Shropshire, and Mountain sheep: on a second examination of those lots, we gave them the benefit of the doubt we had in each case. Our second and closer examination of the sheep referred to will, we are sure, have its good effect, as almost every shepherd in the yard watched our movements with very great interest. We are satisfied—should this marked improvement in shearing go on for a few years—there will be no need for inspection in the Show-yard.

We have further to report, that we found the sheep much improved in shearing from the meeting in 1870, and a very much greater and marked improvement as compared with sheep shown at Manchester in 1869; and we have much pleasure in saying that, on the whole, we have never seen the sheep more fairly shorn.

## Pigs.

Seldom has a finer collection of pigs graced our Royal show-yard. Whilst Messrs. Duckering and Eden carried all before them in the *white* classes, Messrs. Sexton and Ware upheld their reputation in the Suffolk Blacks, and Mr. Russell Swanwick almost "cleared the boards" in Berkshires. Nothing could be more charming to the eye of a pig-fancier than the uniformity of character observable in Mr. Swanwick's various entries of Berkshires. His career has certainly not been a long one, but he has succeeded in creating for himself a wide-spread reputation in the pig-world, whilst the enormous prices at which he sold at Wolverhampton some of his animals for export to America, and the plucky way in which he (shorthorn-like) has been buying others of his own blood back again from that country are sufficient guarantees of the purity of the blood he cultivates

Throughout the pig classes, however, there were many examples of over-feeding, sufficient to render the animals totally unfit for healthy breeding purposes. This is a growing evil for which it is difficult to suggest a remedy. The Judges report:—

We have much pleasure in having to report a very good show; some excellent specimens of the different breeds were exhibited with a good close competition in most of the classes.

Class 106. Boars of a large white breed. First Prize for No. 1092, a fair specimen of the breed. Second Prize for No. 1095, this pig a little coarse in the hair.

Class 107. First Prize for No. 1102; Second Prize for No. 1098. Several of the pigs in this class were not qualified to compete, being of a middle breed.

Class 108. First Prize for No. 1112; Second Prize for No. 1119. This was a fine class of 15 entries, the whole being commended.

Class 109. First Prize for No. 1123; Second Prize for No. 1124. A small class of only 4 entries, but very good pigs.

Class 110. First Prize for No. 1128; Second Prize for No. 1131. A small entry of 6 pens, no remarks.

Class 111. First Prize for No. 1141; Second Prize for No. 1140. Eight entries of very moderate pigs.

Class 112. First Prize for No. 1149; Second Prize for No. 1147. Two very extraordinarily good pigs; the whole of the class commended.

Class 113. First Prize for No. 1152; Second Prize for No. 1154. A small class of only 3 entries.

Class 114. First Prize for No. 1159; Second Prize for No. 1155. The competition in this class was not very close.

Class 115. First Prize for No. 1168; Second Prize for No. 1170. This was a good class of 7 entries, the whole being commended.

Class 116. First Prize for No. 1183; Second Prize for No. 1177. Two splendid sows.

Class 117. First Prize for No. 1190; Second Prize for No. 1189. The first prize pen being pigs of great excellence.

Class 118. Berkshire Boars, First Prize for No. 1194; Second Prize for No. 1197. A moderate class of 9 entries.

Class 119. First Prize for No. 1206; Second Prize for 1205. No remarks.

Class 120. A splendid lot of 20 entries; the First Prize being a sow of great excellence, No. 1226; Second Prize, No. 1220. The whole of the class deservedly commended.

Class 121. This, like the former class was of superior merit, and justly commended.

Classes 122, 123, and 124, were a lot of good cross-bred animals.

A word on the "dentition" of pigs may not be out of place, for instances were not wanting to show that the ages of several of the pigs, especially in the white classes, did not agree with the statements made in the certificates of entry; whilst "in the pens of three" there was more than one instance in which the state of dentition was incompatible with the certificate that the animals were of the same litter. Let this hint be sufficient to guard exhibitors against a repetition of a system which, if persevered in, will assuredly bring down upon the offenders a well merited punishment in future.

Twenty-three competitors appeared for the wool prizes, which were confined to the breed of sheep of the district—Shropshires

—and Lord Chesham carried away the palm into Buckinghamshire, after beating all the best native breeders. Butter and cheese also formed an imposing exhibition, with 47 entries for the former, and 69 for the latter, whilst the Local Committee in their arrangement of these prizes were not forgetful of the fair dairymaids to whose careful manipulation was due, in a great measure, the excellence of the produce thus exhibited.

In conclusion, then, let me observe that in spite of all the difficulties of the occasion, the Wolverhampton Show will for years to come be remembered for its unparalleled exhibition of Shropshire sheep, as well as for the marvellous array of steam-cultivating machinery and traction-engines, and the important results of the trials to which they were subjected. I would further express a hope that, although not generally considered a financial success, yet the Wolverhampton Meeting may bear some good fruit in improving the agriculture of the county of Stafford and the surrounding districts, and be a means also of uniting more closely the interests of agriculture and manufactures, as well as showing to the inhabitants of the "black country" that whilst they, on the one hand, are labouring to furnish *us* with the mechanical means of cultivation—immensely developed in recent years—*we*, on the other hand, are reciprocally labouring to increase the produce of the soil, and thus furnish them with an ample supply of food. A word of thanks is due to the Local Committee, and more especially to the ex-Mayor Mr. Bantock, Mr. Matthews, and Mr. Barnett, the Secretary of the Local Committee, all of whom laboured assiduously and anxiously throughout for the success of the Show; nor must I omit mention of the labourers who acted in the capacity of yardmen on the occasion, for a more intelligent and obliging set of men I have seldom met with in their sphere of life.

With this Report my term of stewardship comes to an end, and my duties as senior steward are fulfilled. To my fellow-stewards, with whom I have laboured with the utmost harmony and greatest pleasure,—as well as to my friend Mr. Brandreth Gibbs,—I would express my warmest thanks for their advice and assistance at all times in the discharge of our common duties. Nor can I ever forget the many pleasing associations and happy moments spent during my three weeks of office at Manchester, Oxford, and Wolverhampton, and the numerous friendships there formed, which, I earnestly trust, may be both mutual and lasting.

*Woodhorn Manor, August*, 1871.

# Royal Agricultural Society of England.

1871.

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LORD VERNON.

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| | |
|---|---|
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| 1867 | *BALDWIN, JOHN, *Luddington, Stratford-on-Avon, Warwickshire.* |
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| 1865 | CLIVE, GEORGE, *Perrystone, Ross, Herefordshire.* |
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| 1861 | *DENT, J. D., M.P., *Ribston Hall, Wetherby, Yorkshire.* |

* Those Members of Council whose names are prefixed by an asterisk retire by rotation in July, but are eligible for re-election in May.

| Year when Elected. | |
|---|---|
| 1860 | Druce, Joseph, *Eynsham, Oxford.* |
| 1868 | Edmonds, William John, *Southrop, Lechlade, Gloucestershire.* |
| 1848 | Gibbs, B. T. Brandreth, *Halfmoon Street, Piccadilly, London,* W. |
| 1869 | Hesketh, Sir Thomas, Bart., M.P., *Rufford Hall, Ormskirk.* |
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| 1866 | Hornsby, Richard, *Spittle Gate, Grantham, Lincolnshire.* |
| 1854 | Hoskyns, Chandos Wren, M.P., *Harewood, Ross, Herefordshire.* |
| 1867 | Kesteven, Lord, *Caswick, Stamford, Lincolnshire.* |
| 1863 | *Kingscote, Colonel, M.P., *Kingscote, Wootton-under-Edge, Gloucestershire.* |
| 1848 | Lawes, John Bennet, *Rothamsted, St. Albans, Herts.* |
| 1869 | *Leeds, Robert, *Wicken Farm, Castleacre, Brandon, Norfolk.* |
| 1868 | Lichfield, Earl of, *Shugborough, Staffordshire.* |
| 1867 | *Liddell, Hon. Henry George, M.P., *Ravensworth Castle, Durham.* |
| 1865 | *Lopes, Sir Massey, Bart., M.P., *Maristow, Roborough, Devon.* |
| 1854 | Macdonald, Sir Archibald Keppel, Bt., *Woolmer Lodge, Liphook, Hants.* |
| 1871 | Masfen, R. Hanbury, *Pendeford, Wolverhampton.* |
| 1846 | *Milward, Richard, *Thurgarton Priory, Southwell, Notts.* |
| 1867 | *Pain, Thomas, *Ugford Cottage, Salisbury, Wilts.* |
| 1861 | Randell, Charles, *Chadbury, Evesham, Worcestershire.* |
| 1868 | *Ransome, Robert Charles, *Ipswich, Suffolk.* |
| 1869 | *Ridley, M. White, M.P., *Blagdon, Cramlington, Northumberland.* |
| 1862 | *Rigden, William, *Hove, Brighton, Sussex.* |
| 1861 | Sanday, William, *Radcliffe-on-Trent, Notts.* |
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| 1869 | Statter, Thomas, *Stand Hill, Whitefield, Manchester.* |
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| 1857 | *Torr, William, *Aylesby Manor, Great Grimsby, Lincolnshire.* |
| 1845 | *Turner, George, *Brampford Speke, Exeter, Devonshire.* |
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| 1867 | *Webb, James, *Spring Hill, Fladbury, Pershore, Worcestershire.* |
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| 1866 | *Wilson, Lieut.-Col. Fuller Maitland, *Stowlangtoft Hall, Bury St. Edmund's, Suffolk.* |
| 1865 | *Wilson, Jacob, *Woodhorn Manor, Morpeth, Northumberland.* |
| 1855 | *Wynn, Sir Watkin Williams, Bt., M.P., *Wynnstay, Rhuabon, Denbighshire.* |

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* Those Members of Council whose names are prefixed by an astesisk retire by rotation in July, but are eligible for re-election in May.

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SHUTTLEWORTH, JOSEPH.
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TORR, WILLIAM.
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WILSON, JACOB.
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The STEWARDS.

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MILWARD, RICHARD.
SANDAY, WILLIAM.
SHUTTLEWORTH, JOSEPH.
THOMPSON, H. S.
TORR, WILLIAM.

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POWIS, Earl of.
BRIDPORT, Viscount.
LOPES, Sir MASSEY, Bart., M.P.
CLAYDEN, JOHN.
DAVIES, D. R.
DENT, J. D., M.P.
GIBBS, B. T. BRANDRETH.
HOLLAND ED.
KINGSCOTE, Col., M.P.
MILWARD, R.
RANDELL, CHARLES.
TORR, WILLIAM.
WELLS, WILLIAM, M.P.

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POWIS, Earl of.
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DENT, J. D., M.P.
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HOSKYNS, C. WREN, M.P.
KINGSCOTE, Col., M.P.
WELLS, WILLIAM, M.P.
VOELCKER, Dr.

## Cattle Plague Committee.

THE WHOLE COUNCIL.

*** The PRESIDENT, TRUSTEES, and VICE-PRESIDENTS are Members *ex officio* of all Committees.

# Royal Agricultural Society of England.

## GENERAL MEETING,

12, HANOVER SQUARE, THURSDAY, DECEMBER 8, 1870.

### REPORT OF THE COUNCIL.

THE Council of the Royal Agricultural Society of England in presenting their half-yearly Report, have to state that since the last General Meeting in May, 3 Governors and 30 Members have died, and the names of 62 Members have been removed from the list; on the other hand, 3 Governors and 172 Members have been elected, so that the Society now consists of

74 Life Governors,
74 Annual Governors,
1547 Life Members,
3899 Annual Members,
15 Honorary Members,

making a total of 5609.

Conformably with the provisions of the Charter, the Council have enacted the following Bye-law:—"Members who have paid their annual subscriptions for twenty years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single payment of 5*l.*"

The half-yearly statement of accounts to the 30th June, 1870, has been examined and approved by the auditors and accountants of the Society, and has been published for the information of the Members in the last number of the 'Journal.' The funded capital of the Society remains the same as at the last half-yearly Meeting, namely, the permanent fund of 20,000*l.* New Three per Cents, and the Reserve Show-fund of 4612*l.* 7*s.* 8*d.* New Three per Cents; but the deficiency in the Show-yard receipts at the Oxford Meeting entailed a cost to the Society of more than Two thousand pounds. On the 1st instant the actual balance of the current account at the London and Westminster Bank was 1535*l.* 14*s.* 6*d.*

Notwithstanding this pecuniary loss, the Council have reason to congratulate the Members of the Society on the result of their second Meeting at Oxford. The Entries of Implements, Cattle, Sheep, and Pigs, were more numerous than at any previous Meeting of the Society, while the quality of the animals exhibited in most classes reached the highest standard.

The most distinctive feature of the Oxford Meeting was the competition for the Farm-prizes offered by Mr. Mason and the Society for the two best-managed farms in the Oxfordshire district. The awards of the Judges were made known at the General Meeting of Members held in the Show-yard, and on their recommendation a third prize was added by the Society. The Report of the Competition, with descriptions of the Prize and Commended Farms, written by Mr. H. W. Keary, one of the Judges, has been published in the last number of the 'Journal.' The farming of every district has its strong and its weak points, and each season its peculiarities. To point out and record these seems a fitting object for the Society's efforts, and must offer valuable and instructive lessons to agriculturists generally. The Council are endeavouring to promote a continuation of these competitions by offering, in conjunction with the landowners of Shropshire and Staffordshire, similar prizes for the two best managed arable and dairy farms in a district to be hereafter determined upon in connection with the Wolverhampton Meeting.

The Council refer with satisfaction to the two numbers of the Society's 'Journal' published during the current year, which contain papers of more than ordinary interest. The Report on the Agriculture of Belgium especially calls for particular notice, as it is an able description of the rural economy of a country whose farming has been so frequently and so loosely described by agricultural writers, that a detailed and trustworthy account of the daily doings of Belgian farmers is a valuable addition to existing knowledge on the subject. It is very creditable to Mr. Jenkins that, in the short period which has elapsed since his appointment as Editor, he should have made himself sufficiently conversant with both the Science and Practice of Agriculture to be able to write a report of this high character.

In accordance with the Society's classification of Implements for trial at the Country Meetings, machinery suitable for steam cultivation will be tried at Wolverhampton. Keeping in view the increasing importance of steam-power as a means of good cultivation, and especially as a means of improving heavy land, the Council have extended and developed the scheme of prizes hitherto offered for Implements and sets of Tackle suitable for steam-cultivation. In order to meet, as far as possible, the requirements of every class of agriculturists, they have decided to offer prizes for the best combination of machinery for the cultivation of the soil by steam power, under three heads, viz., (1) without imposing any restrictions, (2) limiting the weight of the engine to 10 tons, and (3) stipulating that the combination of machinery can be worked by an ordinary farm-engine, whether locomotive or portable. The President of the Society has still further extended this scheme by offering a Silver Cup value 100*l.* for the best combination of machinery for the cultivation of the soil by Steam Power, the cost of which shall not exceed 700*l.*,—the Engine to be Locomotive, and adapted for threshing and other Farm-purposes. In this way the Council have endeavoured to include the whole subject so far as concerns the sets of Tackle; and in addition, with a view to render the result as complete as possible, they have decided to offer a special prize for the best implement of each description suitable for Steam Cultivation, viz., Windlass, Snatch-block or a substitute, Plough, Digger, Cultivator, Harrow, Roller, Drill, Skim-plough or Scarifier, Root or Stone Extractor, and Subsoiler. They also offer a Prize for the best Implement or part of tackle not qualified to compete under the foregoing heads, and for the best combination of any two or more of the above-mentioned implements, not qualified to compete for the general prizes. The Wolverhampton Prize-sheet further deals with the subject of Steam-traction, and prizes are offered for the best Agricultural Locomotive Engine applicable to the ordinary requirements of farming, and for the best Waggon for agricultural purposes to be drawn by the above-mentioned Engine. The Council have also decided to offer a series of Prizes for Implements and Machinery used in the cultivation and management of Hops.

The continued increase in the number of implements exhibited at the Country Meetings of the Society has again received the careful attention of the Council. They have decided that no exhibitor shall be allowed to enter duplicates of the same article, and that a maximum fine of 10 per cent. on the declared price shall be imposed for each article exhibited in breach of this rule; but that in no case shall the fine be less than 1*l.* They hope that this step will have the desired effect of preventing any unnecessary extension of the Exhibition without curtailing its usefulness or diminishing its interest.

The Regulations affecting the Awards of Medals to Miscellaneous Articles have also been revised, and it has been resolved that in future no Medal shall be awarded to any Implement included in the Quinquennial rotation which is not placed in the classes tried at that Meeting, nor to any Miscellaneous Article capable of trial until it has been subjected to such trial as the Stewards may direct.

The Council have received with much regret the resignation of Mr. C. E. Amos, the Consulting Engineer of the Society. In recording their high sense of the very valuable services which Mr. Amos has rendered to the Society during the twenty-three years that he has fulfilled the important duties of his office, they feel sure that they are expressing the general opinion of the Members of the Society.

In the Stock Prize-sheet for the Wolverhampton Meeting the Council have made further additions to the Prizes which have hitherto been offered for Live Stock. In particular, they have added a fourth Prize in the Classes of Shorthorn Bulls above one year old, but have somewhat reduced the amount of the first Prize; they have offered separate Prizes for the two breeds of Guernsey and Jersey Cattle; and they have decided to establish a series of Classes for Cheviot and other Mountain Sheep. In order to ensure the purity of blood of the Shorthorns exhibited at the Society's Country Meetings, it has been resolved "that each animal entered in the Shorthorn Classes shall be certified by the exhibitor to have not less than four crosses of Shorthorn blood which are registered in the Herd-book."

The Council have been requested by Her Majesty's Commissioners for the International Exhibition of 1871 to assist them in forming a collection of live specimens of the best breeds of animals whose wools are principally used in the Woollen and Worsted Manufactures, by recommending breeders of good examples of the different classes of Long-wool, Short-wool, Down, and Mountain Sheep. The Council have, therefore, placed in the hands of the Commissioners the Catalogue of Stock exhibited and the list of Stock-prizes awarded at the last three Country Meetings of the Society.

The Council have fixed the commencement of the Wolverhampton Meeting for Monday, the 10th of July. The arrangements for the arrival and departure of the Stock, and for the opening and closing of the Show-yard, remain the same as at Oxford; but as the Trials of Implements will be of an unusually extensive nature, it has been decided that they shall commence a fortnight before the Show instead of a week.

During the past half-year the Consulting Chemist of the Society has presented two Quarterly Reports on Manures and Feeding Stuffs forwarded to him for analysis by Members of the Society. These Reports, giving the names of the dealers and the analyses of the substances, are regularly published in the Agricultural Journals as well as in the Journal of the Society. This publication has produced some dissatisfaction on the part of vendors whose articles have been analysed; but the Council are prepared to defend their action in this matter, and believe that no part of their work is more valuable to agriculture than the analysis and exposure of inferior or adulterated manures and feeding stuffs. In several instances the dealers have made money compensation to the purchasers, and the Council regret that in some of these the purchasers have been unwilling to give up the names of the dealers, resting satisfied with the settlement made in their individual cases.

The variation in the quality of guano, as now imported, has been under the consideration of the Chemical Committee, and a communication has been addressed to Messrs. Thomson, Bonar, and Co., the agents of the Peruvian Government, suggesting that the Guano trade might be regulated by some standard-analysis, and that deductions from the price might be made according to the variations from such standard. Up to the present time, however, no satisfactory settlement of this matter has been suggested.

The Council have renewed the Education Grant for the year 1871, subject to the following alterations in the scheme which was tried this year:—

1. That the next examination shall commence on Tuesday, April 18, 1871.
2. That the forms of entry, duly filled up, together with a certificate of general education, must be forwarded to the Secretary by March 1, 1871.
3. That no candidate shall be eligible for the Society's Prizes who has completed his 21st year previous to the said March 1; but that any candidate, irrespective of age, may compete for the Society's certificates.
4. That the Prizes for aggregate merit, to be awarded to successful candidates who are eligible and are placed in the first-class, shall be:—1st Prize, 25*l.*; 2nd, 10*l.*; 3rd, 5*l.*

The Council have watched with apprehension the spread of Rinderpest on the Continent; but the establishment of waterside markets, the slaughter of cattle from the scheduled countries at the port of landing, and the inspection which the animals undergo before embarkation and after their arrival in this country, encourage them to hope that we may escape another outbreak of the Cattle-Plague in England.

By order of the Council,

H. M. Jenkins,

Secretary.

# MEMORANDA.

ADDRESS OF LETTERS.—The Society's office being situated in the postal district designated by the letter W, members in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

GENERAL MEETING in London, May 22nd, 1871, at 12 o'clock.

MEETING at Wolverhampton, in July, 1871.

GENERAL MEETING in London, in December, 1871.

MONTHLY COUNCIL (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council and Governors of the Society.

ADJOURNMENTS.—The Council adjourn over Passion and Easter weeks, when those weeks do not include the first Wednesday of the month; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to the first Wednesday in February.

OFFICE HOURS.—10 to 4. From the Council Meeting in August until the Council Meeting in April, on Saturdays, 10 to 2.

DISEASES of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society; and of sending animals to the Royal Veterinary College, on the same terms as if they were subscribers to the College.—(A statement of these privileges will be found in the Appendix.)

CHEMICAL ANALYSIS.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in the Appendix to the present volume.

SUBSCRIPTIONS.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10.

PAYMENTS.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the office of the Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin can be remitted by post, unless the letter be registered.

NEW MEMBERS.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

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:—One Halfpenny for every two ounces or fractional part of two ounces.

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*** 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.

MARCH, 1871.

## DISTRIBUTION OF MEMBERS OF THE SOCIETY AND OF MEMBERS OF COUNCIL.

| DISTRICTS. | COUNTIES. | NUMBER OF MEMBERS. | NUMBER IN COUNCIL. | MEMBERS OF COUNCIL. |
|---|---|---|---|---|
| A. | DURHAM .. .. .. | 97 .. | 1 | Hon. H. G. Liddell. |
| | NORTHUMBERLAND .. | 150 .. | 2 | M. White Ridley; Jacob Wilson. |
| | YORKSHIRE — NORTH AND EAST RIDINGS | 116 .. | 2 | Earl Cathcart, V.P.; T. C. Booth. |
| | | —— 363 | — 5 | |
| B. | CUMBERLAND .. .. | 99 .. | 1 | Sir H. R. Vane. |
| | LANCASHIRE .. .. | 217 .. | 3 | Duke of Devonshire, V.P.; Sir T. Hesketh; T. Statter. |
| | WESTMORELAND .. | 29 | | |
| | YORKSHIRE — WEST RIDING | 131 .. | 2 | H. S. Thompson, T.; J. D. Dent. |
| | | —— 476 | — 6 | |
| C | DERBYSHIRE .. .. | 60 .. | 1 | Lord Vernon, V.P. |
| | LEICESTERSHIRE .. | 134 .. | 3 | Lord Berners, T.; Duke of Rutland, T.; N. C. Stone. |
| | LINCOLNSHIRE .. .. | 185 .. | 5 | R. Hornsby; Lord Kesteven; J. Shuttleworth; W. Torr; W. Earle Welby. |
| | NORTHAMPTONSHIRE | 85 .. | | |
| | NOTTINGHAMSHIRE .. | 139 .. | 3 | The Speaker, T.; R. Milward; W. Sanday. |
| | RUTLANDSHIRE .. | 16 | | |
| | WARWICKSHIRE .. | 148 .. | 1 | J. Baldwin. |
| | | —— 767 | — 13 | |
| D. | BEDFORDSHIRE .. | 46 .. | 1 | C. Barnett. |
| | CAMBRIDGESHIRE .. | 59 | | |
| | ESSEX .. .. .. | 126 .. | 3 | S. Jonas, V.P; J. Clayden; Sir T. Western. |
| | HERTFORDSHIRE .. | 96 .. | 1 | J. B. Lawes. |
| | HUNTINGDONSHIRE .. | 33 .. | 1 | W. Wells. |
| | NORFOLK .. .. .. | 174 .. | 1 | Robert Leeds. |
| | SUFFOLK .. .. .. | 208 .. | 4 | Sir E. Kerrison, V.P.; N. G. Barthropp; R. C. Ransome; Lieutenant - Colonel Wilson. |
| | | —— 742 | — 11 | |

DISTRIBUTION OF MEMBERS OF THE SOCIETY—*continued.*

| Districts. | Counties. | Number of Members. | Number in Council. | Members of Council. |
|---|---|---|---|---|
| E. | Berkshire .. .. | 121 .. | 1 | Viscount Bridport, T. |
| | Buckinghamshire .. | 60 .. | 2 | Lord Chesham, T.; C. S. Cantrell. |
| | Hampshire .. .. | 154 .. | 2 | Viscount Eversley, V.P.; Sir A. Macdonald. |
| | Kent .. .. .. | 203 | 1 | C. Whitehead. |
| | Middlesex .. .. | 275 .. | 1 | B. T. Brandreth Gibbs. |
| | Oxfordshire .. .. | 162 .. | 2 | Duke of Marlborough, T.; J. Druce. |
| | Surrey .. .. .. | 134 .. | 2 | Colonel Challoner, T.; C. E. Amos. |
| | Sussex .. .. .. | 138 .. | 4 | Earl of Chichester, V.P.; Earl of Egmont, V.P.; Duke of Richmond, V.P.; W. Rigden. |
| | | —1247 | — 15 | |
| F. | Cornwall .. .. | 43 | | |
| | Devonshire .. .. | 112 .. | 4 | Sir T. Acland, T.; T. D. Acland; Sir M. Lopes; G. Turner. |
| | Dorsetshire .. .. | 71 .. | 1 | Lord Portman, T. |
| | Somersetshire .. | 120 .. | 1 | Sir W. Miles, V.P. |
| | Wiltshire .. .. | 92 .. | 1 | T. Pain. |
| | | — 438 | — 7 | |
| G. | Gloucestershire .. | 177 .. | 4 | E. Bowly; W. J. Edmonds, E. Holland; Col. Kingscote. |
| | Herefordshire .. | 102 .. | 2 | G. Clive; C. Wren Hoskyns. |
| | Monmouthshire .. | 43 .. | 1 | Lord Tredegar, T. |
| | Worcestershire .. | 142 .. | 2 | C. Randell; James Webb. |
| | South Wales .. .. | 77 | | |
| | | — 541 | — 9 | |
| H. | Cheshire... .. .. | 143 .. | 1 | D. R. Davies. |
| | Shropshire .. .. | 226 .. | 1 | Viscount Hill, V.P. |
| | Staffordshire .. | 207 .. | 2 | Earl of Lichfield; R. H. Masfen. |
| | North Wales .. | 108 .. | 2 | Earl of Powis, T.; Sir W. Wynn. |
| | | — 684 | — 6 | |
| Scotland .. .. .. .. .. .. | | 73 | | |
| Ireland .. .. .. .. .. .. | | 77 | | |
| Channel Islands .. .. .. | | 9 | | |
| Foreign Countries .. .. .. | | 69 | | |
| Members without addresses .. | | 76 | | |
| | | — 304 | | |

DR. HALF-YEARLY CASH ACCOUNT

| | £. s. d. | £. s. d. | £. s. d. |
|---|---|---|---|
| To Balance in hand, 1st July, 1870:— | | | |
| Bankers | 2308 9 3 | | |
| Secretary | 43 5 7 | | |
| | | 2,351 14 10 | |
| At Deposit with London and Westminster Bank | | 3,800 0 0 | |
| | | | 6,151 14 10 |
| To Income:— | | | |
| Dividends on Stock | | 363 0 8 | |
| Subscriptions:— | | | |
| Governors' Life-Compositions | 90 0 0 | | |
| Governors' Annual | 20 0 0 | | |
| Members' Life-Compositions | 340 0 0 | | |
| Members' Annual | 794 0 0 | | |
| | | 1,244 0 0 | |
| Interest on Deposit Account | | 61 11 9 | |
| Journal:—Sales | | 79 7 2 | |
| Farm Inspection:—Entry Fees | | 60 0 0 | |
| Sundries | | 6 9 0 | |
| Total Income | | .. .. | 1,814 8 7 |
| To Country Meetings:— | | | |
| Oxford | | .. .. | 7,218 1 1 |
| | | | £15,184 4 6 |

BALANCE-SHEET,

| LIABILITIES. | £ s. d. | £. s. d. | £. s. d. |
|---|---|---|---|
| To Capital:— | | | |
| Surplus, 30th June, 1870 | | 32,127 2 8 | |
| Less Surplus of Expenditure over Income during the Half-year:— | | | |
| Expenditure | 2,510 9 11 | | |
| Income | 1,814 8 7 | | |
| | | 696 1 4 | |
| | | | 31,431 1 4 |
| Less Oxford Meeting:— | | | |
| Difference between Receipts and Expenditure, the latter exceeding the former by | | .. .. | 2,365 10 1 |
| | | | £29,065 11 3 |

QUILTER, BALL, & Co., *Accountants.*

FROM 1ST JULY, TO 31ST DECEMBER, 1870. CR.

| | £. s. d. | £. s. d. | £. s. d. |
|---|---|---|---|
| By Expenditure:— | | | |
| Establishment:— | | | |
| Salaries and Wages .. .. .. .. | 449 18 0 | | |
| House Expenses, Rent, Taxes, &c. | 440 15 1 | | |
| | | 890 13 1 | |
| Journal:— | | | |
| Printing and Stitching .. .. | 441 4 7 | | |
| Postage and Delivery .. .. .. | 145 15 0 | | |
| Report on Scotland .. .. .. | 100 0 0 | | |
| Essays and Reports .. .. .. | 143 13 0 | | |
| Map .. .. .. .. .. .. | 34 0 0 | | |
| Woodcuts .. .. .. .. .. | 54 5 0 | | |
| Advertisements .. .. .. .. | 4 2 6 | | |
| | | 923 0 1 | |
| Chemical:— | | | |
| Consulting Chemist's Salary .. .. .. .. | | 150 0 0 | |
| Veterinary:— | | | |
| Grant to Royal Veterinary College (half-year) .. .. .. .. .. | 75 0 0 | | |
| Grant for Experiments .. .. | 25 0 0 | | |
| | | 100 0 0 | |
| Education .. .. .. .. .. .. .. .. .. | | 26 0 0 | |
| Advertisements .. .. .. .. .. .. .. | | 7 5 6 | |
| Postage and Carriage .. .. .. .. .. .. | | 19 2 2 | |
| Farm Inspection .. .. .. .. .. .. .. | | 354 16 4 | |
| Sundries .. .. .. .. .. .. .. .. .. | | 20 9 0 | |
| Outstanding Manchester account .. .. .. .. | | 19 3 9 | |
| Total Expenditure .. .. .. | | .. .. .. | 2,510 9 11 |
| By Country Meetings:— | | | |
| Oxford .. .. .. .. .. .. .. .. .. | | 11,239 16 5 | |
| Wolverhampton .. .. .. .. .. .. .. | | 201 16 11 | |
| | | | 11,441 13 4 |
| | | | 13,952 3 3 |
| By Balance in hand, 31st December:— | | | |
| Bankers .. .. .. .. .. .. .. .. .. | | 1179 19 0 | |
| Secretary .. .. .. .. .. .. .. .. .. | | 52 2 3 | |
| | | | 1,232 1 3 |
| | | | £15,184 4 6 |

31ST DECEMBER, 1870.

| ASSETS. | £. s. d. |
|---|---|
| By Cash in hand .. .. .. .. .. .. .. .. .. .. .. .. | 1,232 1 3 |
| By New 3 per Cent. Stock 24,612*l.* 7*s.* 8*d.* cost* .. .. .. .. .. .. | 23,379 15 7 |
| By Books and Furniture in Society's House .. .. .. .. .. .. | 1,451 17 6 |
| By Country Meeting Plant .. .. .. .. .. .. .. .. .. .. .. | 2,800 0 0 |
| By Wolverhampton Meeting, preliminary expenses .. .. .. .. .. | 201 16 11 |
| | £29,065 11 3 |

* *Value at* $91\frac{5}{8}$ = *£22,551 1s. 11d.*

*Mem.*—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 31st December, 1870, which at that date amounted to 894*l.*

Examined, audited, and found correct, this 13th day of February, 1871.

A. H. JOHNSON,
HENRY CANTRELL,
FRANCIS SHERBORN, } *Auditors on behalf of the Society.*

# ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

## Yearly Cash Account, from 1st January to 31st December, 1870.

**Dr.**

| | £. s. d. | £. s. d. | £. s. d. |
|---|---|---|---|
| To Balance in hand, 1st Jan. 1870:— | | | |
| Bankers | . . | 771 4 5 | |
| Secretary | . . | 41 5 4 | |
| At Deposit, London and Westminster Bank | | 2,000 0 0 | |
| | | | 2,812 9 9 |
| To Income, viz.:— | | | |
| Dividends on Stock | . . | 724 10 7 | |
| Interest on Deposit Account | . . | 61 11 9 | |
| Subscriptions:— | | | |
| Governors' Life-Compositions | 140 0 0 | | |
| Governors' Annual | 305 0 0 | | |
| Members' Life-Compositions | 940 0 0 | | |
| Members' Annual | 3,783 2 0 | | |
| | | 5,168 2 0 | |
| Journal:— | | | |
| Sales | 79 7 2 | | |
| Advertisements | 65 9 6 | | |
| | | 144 16 8 | |
| Farm-Inspection—Entry Fees | . . | 60 0 0 | |
| Sundries | . . | 6 9 0 | |
| Total Income | . . | | 6,165 10 0 |
| To Country Meetings:— | | | |
| Manchester | . . | 5 5 0 | |
| Oxford | . . | 12,118 2 7 | |
| | | | 12,123 7 7 |
| | | | £ 21,101 7 4 |

**Cr.**

| | £. s. d. | £. s. d. | £. s. d. |
|---|---|---|---|
| By Expenditure:— | | | |
| Establishment— | | | |
| Salaries and Wages | 900 12 0 | | |
| House Expenses, Rent, &c. | 1,016 19 0 | | |
| | | 1,917 11 0 | |
| Journal:— | | | |
| Printing and Stitching | 761 16 7 | | |
| Postage and Delivery | 297 0 0 | | |
| Essays and Reports | 231 0 0 | | |
| Report on Scotland | 100 0 0 | | |
| Maps | 73 10 6 | | |
| Engravings and Woodcuts | 75 15 0 | | |
| Advertisements | 11 0 0 | | |
| | | 1,550 2 1 | |
| Chemical:— | | | |
| Consulting Chemist's Salary | 300 0 0 | | |
| Grant for Investigations | 200 0 0 | | |
| | | 500 0 0 | |
| Veterinary:— | | | |
| Grant to Royal Veterinary College | 175 0 0 | | |
| Grant for Experiments | 25 0 0 | | |
| | | 200 0 0 | |
| Education | . . | 49 2 6 | |
| Advertisements | . . | 7 5 6 | |
| Postage and Carriage | . . | 62 4 0 | |
| Subscriptions (paid in error) returned | . . | 2 0 0 | |
| Sundries | . . | 20 9 0 | |
| Farm Inspection | . . | 354 16 4 | |
| Total Expenditure | . . | | 4,663 10 5 |
| By Country Meetings— | | | |
| Manchester | . . | 611 3 9 | |
| Oxford | . . | 14,392 15 0 | |
| Wolverhampton | . . | 201 16 11 | |
| | | | 15,205 15 8 |
| By Balance in hand, 31st Dec.:— | | | |
| Bankers | . . | 1,179 19 0 | |
| Secretary | . . | 52 2 3 | |
| | | | 1,232 1 3 |
| | | | £ 21,101 7 4 |

| Receipts. | £. | s. | d. |
|---|---|---|---|
| Subscription from Oxford | 1,800 | 0 | 0 |
| Admissions to Show Yard by Payment | 5,418 | 18 | 3 |
| Admissions by Season Tickets | 601 | 11 | 0 |
| Sale of Catalogues | 539 | 5 | 8 |
| Implement Exhibitors' Payments for Shedding | 1,908 | 6 | 0 |
| Non-Members' Fees for entry of Implements | 248 | 0 | 0 |
| Fees for entry of Live-Stock | 496 | 0 | 0 |
| Fees for Horse Boxes and Stalls | 167 | 0 | 0 |
| Premium for Supply of Refreshments | 595 | 0 | 0 |
| Cloak Room Receipts | 37 | 0 | 0 |
| Fines for Non-Exhibition of Live Stock | 26 | 10 | 0 |
| Fines for Non-Exhibition of Implements | 17 | 10 | 0 |
| Extra lines in Implement Catalogue | 37 | 5 | 0 |
| | 11,892 | 5 | 11 |
| Balance of Expenditure over Receipts | 2,504 | 4 | 8 |
| | £11,396 | 10 | 7 |

| Expenditure. | £. | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|
| Show Yard Works:—Carriage, Storage, taking to pieces, Packing and Insurance of the Permanent Buildings, and other Plant | 250 | 14 | 8 | | | |
| Implement Shedding, &c. | 1964 | 2 | 4 | | | |
| Stock Sheds, 685*l.* 17*s.* 11*d.*; Horse-boxes, 746*l.* 14*s.* 5*d.*; Hurdles, 255*l.* 18*s.* 9*d.* | 1638 | 11 | 1 | | | |
| Tent and Fittings, 52*l.* 12*s.* 6*d.*; Awnings, 90*l.* 13*s.* 6*d.*; Notice-boards, 18*l.* 11*s.* | 161 | 17 | 0 | | | |
| Outside and other Fencing, and General Works | 1350 | 15 | 4 | | | |
| Works in Trial Yard | 110 | 2 | 1 | | | |
| Surveyor | 188 | 8 | 0 | | | |
| | | | | 5,714 | 10 | 6 |
| Judges: Implements, 354*l.*; Stock, 430*l.* | | | | 784 | 0 | 0 |
| Consulting Engineer's Assistants | | | | 205 | 10 | 1 |
| Inspectors: Veterinary, 74*l.* 17*s.*; Shearing, 30*l.* | | | | 104 | 17 | 0 |
| Police: Metropolitan, 226*l.* 19*s.* 2*d.*; Oxford City, 8*l.* 10*s.* | | | | 235 | 9 | 2 |
| Clerks: Secretary, 31*l.* 2*s.*; Hon. Director, 46*l.* 13*s.* 10*d*; Bankers, 44*l.* 2*s.* | | | | 121 | 17 | 10 |
| Assistant Steward of Implements | | | | 34 | 13 | 0 |
| Foremen: Implements, 31*l.* 9*s.* 8*d.*; Stock-yard, 16*l.* 13*s.* 4*d.*; Cattle, 9*l.* 11*s.* 6*d.*; Horses, 20*l.* 18*s.* 6*d.*; Forage, 14*l.* 19*s.* | | | | 93 | 12 | 0 |
| Yardmen and Foragemen | | | | 217 | 10 | 0 |
| Index-Clerk and Money-takers, 52*l.* 16*s.* 9*d*; Money-changer and Door-keepers, 52*l.* 3*s.* 9*d.*; Cloak-room Attendants, 10*l.* 10*s.* | | | | 115 | 10 | 6 |
| Refreshments for Stewards, Judges, &c. | | | | 188 | 8 | 0 |
| Lodgings for ditto | | | | 189 | 10 | 6 |
| Catalogues: Implements, 329*l.* 1*s.*; Awards, 7*l.* 15*s.*: Stock, 108*l.* 8*s.*; Awards, 19*l.* 2*s.* 6*d.*; Plan of Yard, 20*l.*; Sellers, 36*l.* 17*s.* 6*d.*; Carriage and Packing, 16*l.* | | | | 537 | 4 | 0 |
| Printing Prize-sheets, Certificates, Admission-Orders, Tickets, Railway Papers, Circulars, Programmes, &c. | | | | 362 | 13 | 1 |
| Advertising and Bill-Posting | | | | 657 | 4 | 3 |
| Hay, 162*l.* 10*s.*; Straw, 184*l.*; Green Food, 500*l.*; Insurance, 1*l.* 3*s.* 3*d.* | | | | 847 | 13 | 3 |
| Postage, Carriage, Stationery, and Telegrams | | | | 124 | 14 | 8 |
| Repairs, Insurance, and Carriage of Testing Machines | | | | 173 | 14 | 9 |
| Hire of Steam Crane, 56*l.* 19*s.* 4*d.*; Hire of Engines, 17*l.* 17*s.* | | | | 74 | 16 | 4 |
| Horse Hire, 42*l.* 6*s.*; Hire of Conveyances for Stewards and Judges, 60*l.* 15*s.* 6*d.* | | | | 103 | 1 | 6 |
| Extra Land for Show-yard and Siding | | | | 131 | 17 | 6 |
| Fire-Engine Men | | | | 26 | 1 | 6 |
| Materials used at Trials of Implements | | | | 74 | 5 | 4 |
| Milk and Cream, &c., for Trials of Churns, 36*l.* 17*s.*; Dairy Women and Men assisting at Trials, 5*l.* 17*s.* | | | | 42 | 14 | 0 |
| Shorthand Writer, 6*l.* 10*s.* 8*d.*; Messenger, 2*l.* 2*s.*; Miller, 3*l.*; Gratuities to Post-office Clerk and Letter Carrier, 3*l.* 3*s.* | | | | 14 | 15 | 8 |
| Coals, 15*l.* 14*s.* 1*d.*; Brooms, Cords, Sacks, &c., 10*l.*; Shovels, Rakes, &c., 3*l.* 13*s.* 9*d.* | | | | 29 | 7 | 10 |
| Rosettes, 12*l.* 0*s.* 6*d.*; Sundries, 6*l.* 10*s.* 2*d.* | | | | 18 | 10 | 8 |
| Official Staff | | | | 29 | 7 | 8 |
| Prizes: Stock, 2,755*l.*; Implement, 370*l.*; Medals, 18*l.* | | | | 3,143 | 0 | 0 |
| | | | | £14,396 | 10 | 7 |

*March* 1, 1871,

BRIDPORT,

*Chairman of Finance Committee.*

# Wolverhampton Meeting, 1871:

## ON MONDAY THE 10TH OF JULY, AND FOUR FOLLOWING DAYS.

## SCHEDULE OF PRIZES.

### I.—LIVE-STOCK PRIZES.

SPECIAL PRIZES OFFERED FOR HORSES :—*Those marked* a, *by Arthur Bass, Esq., M.P.;* b, *H. Meynell-Ingram, Esq., M.P.;* c, *Captain Boughey, Major Thorneycroft, and Members of the Albrighton Hunt;* d, *T. M. Weguelin, Esq., M.P.;* e, *Henry Ward, Esq.;* f, *S. Loveridge, Esq.;* g, *C. F. Clark, Esq.;* h, *The Earl of Dartmouth;* i, *C. W. Lyon, Esq.;* k, *M. T. Bass, Esq., M.P.;* l, *Frank James, Esq.;* m, *T. J. Perry, Esq.;* n, *Sir Smith Child, Bart, M.P.;* o, *W. Perry Herrick, Esq.;* p, *W. T. C. Giffard, Esq.;* q, *C. Boycett Wright, Esq.;* r, *The Earl of Bradford;* The Wolverhampton Local Committee;* †, *The Staffordshire Agricultural Society.*

| Reference Number in Certificates. | HORSES. | First Prize. | Second Prize. | Third Prize. | Fourth Prize. |
|---|---|---|---|---|---|
| Class. | | £. | £. | £. | £. |
| 1 | Agricultural Stallion, foaled before 1st Jan. 1869, *not qualified to compete as Clydesdale or Suffolk* | 25 | 15 | 5 | .. |
| 2 | Agricultural Stallion, foaled in the year 1869, *not qualified to compete as Clydesdale or Suffolk* .. | 20 | 10 | 5 | .. |
| 3 | Clydesdale Stallion, foaled before the 1st Jan. 1869 | 25 | 15 | 5 | .. |
| 4 | Clydesdale Stallion, foaled in the year 1869 .. | 20 | 10 | 5 | .. |
| 5 | Suffolk Stallion, foaled before the 1st of Jan. 1869 | 25 | 15 | 5 | .. |
| 6 | Suffolk Stallion, foaled in the year 1869 .. .. | 20 | 10 | 5 | .. |
| 7 | Thorough-bred Stallion, suitable for getting hunters | 50 | 25 | 10 | .. |
| 8 | Stallion, above 14 hands but not exceeding 15 hands 2 inches, suitable for getting Hackneys .. | 20 | 10 | 5 | .. |
| 9 | Pony Stallion, not exceeding 14 hands .. .. | 15 | 10 | 5 | .. |
| 10 | Agricultural Mare, in foal, or with foal at foot, *not suitable to compete as Clydesdale or Suffolk* .. | 20 | 10 | 5 | .. |
| 11 | Clydesdale Mare, in foal, or with foal at foot .. | 20 | 10 | 5 | .. |
| 12 | Suffolk Mare, in foal, or with foal at foot .. .. | 20 | 10 | 5 | .. |
| 13 | Mare, in foal, or with foal at foot, suitable for breeding Hunters .. .. .. .. .. .. | 25 | 15 | 5 | .. |
| 14 | Mare, above 14 hands, but not exceeding 15 hands 1 inch, in foal, or with foal at foot, suitable for breeding Hackneys .. .. .. .. .. .. | 20 | 10 | 5 | .. |
| 15 | Pony Mare, not exceeding 14 hands .. .. .. | 10 | 5 | .. | .. |
| | *No Third Prize will be given unless at least Six animals be exhibited, except on the special recommendation of the Judges.* | | | | |

| Reference Number in Certificates. | HORSES—*continued.* | First Prize. | Second Prize. | Third Prize. | Fourth Prize. |
|---|---|---|---|---|---|
| Class. | | £. | £. | £. | £. |
| 16 | Hunter Gelding, three years old .. .. .. .. | a 20 | *15 | *10 | *5 |
| 17 | Hunter Filly, three years old .. .. .. .. | *20 | *15 | *10 | *5 |
| 18 | Hunter Gelding or Filly, four years old .. .. | b 30 | b 20 | b 10 | b 5 |
| 19 | Hunter, Mare or Gelding, up to not less than 15 stone .. .. .. .. .. .. .. .. .. | c 30 | c 20 | c 10 | c 5 |
| 20 | Hunter, Mare or Gelding, up to not less than 12 stone .. .. .. .. .. .. .. . .. | d 25 | e 15 | f 10 | g 5 |
| 21 | Carriage Horses or Mares, in pairs, under six years old .. .. .. .. .. .. .. .. .. .. | h 25 | h 15 | h 10 | .. |
| 22 | Brougham Horse or Mare, under six years old .. | h 20 | h 10 | h 5 | .. |
| 23 | Roadster, Mare or Gelding, above 14 hands 1 inch, and not exceeding 15 hands 1 inch .. .. .. | i 20 | *10 | *5 | .. |
| 24 | Roadster, Mare or Gelding, above 15 hands 1 inch | k 20 | k 10 | k 5 | .. |
| 25 | Cob, Mare or Gelding, above 13 hands, and not exceeding 14 hands 1 inch .. .. .. .. .. .. | *15 | l 10 | *5 | .. |
| 26 | Pony, not exceeding 13 hands .. .. .. .. | m 10 | *5 | .. | .. |
| 27 | Agricultural Filly, two years old, *not qualified to compete as Clydesdale or Suffolk* .. .. .. | 15 | 10 | 5 | .. |
| 28 | Clydesdale Filly, two years old .. .. .. .. | 15 | 10 | 5 | .. |
| 29 | Suffolk Filly, two years old .. .. .. .. .. | 15 | 10 | 5 | .. |
| 30 | Agricultural Pair of Geldings or Mares of any age | n 20 | o 10 | †5 | .. |
| 31 | Agricultural Pair of Geldings or Mares, four years old .. .. .. .. .. .. .. .. .. .. | p 20 | †10 | †5 | .. |
| 32 | Agricultural Pair of Geldings or Mares, three years old .. .. .. .. .. .. .. .. .. .. | q 20 | †10 | †5 | .. |
| 33 | Agricultural Gelding, three years old .. .. .. | r 10 | r 5 | .. | .. |
| 34 | Agricultural Gelding, two years old .. .. .. | †10 | †5 | .. | .. |
| 35 | Agricultural Gelding, yearling .. .. .. .. | †10 | †5 | .. | .. |

*No Third Prize will be given unless at least Six animals be exhibited, except on the special recommendation of the Judges.*

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## CATTLE,

(ALL AGES CALCULATED TO JULY 1ST, 1871).

### SHORTHORN.

| | | | | | |
|---|---|---|---|---|---|
| 36 | Bull, above three years old .. .. .. .. .. .. | 30 | 20 | 15 | 10 |
| 37 | Bull, above two and not exceeding three years old | 25 | 15 | 10 | 5 |
| 38 | Yearling Bull, above one and not exceeding two years old .. .. .. .. .. .. .. .. .. | 25 | 15 | 10 | 5 |

*No Third Prize will be given unless at least Six animals be exhibited, and in Classes* 19, 20, *and* 21 *no Fourth Prize will be given unless at least Ten animals be exhibited, except on the special recommendation of the Judges.*

| Reference Number in Certificates. | CATTLE—*continued.* | First Prize. | Second Prize. | Third Prize. |
|---|---|---|---|---|
| Class. | | £. | £. | £. |
| 39 | Bull-Calf, above six and not exceeding twelve months old .. .. .. .. .. .. .. .. | 15 | 10 | 5 |
| 40 | Cow, above three years old .. .. .. .. .. | 20 | 10 | 5 |
| 41 | Heifer, in-milk or in-calf, not exceeding three years old .. .. .. .. .. .. .. .. | 15 | 10 | 5 |
| 42 | Yearling Heifer, above one and not exceeding two years old .. .. .. .. .. .. .. .. | 15 | 10 | 5 |
| 43 | Heifer-Calf, above six and under twelve months old | 10 | 5 | .. |
| | HEREFORD. | | | |
| 44 | Bull, above three years old .. .. .. .. .. | 25 | 15 | 5 |
| 45 | Bull, above two and not exceeding three years old | 25 | 15 | 5 |
| 46 | Yearling Bull, above one and not exceeding two years old .. .. .. .. .. .. .. .. | 25 | 15 | 5 |
| 47 | Bull-Calf, above six and not exceeding twelve months old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 48 | Cow, above three years old .. .. .. .. .. | 20 | 10 | 5 |
| 49 | Heifer, in-milk or in-calf, not exceeding three years old .. .. .. .. .. .. .. .. | 15 | 10 | 5 |
| 50 | Yearling Heifer, above one and not exceeding two years old .. .. .. .. .. .. .. .. | 15 | 10 | 5 |
| 51 | Heifer-Calf, above six and under twelve months old | 10 | 5 | .. |
| | DEVON. | | | |
| 52 | Bull, above three years old .. .. .. .. .. | 25 | 15 | 5 |
| 53 | Bull, above two and not exceeding three years old | 25 | 15 | 5 |
| 54 | Yearling Bull, above one and not exceeding two years old .. .. .. .. .. .. .. .. | 25 | 15 | 5 |
| 55 | Bull-Calf, above six and not exceeding twelve months old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 56 | Cow, above three years old .. .. .. .. .. | 20 | 10 | 5 |
| 57 | Heifer, in-milk or in-calf not exceeding three years old .. .. .. .. .. .. .. .. | 15 | 10 | 5 |
| 58 | Yearling Heifer, above one and not exceeding two years old .. .. .. .. .. .. .. .. | 15 | 10 | 5 |
| 59 | Heifer-Calf, above six and under twelve months old | 10 | 5 | .. |
| | JERSEY. | | | |
| 60 | Bull, above one year old .. .. .. .. .. | 10 | 5 | .. |
| 61 | Cow, above three years old .. .. .. .. .. | 10 | 5 | .. |
| 62 | Heifer, in-milk or in-calf, not exceeding three years old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| | *No Second Prize will be given unless at least Six animals be exhibited, except on the special recommendation of the Judges.* | | | |

| Reference Number in Certificates. | CATTLE—*continued.* | First Prize. | Second Prize. | Third Prize. |
|---|---|---|---|---|
| Class. | GUERNSEY. | £. | £. | £. |
| 63 | Bull, above one year old .. .. .. .. .. .. | 10 | 5 | .. |
| 64 | Cow, above three years old .. .. .. .. .. | 10 | 5 | .. |
| 65 | Heifer, in-milk or in-calf, not exceeding three years old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| | NORFOLK AND SUFFOLK POLLED. | | | |
| 66 | Bull, above one year old .. .. .. .. .. .. | 10 | 5 | .. |
| 67 | Cow, above three years old .. .. .. .. .. | 10 | 5 | .. |
| 68 | Heifer, in-milk or in-calf, not exceeding three years old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| | OTHER ESTABLISHED BREEDS. | | | |
| | *Not including the Shorthorn, Hereford, Devon, Jersey, Guernsey, or Norfolk and Suffolk Polled Breeds.* | | | |
| 69 | Bull, above one year old .. .. .. .. .. | 10 | 5 | .. |
| 70 | Cow, above three years old .. .. .. .. .. | 10 | 5 | .. |
| 71 | Heifer, in-milk or in-calf, not exceeding three years old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| | DAIRY CATTLE. | | | |
| 72 | †Pair of Heifers, under three years and eight months old, in milk .. .. .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 73 | †Pair of Cows, over three years and eight months old, in milk .. .. .. .. .. .. .. | 20 | 10 | 5 |

† [*Special Prizes offered by the Staffordshire Agricultural Society. Members of that Society may compete for these Prizes on the same terms as Members of the Royal Agricultural Society.*]

*No Second Prize will be given unless at least Six animals be exhibited, except on the special recommendation of the Judges.*

| Reference Number in Certificates. | SHEEP. | First Prize. | Second Prize. | Third Prize. |
|---|---|---|---|---|
| Class. | **LEICESTER.** | £. | £. | £. |
| | SPECIAL PRIZES OFFERED FOR SHEEP:—*Those marked* a, *by the Earl of Shrewsbury;* b, *F. Monckton, Esq.;* c, *R. H. Masfen, Esq., and other breeders of Shropshire sheep;* †, *Staffordshire Agricultural Society.* | | | |
| 74 | Shearling Ram .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 75 | Ram of any other age .. .. .. .. .. .. | 20 | 10 | 5 |
| 76 | Pen of Five Shearling Ewes, of the same flock .. | 15 | 10 | 5 |
| | **COTSWOLD.** | | | |
| 77 | Shearling Ram .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 78 | Ram of any other age .. .. .. .. .. .. | 20 | 10 | 5 |
| 79 | Pen of Five Shearling Ewes, of the same flock .. | 15 | 10 | 5 |
| | **LINCOLNS.** | | | |
| 80 | Shearling Ram .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 81 | Ram of any other age .. .. .. .. .. .. | 20 | 10 | 5 |
| 82 | Pen of Five Shearling Ewes, of the same flock .. | 15 | 10 | 5 |
| | **OXFORDSHIRE DOWN.** | | | |
| 83 | Shearling Ram .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 84 | Ram of any other age .. .. .. .. .. .. | 20 | 10 | 5 |
| 85 | Pen of Five Shearling Ewes, of the same flock .. | 15 | 10 | 5 |
| | **RYLAND AND OTHER LONG-WOOLLED BREEDS.** | | | |
| | *Not qualified to compete as Leicester, Cotswold or Lincoln.* | | | |
| 86 | Shearling Ram .. .. .. .. .. .. .. | 15 | 5 | .. |
| 87 | Pen of Five Shearling Ewes, of the same flock .. | 10 | 5 | .. |
| | **SOUTHDOWN.** | | | |
| 88 | Shearling Ram .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 89 | Ram of any other age .. .. .. .. .. .. | 20 | 10 | 5 |
| 90 | Pen of Five Shearling Ewes, of the same flock .. | 15 | 10 | 5 |
| | *No Third Prize will be given unless at least Six animals be exhibited, except on the special recommendation of the Judges.* | | | |

| Reference Number in Certificates. | SHEEP—*continued.* | First Prize. | Second Prize. | Third Prize. |
|---|---|---|---|---|
| Class. | SHROPSHIRE. | £. | £. | £. |
| 91 | Shearling Ram .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 92 | Ram of any other age .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 93 | Pen of Five Shearling Ewes, of the same flock .. | 15 | 10 | 5 |
| 94 | Ten Shropshire ewes, having had lambs in 1871 | a 20 | * 10 | * 5 |
| 95 | Ten Shropshire ewe lambs .. .. .. .. .. .. | b 15 | b 10 | b 5 |
| 96 | Five Shropshire ram lambs .. .. .. .. .. .. | † 15 | † 10 | † 5 |
| | A Silver Cup (*c*), value £10, to the Exhibitor taking the greatest number of Prizes in all the Shropshire Classes. | | | |
| | *N.B.—In case two or more Exhibitors take an equal number of Prizes, the Cup will be awarded to the Exhibitor taking the greatest amount in value.* | | | |
| | HAMPSHIRE AND OTHER SHORT-WOOLLED BREEDS. | | | |
| | *Not qualified to compete as Southdown or Shropshire.* | | | |
| 97 | Shearling Ram .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 98 | Ram of any other age .. .. .. .. .. .. .. | 20 | 10 | 5 |
| 99 | Pen of Five Shearling Ewes, of the same flock .. | 15 | 10 | 5 |
| | DORSET. | | | |
| 100 | Shearling Ram .. .. .. .. .. .. .. | 15 | 5 | .. |
| 101 | Pen of Five Shearling Ewes .. .. .. .. .. | 10 | 5 | .. |
| | CHEVIOTS. | | | |
| 102 | Ram of any age .. .. .. .. .. .. .. | 15 | 5 | .. |
| 103 | Pen of five ewes of any age .. .. .. .. .. | 10 | 5 | .. |
| | MOUNTAIN SHEEP. | | | |
| | *Not qualified to compete as Cheviots.* | | | |
| 104 | Ram of any age .. .. .. .. .. .. .. | 15 | 5 | .. |
| 105 | Pen of five ewes of any age .. .. .. .. .. | 10 | 5 | .. |
| | *No Third Prize will be given in the Ram Classes unless at least Six animals be exhibited, nor in the Ewe Classes unless Six Pens be exhibited, except on the special recommendation of the Judges.* | | | |

| Reference Number in Certificates. | PIGS. | First Prize. | Second Prize. | Third Prize. |
|---|---|---|---|---|
| | **Large White Breed.** | | | |
| Class. | | £. | £. | £. |
| 106 | Boar, above twelve months old .. .. .. .. | 10 | 5 | .. |
| 107 | Boar, above six months and not exceeding twelve months old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 108 | Breeding Sow .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 109 | Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old .. .. | 10 | 5 | .. |
| | **Small White Breed.** | | | |
| 110 | Boar, above twelve months old .. .. .. .. | 10 | 5 | .. |
| 111 | Boar, above six months and not exceeding twelve months old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 112 | Breeding Sow .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 113 | Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old .. .. | 10 | 5 | .. |
| | **Small Black Breed.** | | | |
| 114 | Boar, above twelve months old .. .. .. .. | 10 | 5 | .. |
| 115 | Boar, above six months and not exceeding twelve months old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 116 | Breeding Sow .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 117 | Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old .. | 10 | 5 | .. |
| | **Berkshire Breed.** | | | |
| 118 | Boar, above twelve months old .. .. .. .. | 10 | 5 | .. |
| 119 | Boar, above six months and not exceeding twelve months old .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 120 | Breeding Sow .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 121 | Pen of three Breeding Sow-Pigs of the same litter, above four and under eight months old .. .. | 10 | 5 | .. |
| | **Other Breeds.** | | | |
| | *Not eligible to compete in any of the preceding Classes.* | | | |
| 122 | Boar .. .. .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 123 | Breeding Sow .. .. .. .. .. .. .. .. | 10 | 5 | .. |
| 124 | Pen of three Breeding-Sow Pigs of the same litter, above four and under eight months old .. .. | 10 | 5 | .. |

| | First Prize. | Second Prize. | Third Prize. | Fourth Prize. | Fifth Prize. |
|---|---|---|---|---|---|
| **WOOL.*** | £ | £ | £ | £ | £ |
| Special Prizes:—*Those marked* a, *by the Earl of Dartmouth*; b, *J. Hartley, Esq.*; c, *the Earl of Shrewsbury*; †, *the Staffordshire Agricultural Society.* | | | | | |
| Six Shropshire Fleeces .. .. .. .. .. | a 6 | a 5 | a 4 | a 3 | a 2 |
| **BUTTER.*** | | | | | |
| 6 lbs., to be made up in lbs. .. .. .. .. | b 6 | b 5 | b 4 | b 3 | b 2 |
| **CHEESE.*** | | | | | |
| (*The produce of* 1871.) | | | | | |
| Coloured, over 6 inches thick .. .. .. .. | † 15 | † 10 | † 5 | .. | .. |
| Coloured, under 6 inches thick .. .. .. | † 15 | † 10 | † 5 | .. | .. |
| Uncoloured, over 6 inches thick .. .. .. | † 15 | † 10 | † 5 | .. | .. |
| Uncoloured, under 6 inches thick .. .. .. | c 15 | c 10 | c 5 | .. | .. |
| *To the maker of the Prize Butter and Cheese in each Class .. .. .. .. .. .. .. .. | †3 | †2 | †1 | †1 | †1 |

* Members of the Royal Agricultural Society, and of the Staffordshire Agricultural Society, may compete for these Prizes, without payment, but Non-members of either Society must pay an Entrance-fee of Five Shillings on each Certificate.

## II.—Implement and Machinery Prizes offered by the Society.

### Section I.—Steam Cultivation.

Class £

1. For the best combination of Machinery for the cultivation of the soil by Steam-power .. .. .. .. .. .. .. .. 1st Prize 100
   Ditto ditto ditto ditto 2nd Prize 50
2. For the best combination of Machinery for the cultivation of the soil by Steam-power, the weight of the Steam-engine not to exceed 10 tons .. .. .. .. .. .. .. .. .. .. .. 1st Prize 50
   Ditto ditto ditto ditto 2nd Prize 25
3. For the best combination of Machinery for the cultivation of the soil by an ordinary Agricultural Engine, whether self-propelling or portable .. .. .. .. .. .. .. .. .. .. 1st Prize 50
   Ditto ditto ditto ditto 2nd Prize 25
4. For the best Windlass, detached .. .. .. .. .. .. .. .. 20
5. For the best Snatch-block, or substitute thereof.. .. .. .. .. 10
6. For the best Plough, suitable for Steam cultivation .. .. .. .. 25
7. For the best Subsoiler ditto ditto .. .. .. .. 20
8. For the best Digger ditto ditto .. .. .. .. 25
9. For the best Cultivator ditto ditto .. .. .. .. 25
10. For the best Skim-Plough or Scarifier ditto .. .. .. .. 20
11. For the best Roller ditto ditto .. .. .. .. 10
12. For the best Harrow ditto ditto .. .. .. .. 10
13. For the best Drill ditto ditto .. .. .. .. 20
14. For the best Root or Stone Extractor ditto .. .. .. .. 10
15. For the best combination of any of the above Implements not qualified to compete in Classes 1, 2, or 3 .. .. .. .. .. .. .. 20
16. For the best Implement, or part of Tackle, suitable for steam cultivation, of any other description, not qualified to compete in the preceding Classes .. .. .. .. .. .. .. .. .. .. .. 20
17. For the best Agricultural Locomotive Engine applicable to the ordinary requirements of farming .. .. .. .. .. .. .. 50
18. For the best Waggon for Agricultural purposes to be drawn by an Agricultural Locomotive Engine .. .. .. .. .. .. .. 20

A Silver Cup, value 100*l*., offered by the Right Hon. Lord Vernon, President, will be given for the best combination of Machinery for the cultivation of the soil by Steam-power, the cost of which shall not exceed 700*l*. The Engine to be Locomotive, and adapted for Threshing and other Farm purposes.

### Section II.—Hop Machinery.

1. For the best machine for the cultivation of Hop Gardens, to supersede manual labour .. .. .. .. .. .. .. .. .. .. .. .. 20
2. For the best machine for washing the Hop Plant to remove the Aphis blight .. .. .. .. .. .. .. .. .. .. .. .. 10
3. For the best Hop-Presser .. .. .. .. .. .. .. .. .. .. .. 10
4. For any other improved Implement or Implements used in the cultivation or management of Hops .. .. .. .. .. .. .. .. 10

### Miscellaneous.

Awards to Agricultural articles, and essential improvements therein
10 Silver Medals.

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In the Classes for which one Prize only is offered, the Judges will be empowered to divide it equally between two competing Implements, if they consider them equal in merit.

# CONDITIONS APPLYING TO CERTAIN CLASSES OF LIVE STOCK ONLY.

## Cattle.

1. No bull above two years old will be eligible for a prize unless certified to have served not less than three different cows (or heifers) within the three months preceding the 1st of June in the year of the Show.

2. All bulls above one year old shall have rings or "bull-dogs" in their noses, and be provided with leading sticks.

3. No cow will be eligible for a prize unless certified either at the date of entry or between the date of entry and that of the Show, to have had a live calf within the twelve months preceding the date of the Show.

4. No heifer, except yearlings, entered as in-calf, will be eligible for a prize unless she is certified to have been bulled before the 31st of March in the year of the Show, nor will her owner afterwards receive the prize until he shall have furnished the Secretary with a further certificate that she produced a live calf before the 31st of January in the subsequent year.

5. Shorthorns.—Each animal entered in the Shorthorn Classes, shall be certified by the Exhibitor to have not less than four crosses of Shorthorn blood which are registered in the herd book.

## Horses.

6. All foals must be the offspring of the mare along with which they are exhibited; and the sire of the foal must be given on the certificate of entry as well as sire of the mare.

7. No veterinary inspection of horses will be required except when considered necessary by the Judges, who will be accompanied by the Veterinary Inspectors.

8. A charge of 1*l.* for the accommodation of a horse-box will be made for each entry for stallions and mares in-foal, or with foals at foot, which includes hay, straw, and green fodder.

9. A charge of 10*s.* will be made for the accommodation of a stall for each entry in the other horse Classes, which includes hay, straw, and green fodder.

## Sheep.

10. All rams, except shearlings, must have been used in the present season.

11. Sheep exhibited for any of the prizes must have been *really and fairly shorn bare* after the 1st of April in the year of the Exhibition; and the date of such shearing must form part of the Certificate of Entry. Three Inspectors will be appointed by the Council to examine the sheep on their admission to the Show-Yard, with instructions to report to the Stewards any cases in which the sheep have not been *really and fairly shorn bare.*

## Pigs.

12. The three sow-pigs in each pen must be of the same litter.

13. The breeding sows in Classes 108, 112, 116, 120, and 123, shall be certified to have had a litter of live pigs within the six months preceding the Show, or to be in-pig at the time of entry, so as to produce a litter before the 1st of September following. In the case of in-pig sows, the prize will be withheld until the Exhibitor shall have furnished the Secretary with a certificate of farrowing, as above.

14. No sow, if above eighteen months old, that has not produced a litter of live pigs, shall be eligible to compete in any of the classes.

15. The Judges of pigs will be instructed, with the sanction of the Stewards, to withhold prizes from any animals which shall appear to them to have been entered in a wrong class.

16. All pigs exhibited at the country meetings of the Society shall be subjected to an examination of their mouths by the Veterinary Inspector of the Society; and should the state of dentition in any pig indicate that the age of the animal has not been correctly returned in the Certificate of Entry, the Stewards shall have power to disqualify such pig, and shall report the circumstance to the Council at its ensuing monthly meeting. No pig shall be oiled or coloured while in the Show-Yard.

17. If a litter of pigs be sent with a breeding sow, the young pigs must be the produce of the sow, and must not exceed two months old.

18. All disqualifications will be published in the awards of the Judges.

## RULES OF ADJUDICATION.

1. As the object of the Society in giving prizes for cattle, sheep, and pigs, is to promote improvement in *breeding* stock, the Judges in making their awards will be instructed not to take into their consideration the present value to the butcher of animals exhibited, but to decide according to their relative merits for the purpose of *breeding.*

2. If, in the opinion of the Judges, there should be equality of merit, they will be instructed to make a special report to the Council, who will decide on the award.

3. The Judges will be instructed to withhold any prize if they are of opinion that there is not sufficient merit in any of the stock exhibited for such prize to justify an award.

4. The Judges will be instructed to give in a *reserved number* in each class of live stock; viz., which animal would, in their opinion, possess sufficient merit for the prize, in case the animal to which the prize is awarded should subsequently become disqualified.

5. In the classes for stallions, mares, and fillies, the Judges in awarding the prizes will be instructed, in addition to symmetry, to take activity and strength into their consideration.

# CONDITIONS RELATING TO MACHINERY.

## Steam Engines.

All Engines must be fitted with a Steam-Indicator, in addition to the ordinary Spring Balance, which Indicator must be proved by the Indicator of the Society.

## Steam Cultivation.

1. The weight of the Engine shall be deemed to be exclusive of coal, water, and rope, but to include the weight of the drum or windlass.

2. The Implements for Steam Cultivation must be tested by dynamometer, if possible, and such experiments made as will enable the Judges to ascertain the relative value in usefulness of such Implements.

3. The Steam Boiler must be provided with a pipe or tube, the thread of which must be equal to the "half-inch gas-pipe thread," for the purpose of attaching the forcing pump of the Society. The Exhibitor may declare to work the Engine at any pressure he thinks fit, if the Judges are satisfied the Boiler would bear safely three times that pressure. The Boiler shall then be tested by the forcing pump to twice the pressure before the Engine is set to work, and the declared pressure must not be exceeded by the Exhibitor while he is working before the Judges.

4. Any Engine which is entered for competition, or for working in the the Yard of "Machinery-in-motion," which, from defect in construction or any other cause, is in the opinion of the Judges and Consulting Engineer, *unsafe*, shall not be allowed to work on the Society's premises: and further, the word *unsafe* shall be attached to the Engine during the remainder of the Exhibition.

5. The trials of the Steam-Engines will be made with Llangennech coal.

*** Forms of Certificate for entry, as well as Prize-Sheets for the Wolverhampton Meeting, containing the whole of the conditions and regulations, may be obtained at the Office of the Society, No. 12, Hanover Square, London, W.

# DATES OF ENTRY.

Certificates for the entry of Implements for the Wolverhampton Meeting must be forwarded to the Secretary of the Society, No. 12, Hanover Square, London (W.), by the 1st of May, and Certificates for the entry of Live Stock by the 1st of June. Certificates received after those respective dates will not be accepted, but returned to the persons by whom they have been sent.

The Prizes of the Royal Agricultural Society of England, and all Prizes offered by the Wolverhampton Local Committee, the Staffordshire Agricultural Society and private individuals, are open to general competition.

# Members' Privileges of Chemical Analysis.

**The Council have fixed the following rates of Charge for Analyses to be made by the Consulting Chemist for the *bonâ-fide* use of Members of the Society; who (to avoid all unnecessary correspondence) are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens, must be paid to him by members at the time of their application.**

No. 1.—An opinion of the genuineness of Peruvian guano, bone-dust, or oil-cake (each sample) .. .. .. .. .. **5s.**

" 2.—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts, and ammonia .. .. .. .. .. .. **10s.**

" 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 .. .. **10s.**

" 4.—An analysis of superphosphate of lime for soluble phosphates only .. .. .. .. .. .. **10s.**

" 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 .. .. .. .. .. .. .. **15s.**

" 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 **10s.** to **30s.**

" 14.—Determination of the "hardness" of a sample of water before and after boiling .. .. .. .. . **10s.**

" 15.—Analysis of water of land drainage, and of water used for irrigation .. .. .. .. .. .. .. **£2.**

" 16.—Determination of nitric acid in a sample of water .. .. **£1.**

N.B.—*The above Scale of Charges is not applicable to the case of persons commercially engaged in the Manufacture or Sale of any Substance sent for Analysis.*

☞ The Address of the Consulting Chemist of the Society is, Dr. Augustus Voelcker, 11, Salisbury Square, London, E.C., to which he requests that all letters and parcels (postage and carriage paid) should be directed.

By order of the Council,

H. M. JENKINS, *Secretary.*

# INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil silk, about 3 ozs. of the well-mixed sample, and send it to 11, SALISBURY SQUARE, FLEET STREET, E.C., by sample post: or place the mixed manure in a small wooden or tin box, which may be tied by string, but must not be sealed, and send it by sample post. If the manure be very wet and lumpy, a larger boxful, weighing from 12 to 15 ozs., should be sent either by sample post or railway.

There must be no writing or printing in the packet or its cover in addition to the address: DR. AUGUSTUS VOELCKER, 11, SALISBURY SQUARE, FLEET STREET, LONDON, E.C., and the address of the sender of the parcel, and the number or mark of the article sent.

These particulars must in all cases be given not on loose pieces of paper but on small labels attached to the samples or packages containing them.

The samples must be sent in covers, open at the ends or in boxes, bags of linen or other materials, which may be fastened by string, but must not be sealed, so as to be easily examined. No parcel sent by sample post must exceed 1½ lb. in weight, or 2 feet in length, or 1 foot in width or depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel train to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 ozs., should be sent enclosed in small linen bags, or wrapped in paper.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by sample post. The piece should weigh from 12 to 15 ozs. If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 ozs. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by sample post.

On forwarding samples, separate letters should be sent by post to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

H. M. JENKINS, *Secretary.*

# Members' Veterinary Privileges.

### I.—Serious or Extensive Diseases.

No. 1. Any Member of the Society who may desire professional attendance and special advice in cases of serious or extensive disease among his cattle, sheep, or pigs, and will address a letter to the Secretary, will, by return of post, receive a reply stating whether it be considered necessary that Professor Simonds, the Society's Veterinary Inspector, should visit the place where the disease prevails.

No. 2. The remuneration of the Inspector will be 2*l.* 2*s.* each day as a professional fee, and 1*l.* 1*s.* each day for personal expenses; and he will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. The fees will be paid by the Society, but the travelling expenses will be a charge against the applicant. This charge may, however, be reduced or remitted altogether at the discretion of the Council, on such step being recommended to them by the Veterinary Committee.

No. 3. The Inspector, on his return from visiting the diseased stock, will report to the Committee, in writing, the results of his observations and proceedings, which Report will be laid before the Council.

No. 4. When contingencies arise to prevent a personal discharge of the duties confided to the Inspector, he may, subject to the approval of the Committee, name some competent professional person to act in his stead, who shall receive the same rates of remuneration.

### II.—Ordinary or Other Cases of Disease.

Members may obtain the attendance of the Veterinary Inspector on any case of disease by paying the cost of his visit, which will be at the following rate, viz., 2*l.* 2*s.* per diem, and travelling expenses.

### III.—Consultations without visit.

| | |
|---|---|
| Personal consultation with Veterinary Inspector .. .. | 5*s.* |
| Consultation by letter .. .. .. .. .. .. | 5*s.* |
| Consultation necessitating the writing of three or more letters. | 10*s.* |
| Post-mortem examination, and report thereon .. .. .. | 10*s.* |

A return of the number of applications during each half-year being required from the Veterinary Inspector.

### IV.—Admission of Diseased Animals to the Veterinary College Investigations, Lectures, and Reports.

No. 1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the same terms as if they were Members of the College; viz., by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs "a small proportionate charge to be fixed by the Principal according to circumstances."

No. 2. The College has also undertaken to investigate such particular classes of disease, or special subjects connected with the application of the Veterinary art to cattle, sheep, and pigs, as may be directed by the Council.

No. 3. In addition to the increased number of lectures now given by Professor Simonds—the Lecturer on Cattle Pathology—to the pupils in the Royal Veterinary College, he will also deliver such lectures before the Members of the Society, at their house in Hanover Square, as the Council shall decide.

No. 4. The Royal Veterinary College will from time to time furnish to the Council a detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary.

By order of the Council,

H. M. JENKINS, *Secretary.*

# Royal Agricultural Society of England.

1871.


## President.

SIR WATKIN W. WYNN, Bart., M.P.

## Trustees.

| Year when Elected. | |
|---|---|
| 1857 | Bridport, Viscount, *Cumberland Lodge, Windsor, Berkshire.* |
| 1839 | Challoner, Colonel, *Portnall Park, Staines, Middlesex.* |
| 1850 | Chesham, Lord, *Latimer, Chesham, Bucks.* |
| 1860 | Marlborough, Duke of, K.G., *Blenheim Park, Oxford.* |
| 1839 | Portman, Lord, *Bryanston, Blandford, Dorset.* |
| 1856 | Powis, Earl of, *Powis Castle, Welshpool, Montgomeryshire.* |
| 1858 | Rutland, Duke of, K.G., *Belvoir Castle, Grantham, Leicestershire.* |
| 1848 | Speaker, The Rt. Hon. the, *Ossington, Newark-on-Trent, Notts.* |
| 1839 | Thompson, Harry Stephen, *Kirby Hall, York.* |
| 1839 | Tredegar, Lord, *Tredegar Park, Newport, Monmouthshire.* |

## Vice-Presidents.

| | |
|---|---|
| 1861 | Cathcart, Earl, *Thornton-le-Street, Thirsk, Yorkshire.* |
| 1839 | Chichester, Earl of, *Stanmer Park, Lewes, Sussex.* |
| 1867 | Devonshire, Duke of, K.G., *Holker Hall, Lancashire.* |
| 1847 | Egmont, Earl of, *Cowdray Park, Petworth, Sussex.* |
| 1847 | Eversley, Viscount, *Heckfield Place, Winchfield, Hants.* |
| 1848 | Gibbs, B. T. Brandreth, *Halfmoon Street, Piccadilly, London,* W. |
| 1847 | Hill, Viscount, *Hawkstone Park, Salop.* |
| 1858 | Kerrison, Sir Edward C., Bart., *Brome Hall, Scole, Suffolk.* |
| 1839 | Miles, Sir William, Bart., *Leigh Court, Bristol, Somersetshire.* |
| 1852 | Richmond, Duke of, K.G., *Goodwood, Chichester, Sussex.* |
| 1859 | Vernon, Lord, *Sudbury Hall, Derby.* |
| 1855 | Wynn, Sir Watkin Williams, Bt., M.P., *Wynnstay, Rhuabon, Denbighshire.* |

## Other Members of Council.

| | |
|---|---|
| 1855 | Acland, Sir Thomas Dyke, Bart., M.P., *Sprydoncote, Exeter, Devonshire.* |
| 1858 | Amos, Charles Edwards, 5, *Cedars Road, Clapham Common, Surrey.* |
| 1867 | Baldwin, John, *Luddington, Stratford-on-Avon, Warwickshire.* |
| 1848 | Barnett, Charles, *Stratton Park, Biggleswade, Bedfordshire.* |
| 1853 | Barthropp, Nathaniel George, *Hacheston, Wickham Market, Suffolk.* |
| 1868 | Booth, Thomas Christopher, *Warlaby, Northallerton, Yorkshire.* |
| 1863 | Bowly, Edward, *Siddington House, Cirencester, Gloucestershire.* |
| 1861 | Cantrell, Charles S., *Riding Court, Datchet, Bucks.* |
| 1865 | Clive, George, *Perrystone, Ross, Herefordshire.* |
| 1866 | Davies, David Reynolds, *High Legh Hall, Knutsford, Cheshire.* |
| 1861 | Dent, J. D., M.P., *Ribston Hall, Wetherby, Yorkshire.* |
| 1860 | Druce, Joseph, *Eynsham, Oxford.* |
| 1868 | Edmonds, William John, *Southrop, Lechlade, Gloucestershire.* |

| Year when Elected. | |
|---|---|
| 1869 | HESKETH, Sir THOMAS, Bart., M.P., *Rufford Hall, Ormskirk, Lancashire.* |
| 1861 | HOLLAND, EDWARD, *Dumbleton Hall, Evesham, Gloucestershire.* |
| 1866 | HORNSBY, RICHARD, *Spittle Gate, Grantham, Lincolnshire.* |
| 1854 | HOSKYNS, CHANDOS WREN, M.P., *Harewood, Ross, Herefordshire.* |
| 1871 | JONES, J. BOWEN. *Ensdon House, Shrewsbury, Salop.* |
| 1867 | KESTEVEN, Lord, *Caswick, Stamford, Lincolnshire.* |
| 1863 | KINGSCOTE, Colonel, M.P., *Kingscote, Wootton-under-Edge, Gloucestershire.* |
| 1848 | LAWES, JOHN BENNET, *Rothamsted, St. Albans, Herts.* |
| 1869 | LEEDS, ROBERT, *Wicken Farm, Castleacre, Brandon, Norfolk.* |
| 1868 | LICHFIELD, Earl of, *Shugborough, Staffordshire.* |
| 1867 | LIDDELL, Hon. HENRY GEORGE, M.P., *Ravensworth Castle, Durham.* |
| 1865 | LOPES, Sir MASSEY, Bart., M.P., *Maristow, Roborough, Devon.* |
| 1854 | MACDONALD, Sir ARCHIBALD KEPPEL, Bt., *Woolmer Lodge, Liphook, Hants.* |
| 1871 | MASFEN, R. HANBURY, *Pendeford, Wolverhampton, Staffordshire.* |
| 1846 | MILWARD, RICHARD, *Thurgarton Priory, Southwell, Notts.* |
| 1857 | PAIN, THOMAS, *The Grove, Basingstoke, Hants.* |
| 1861 | RANDELL, CHARLES, *Chadbury, Evesham, Worcestershire.* |
| 1868 | RANSOME, ROBERT CHARLES, *Ipswich, Suffolk.* |
| 1869 | RIDLEY, M. WHITE, M.P., *Blagdon, Cramlington, Northumberland.* |
| 1862 | RIGDEN, WILLIAM, *Hove, Brighton, Sussex.* |
| 1861 | SANDAY, WILLIAM, *Radcliffe-on-Trent, Notts.* |
| 1856 | SHUTTLEWORTH, JOSEPH, *Hartsholme Hall, Lincoln.* |
| 1869 | STATTER, THOMAS, *Stand Hill, Whitefield, Manchester, Lancashire.* |
| 1867 | STONE, N. CHAMBERLAIN, *Aylestone Hall, Leicester.* |
| 1857 | TORR, WILLIAM, *Aylesby Manor, Great Grimsby, Lincolnshire.* |
| 1845 | TURNER, GEORGE, *Brampford Speke, Exeter, Devonshire.* |
| 1871 | TURNER, JABEZ, *Haddon, Huntingdonshire.* |
| 1871 | WAKEFIELD, WILLIAM H., *Kendal, Westmoreland.* |
| 1867 | WEBB, JAMES, *Spring Hill, Fladbury, Pershore, Worcestershire.* |
| 1870 | WELBY, WILLIAM EARLE, M.P., *Newton House, Folkingham, Lincolnshire.* |
| 1871 | WELLS, JOHN, *Booth Ferry, Howden, Yorkshire.* |
| 1861 | WELLS, WILLIAM, M.P., *Holmewood, Peterborough, Northamptonshire.* |
| 1870 | WHITEHEAD, CHARLES, *Barming House, Maidstone, Kent.* |
| 1866 | WILSON, Lieut.-Col. FULLER MAITLAND, *Stowlangtoft Hall, Bury St. Edmund's, Suffolk.* |
| 1865 | WILSON, JACOB, *Woodhorn Manor, Morpeth, Northumberland.* |

## Secretary and Editor.

H. M. JENKINS, 12, *Hanover Square, London,* **W.**

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*Consulting Chemist*—Dr. AUGUSTUS VOELCKER, F.R.S., 11, *Salisbury Square,* **E.C.**
*Consulting Botanist*—W. CARRUTHERS, F.R.S., F.L.S., *British Museum,* **W.C.**
*Veterinary Inspector*—JAMES BEART SIMONDS, *Royal Veterinary College,* **N.W.**
*Consulting Engineers*—EASTONS, AMOS & ANDERSON, *The Grove, Southwark St.,* **S.E.**
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# STANDING COMMITTEES FOR 1871.

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TORR, WILLIAM.

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DENT, J. D., M.P.
DRUCE, JOSEPH.
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PAIN, THOMAS.
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SANDAY, WM.
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Druce, Joseph.
Edmonds, W. J.
Gibbs, B. T. Brandreth.
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Welby, W. Earle, M.P.
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Powis, Earl of.
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Barnett, C.
Booth, T. C.
Bowly, Edward.
Cantrell, Charles S.
Davies, D. R.
Druce, Joseph.
Edmonds, W. J.
Gibbs, B. T. Brandreth.
Hornsby, Richard.
Hoskyns, C. Wren, M.P.
Kingscote, Col., M.P.
Leeds, Robert.
Masfen, R. H.
Milward, Richard.
Randell, Charles.
Ransome, R. C.
Ridley, M. W., M.P.
Sanday, William.
Shuttleworth, Joseph.
Torr, William.
Webb, James.
Wells, William, M.P.
Whitehead, Charles.
Wilson, Lieut.-Col.
Wilson, Jacob.
The Stewards.

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Gibbs, B. T. Brandreth.
Hornsby, Richard.
Milward, Richard.
Sanday, William.
Shuttleworth, Joseph.
Thompson, H. S.
Torr, William.

## Committee of Selection.

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Powis, Earl of.
Bridport, Viscount.
Lopes, Sir Massey, Bart., M.P.
Davies, D. R.
Dent, J. D., M.P.
Gibbs, B. T. Brandreth.
Holland Ed.
Kingscote, Col., M.P.
Milward, R.
Randell, Charles.
Torr, William.
Wells, William, M.P.

And the Chairmen of the Standing Committees.

## Education Committee.

Holland, E. (Chairman).
Lichfield, Earl of.
Powis, Earl of.
Bridport, Viscount.
Acland, Sir T. Dyke, Bart., M.P.
Dent, J. D., M.P.
Hoskyns, C. Wren, M.P.
Kingscote, Col., M.P.
Wells, William, M.P.
Voelcker, Dr.

## Cattle Plague Committee.

The whole Council.

*** The President, Trustees, and Vice-Presidents are Members *ex officio* of all Committees.

# Royal Agricultural Society of England.

## GENERAL MEETING,

12, Hanover Square, Monday, May 22, 1871.

### REPORT OF THE COUNCIL.

The Council of the Royal Agricultural Society of England in presenting their half-yearly Report, have to state that since the last General Meeting in December, 3 Governors and 37 Members have died, and the names of 132 Members have been removed from the list; on the other hand, 1 Governor and 210 Members have been elected, so that the Society now consists of

72 Life Governors,
74 Annual Governors,
1589 Life Members,
3896 Annual Members,
17 Honorary Members,

making a total of 5648.

The accounts for the year 1870 have been examined and certified by the auditors and accountants of the Society, and have been published, together with the Oxford Country Meeting account, in the last number of the Journal. The Council refer with satisfaction to these documents as showing the prosperous condition of the finances, notwithstanding the large and increasing sum annually spent in furthering the objects for which the Society was founded.

The ordinary income of the Society for the year 1870 exceeded the expenditure by 1501*l.* 19*s.* 7*d.*; but the show-yard receipts at Oxford fell short of the expenses by 2504*l.* 4*s.* 8*d.*, leaving a net deficiency on the year of 1002*l.* 5*s.* 1*d.* The funded capital of the Society remains the same as at the last half-yearly meeting, namely, the permanent fund of 20,000*l.* New Three per Cents., and the Reserve Show-fund of 4612*l.* 7*s.* 8*d.* New Three per

Cents. In addition, the sum of 2000*l.* lies on deposit with the Society's bankers, and the balance of the current account, on the 1st instant, was 3362*l.* 7*s.* 3*d.*, both these sums being available for defraying the expenses of the Wolverhampton Meeting.

During the past half-year the Council have sustained a heavy loss by the death of their valued colleague Lord Walsingham, a vice-president of the Society; and they have also received, with much regret, the resignation of Mr. T. W. Bramston, as trustee, and of Mr. W. Hassall, as Member of Council. The vacancies thus created have been filled up by the election of Major-General Viscount Bridport as trustee in the room of Mr. Bramston; by the election as vice-president of Lord Vernon in the room of the late Lord Walsingham, and of Sir Watkin W. Wynn, Bart., in the room of Viscount Bridport; and by the election of the following Members of Council:—Mr. R. H. Masfen, of Pendeford, Wolverhampton, in the room of Mr. W. Hassall; and Mr. J. Wells, of Booth Ferry, Howden, in the place of Lord Vernon.

Mr. Juhlin-Dannfelt, Superintendent of the Experimental Farm and Agricultural College at Stockholm, has been elected an Honorary Member of the Society.

The Wolverhampton Local Committee are making every exertion to promote the success of the Country Meeting, and have added to the Society's list, prizes for Hunters and Roadsters, also for Carriage and Agricultural Horses, as well as for Dairy Cattle, for extra classes of Shropshire Sheep, and for Wool, Butter, and Cheese, amounting in all to upwards of 1000*l.*

The Farm Prize competition in connection with the Wolverhampton Meeting promises to equal in interest that of last year. The conditions of competition have not been varied more than was required by the addition of Dairy Prizes, but some of the regulations have been more clearly defined than they were previously. It has been decided that competing arable farms must be not less than 200 acres in extent, and that the dairy farms be those on which not less than 20 cows are kept, and which are chiefly devoted to dairy purposes, including the sale of milk, either to towns or cheese factories. It has also been decided that every competitor must enter all the land in his occupation within the area of competition; and that a tenant-farmer, in order to be eligible to compete for the prizes offered, must pay a *bonâ fide* rent for at least three-fourths of the land which he occupies. Twenty-three arable and four dairy farms have been entered; and it is hoped that the awards of the Judges may be made known, as on the last occasion, at the General Meeting of Members held in the Show-yard.

The Council having considered in what manner they could best recognize the long services of Mr. Amos as a Consulting Engineer to the Society, and, being desirous that he might still assist the Council with his advice, have appointed him Honorary Consulting Engineer to the Society; they have also presented him with the vote of thanks of the Council engrossed on vellum, and accompanied by the Society's gold medal.

The alteration in the Engineering staff of the Society, consequent on the retirement of Mr. Amos, has received the careful attention of the Council, and they have resolved that as the original appointment of Consulting Engineers was the firm of Messrs. Easton and Amos, the responsibility of carrying on the business of the Society remains with the existing firm, viz., Messrs. Eastons, Amos, and Anderson.

The arrangements now in force for supplying the Members of the Society with veterinary information, and with reports on diseases amongst cattle or other live stock, have also been discussed by the Council, with a view of ascertaining whether these arrangements may with advantage be modified.

The original purposes of the grant made by this Society to the Royal Veterinary College were twofold :—

First: to advance veterinary science by means of the instruction afforded to students at the College.

Second: to enable Members of this Society to obtain the best assistance and advice in case of the outbreak of disease amongst their stock.

In addition to these primary objects the Society hoped to present to its Members in general, information on veterinary science, by means of lectures, reports on cases treated, and on measures to be adopted to prevent disease.

The first of these objects has scarcely been so satisfactorily performed as could be wished; the number of veterinary surgeons who have gone out from the College, and become established in the country, have not so full a knowledge of the treatment of the diseases of cattle, sheep, and pigs as to give confidence to their employers, though thoroughly competent as far as treatment of horses is concerned, and generally possessing a higher standard of scientific education than their predecessors.

Neither has the second object been satisfactorily attained. Members of the Society do not apply to the Veterinary Inspector in cases of disease so much as they might do, and complain that it is not easy in these cases to obtain the professional advice which they require.

Further than this, the Society does not receive from the College, or its Professors, the current information on diseases, or the suggestions for their cure and prevention which the Council think ought to be at their service.

They have therefore decided that the conditions on which the grant should be made, shall be as follows:—

That the grant to the College shall be specially devoted to the advancement of veterinary science as applied to the diseases of cattle, sheep, and pigs.

That it is desirable that the Governors of the Veterinary College should appoint an efficient assistant to the Professor of Cattle Pathology, in order that he may more satisfactorily attend to the applications of Members of the Society; and by lectures and practical treatment of cattle diseases at the College give more thorough instruction to the students on these subjects; and further, that the Professor should present to the Council quarterly reports on matters connected with diseases of cattle, sheep, and pigs, and on any question of veterinary science which may be of interest to agriculturalists.

A deputation of the Governors of the Royal Veterinary College has therefore been invited to meet the Veterinary Committee of the Council, to discuss the measures which have been considered necessary to be adopted, in order to render the cattle Department of the Royal Veterinary College really efficient.

The Council have noted with great satisfaction that the Members of the Society avail themselves of their chemical privileges in increasing numbers; and they have been much gratified at the general testimony as to the value of Dr. Voelcker's Quarterly Reports on inferior and adulterated manures and feeding stuffs. Were other evidence wanting, the fact that the Council of the Royal Agricultural Society of Ireland have deter mined to adopt the same course would be sufficient to indicate that these reports are considered of great value by the agricultural community.

The case of Bradburn *v.* The Royal Agricultural Society is expected to be tried during the month of June in Westminster.

Four out of nine candidates who had entered their names for competition presented themselves for examination for the Society's Educational Prizes and Certificate. Of these, three were under the age of 21.

Mr. G. P. Smith, of the Royal Agricultural College, Cirencester, passed an excellent examination in the Science and Practice of Agriculture and in Book-keeping, and he is also entitled to the prizes for Chemistry and Land Surveying. Mr. H. G. Ohrly, also of the Royal Agricultural College, Cirencester, being over age, does not receive a prize, although he stands first for Geology.

One candidate only entered for Anatomy and Animal Physiology, and the examiner did not think him worthy of a prize. Three candidates entered for Botany, and all failed.

The result of the examination is that:—

Mr. Smith becomes a Life Member of the Society, and obtains a first-class certificate, the first prize 25*l.*, and the following prizes for proficiency in special subjects:—

| | |
|---|---|
| Science and Practice of Agriculture .. .. .. | 10*l.* |
| Chemistry .. .. .. .. .. .. .. .. .. .. .. | 10 |
| Book-keeping .. .. .. .. .. .. .. .. .. .. | 10 |
| Land Surveying .. .. .. .. .. .. .. .. | 5 |

Mr. Ohrly gains a first-class certificate and becomes a Life Member of the Society.

Mr. T. S. Minton obtains a second-class certificate.

The Council cannot but express their regret that more candidates have not come forward for the prize offered, and that out of the number entered more than half did not present themselves for examination.

By order of the Council,

H. M. Jenkins,

Secretary.

Dr. HALF-YEARLY CASH ACCOUNT

| | £. | s. | d. | £. | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|---|---|---|
| To Balance in hand, 1st Jan., 1871:— | | | | | | | | | |
| Bankers | | | | 1,179 | 19 | 0 | | | |
| Secretary | | | | 52 | 2 | 3 | | | |
| | | | | | | | 1,232 | 1 | 3 |
| To Income:— | | | | | | | | | |
| Dividends on Stock | | | | 363 | 0 | 8 | | | |
| Subscriptions:— | | | | | | | | | |
| Governor's Life-Composition | 40 | 0 | 0 | | | | | | |
| Governors' Annual | 260 | 0 | 0 | | | | | | |
| Members' Life-Compositions | 610 | 0 | 0 | | | | | | |
| Members' Annual | 2,943 | 18 | 0 | | | | | | |
| | | | | 3,853 | 18 | 0 | | | |
| Journal:— | | | | | | | | | |
| Sales | 52 | 0 | 11 | | | | | | |
| Advertisements | 44 | 2 | 6 | | | | | | |
| | | | | 96 | 3 | 5 | | | |
| Sundries | | | | 4 | 4 | 0 | | | |
| Farm Inspection:— | | | | | | | | | |
| Entry Fees | | | | 64 | 0 | 0 | | | |
| Oxford Meeting | | | | 3 | 4 | 5 | | | |
| Total Income | | | | 4,384 | 10 | 6 | | | |
| To Wolverhampton Meeting | | | | 4,792 | 11 | 10 | | | |
| | | | | | | | 9,177 | 2 | 4 |
| | | | | | | | £10,409 | 3 | 7 |

BALANCE-SHEET,

| LIABILITIES. | £ | s. | d. | £. | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|---|---|---|
| To Capital:— | | | | | | | | | |
| Surplus, 31st December, 1870 | | | | 29,065 | 11 | 3 | | | |
| Surplus of Income over Expenditure during the Half-year:— | | | | | | | | | |
| Income | 4,384 | 10 | 6 | | | | | | |
| Expenditure | 2,352 | 13 | 6 | | | | | | |
| | | | | 2,031 | 17 | 0 | | | |
| | | | | | | | £31,097 | 8 | 3 |

QUILTER, BALL, & Co., *Accountants.*

FROM 1ST JANUARY TO 30TH JUNE, 1871. CR.

| | £. s. d. | £. s. d. | £. s. d. |
|---|---|---|---|
| By Expenditure:— | | | |
| Establishment:— | | | |
| Salaries and Wages .. .. .. .. | 459 18 0 | | |
| House Expenses, Rent, Taxes, &c. | 416 1 9 | | |
| | | 875 19 9 | |
| Journal:— | | | |
| Printing and Stitching .. .. | 358 6 0 | | |
| Postage and Delivery .. .. .. | 111 2 0 | | |
| Essays and other Contributions | 101 3 0 | | |
| Map of New Forest .. .. .. .. | 30 0 0 | | |
| Woodcuts .. .. .. .. .. .. .. | 44 10 0 | | |
| Advertisements .. .. .. .. .. | 9 0 0 | | |
| | | 654 1 0 | |
| Chemical:— | | | |
| Consulting Chemist's Salary .. | 150 0 0 | | |
| Grant for Investigations .. .. | 200 0 0 | | |
| | | 350 0 0 | |
| Veterinary:— | | | |
| Grant to Royal Veterinary College (half-year) | | 75 0 0 | |
| Education .. .. .. .. .. .. .. .. .. .. | | 113 18 6 | |
| Postage and Carriage .. .. .. .. .. .. .. | | 42 11 11 | |
| Advertisements .. .. .. .. .. .. .. .. | | 12 3 6 | |
| Stock:— | | | |
| Expense of Transfer to New Trustee .. .. | | 3 14 3 | |
| Subscriptions paid in error returned .. .. .. | | 2 0 0 | |
| Sundries:— | | | |
| Gold Medal for Mr. Amos .. .. | 18 13 0 | | |
| Expenses of Inspection Committee | 17 8 10 | | |
| Outstanding Plymouth Account | 10 14 8 | | |
| | | 46 16 6 | |
| Farm Inspection:— | | | |
| Advertising, &c. .. .. .. .. .. .. .. .. | | 34 16 9 | |
| Oxford Meeting .. .. .. .. .. .. .. .. | | 141 11 4 | |
| Total Expenditure .. .. .. | | .. .. .. | 2,352 13 6 |
| By Wolverhampton Meeting .. .. .. .. .. .. | | .. .. .. | 3,592 17 5 |
| | | | 5,945 10 11 |
| By Balance in hand, 30th June:— | | | |
| Bankers .. .. .. .. .. .. .. .. | 2448 12 11 | | |
| Secretary .. .. .. .. .. .. | 14 19 9 | | |
| | | 2,463 12 8 | |
| At Deposit with London and Westminster Bank | | 2,000 0 0 | |
| | | | 4,463 12 8 |
| | | | £10,409 3 7 |

30TH JUNE, 1871.

| ASSETS. | £. s. d. |
|---|---|
| By Cash in hand .. .. .. .. .. .. .. .. .. .. .. .. | 2,463 12 8 |
| By Deposit Account .. .. .. .. .. .. .. .. .. .. .. .. | 2,000 0 0 |
| By New 3 per Cent. Stock 24,612*l.* 7*s.* 8*d.* cost* .. .. .. .. .. | 23,379 15 7 |
| By Books and Furniture in Society's House .. .. .. .. .. | 1,451 17 6 |
| By Country Meeting Plant .. .. .. .. .. .. .. .. .. .. | 2,800 0 0 |
| | 32,095 5 9 |
| Less at Credit of Wolverhampton Meeting .. .. .. .. .. .. .. | 997 17 6 |
| | £31,097 8 3 |

* *Value at* $92\frac{1}{4}$ = £22,704 18*s.* $5\frac{1}{2}$*d.*

*Mem.*—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 30th June, 1871, which at that date amounted to 1915*l.*

Examined, audited, and found correct, this 21st day of August, 1871.

A. H. JOHNSON,
FRANCIS SHERBORN,
HENRY CANTRELL, } *Auditors on behalf of the Society.*

# SHOW AT WOLVERHAMPTON,

## JULY, 1871.

### STEWARDS OF THE YARD.

**Stock.**

JACOB WILSON,
SIR WATKIN W. WYNN, BART., M.P.
RICHARD MILWARD,

**Implements.**

LIEUT.-COL. F. M. WILSON.
C. WREN HOSKYNS, M.P.
W. J. EDMONDS.

**Forage.**

R. H. MASFEN.

**Honorary Director of the Show.**

B. T. BRANDRETH GIBBS.

### JUDGES OF STOCK.

**HORSES.**

The Hon. G. E. LASCELLES,
N. G. BARTHROPP,
J. E. BENNETT,
A. L. MAYNARD,
J. H. WOOD,
D. WRIGHT.

**CATTLE.**

**Shorthorns.**

G. BLAND,
W. PARKER,
J. ROBINSON.

**Herefords and other Established Breeds.**

H. HAYWOOD,
W. TAYLOR.

**Devons and Norfolk and Suffolk Polled.**

S. P. NEWBURY,
THOMAS POPE.

**Jersey, Guernsey, and Dairy Cattle.**

C. P. LE CORNU,
HENRY TAIT.

**SHEEP.**

**Leicesters.**

R. FISHER,
T. POTTER,
T. H. SIMPKIN.

**Cotswolds and Oxfordshire Downs.**

R. GARNE,
R. J. NEWTON.

**Lincolns and Rylands and other Long-woolled Breeds.**

C. CLARKE,
J. GREETHAM.

**Southdowns, Hampshires, Dorsets, and other Short Wools.**

H. FOOKES,
J. S. TURNER.

**Shropshires.**

B. BOND,
W. KEMP BOURNE,
R. H. MASFEN.

## JUDGES OF STOCK—*continued.*

### SHEEP—*continued.*

**Cheviots and Mountain Sheep.**

J. IRVING,
R. SHORTREED.

**PIGS.**

J. ANGUS,
H. AYLMER,
J. SMITH.

**Inspectors of Shearing.**

W. B. CANNING, W. JOBSON, J. B. WORKMAN,

**Veterinary Inspectors.**

PROFESSOR SIMONDS, PROFESSOR VARNELL.

*Assistant*—R. L. HUNT.

## JUDGES OF BUTTER AND CHEESE.

W. CLARK, J. ROBINSON, J. WATSON.

## JUDGE OF WOOL.

JASON GURNEY.

## JUDGES OF IMPLEMENTS.

**Steam Cultivating Machinery.**

F. J. BRAMWELL, C.E.
W. MENELAUS, C.E.
Major H. V. GRANTHAM,
JOHN HEMSLEY,
F. SHERBORN.

**Separate Implements for Steam Cultivation.**

JOHN HICKEN,
J. W. KIMBER.

**Hop Machinery and Miscellaneous.**

H. B. CALDWELL,
C. WHITEHEAD.

## FARM JUDGES.

G. JACKSON, W. SANDAY, J. WHEATLEY.

# AWARD OF PRIZES.

NOTE.—The Judges were instructed, besides awarding the Prizes, to designate as the *Reserve Number* one animal in each Class, next in order of merit, if it possessed sufficient for a Prize—in case an animal to which a Prize was awarded should subsequently become disqualified.

*Local Prizes are marked thus* (*).

## HORSES.

### *Agricultural Stallions foaled before the 1st of January,* 1869.

WILLIAM WELCHER, Mouse Hall, West Tofts, Brandon, Norfolk: FIRST PRIZE, 25*l*., for "Honest Tom," bay, 6 years-old; bred by himself; sire, Tibbet's "Thumper;" dam, "Beauty;" sire of dam, "Emperor."

JOHN MANNING, Orlingbury, Wellingborough: SECOND PRIZE, 15*l*., for "Young Champion," chestnut, 4 years-old; bred by Mr. Stokes, Caldecot, Rockingham; sire, "Champion."

COATES SHARPLEY, Kelston Hall, Louth, Lincolnshire: THIRD PRIZE, 5*l*., for "Le Bon," bay, 3 years-old; bred by Mr. T. Fullard, Thorney, Peterborough; sire, "Wonder;" sire of dam, "Thumper."

THE REV. JOHN HITCHCOCK, Chitterne All Saints, Heytesbury, Wilts: the *Reserve Number*, to "Lion," iron grey, 5 years-old; bred by Mr. H. Hitchcock, Chitterne All Saints; sire, "Champion;" dam, "Smart;" sire of dam, "Lion."

### *Agricultural Stallions—Two Years Old.*

THOMAS CORFIELD, Cardington, Church Stretton, Salop: FIRST PRIZE, 20*l*. for "The Shropshire Friend," bright bay; bred by himself; sire, "Farmer's Friend;" dam, "Darling."

LAWRENCE ASHCROFT, Maudesley, Ormskirk, Lancashire: SECOND PRIZE, 10*l*., for "John Bull," bright bay; bred by himself; sire, "The British Ensign;" dam, "Lofty;" sire of dam, "John Bull."

GEORGE STREET, Mauldon, Ampthill, Bedfordshire: THIRD PRIZE, 5*l*., for "Captain," brown; bred by himself; sire, "Young Britain;" dam, "Star;" sire of dam, "Golden Ball."

JAMES PERKIN, Manstey Farm, Penkridge, Staffordshire: the *Reserve Number* to "Young Prince," dark bay; bred by Mr. Heath, Harvington Birch, Brewood, Staffs.

### *Clydesdale Stallions foaled before the 1st of January,* 1869.

HENRY TOMLINSON, Blithford, Rugeley, Staffordshire: FIRST PRIZE, 25*l*., for "Young Lofty," bay, 10 years-old; bred by Mr. J. Clarke, Mansurrae, Killarchan, N.B.

LIEUT.-COLONEL R. LOYD LINDSAY, M.P., Lockinge Park, Wantage, Berks: SECOND PRIZE, 15*l.*, for "Prince Albert," bay, 3 years-old; bred by Mr. Snodgrass, Clochkeil, Campbeltown, Argyleshire.

MATTHEW REED, Beamish Burn, Chester-le-Street, Durham: THIRD PRIZE, 5*l.*, for "Wellington," brown, 6 years-old; bred by Mr. H. West, Kilbride, N.B.

### *Suffolk Stallions foaled before the* 1*st of January*, 1869.

RICHARD GARRET, of Carleton Hall, Saxmundham, Suffolk: FIRST PRIZE, 25*l.*, for "Cupbearer," chestnut, 7 years-old; bred by Mrs. Sargent, Marlesford, Wickham Market; sire, Crisp's "Conqueror;" sire of dam, Crisp's "Prince."

GEORGE DAVID BADHAM, The Lawn, Bulmer, Sudbury, Suffolk: SECOND PRIZE, 15*l.*, for "Hercules," chestnut, 6 years-old; bred by himself; sire, "Royal George;" dam, "Duchess:" sire of dam, "Chester Emperor."

WILLIAM WILSON, Baylham Hall, Ipswich: THIRD PRIZE, 5*l.*, for "Bismarck," chestnut, 3 years-old; bred by Mr. C. Cordy, Trimley, Ipswich; sire, "Monarch;" sire of dam, "Canterbury Pilgrim."

THE STONETROUGH COLLIERY COMPANY, Ramsdell Hall, Lawton, Cheshire: the *Reserve Number*, to "Harwich Emperor," chestnut, 10 years-old; bred by Mr. I. Rist, Tattingstone, Ipswich; sire, "Chester Emperor."

### *Suffolk Stallions—Two Years Old.*

LIEUT.-COLONEL FULLER MAITLAND WILSON, Stowlangtoft Hall, Bury St. Edmund's, Suffolk: FIRST PRIZE, 20*l.*, for "Heir Apparent," chestnut; bred by Mr. S. Wolton, Newbourn, Woodbridge; sire, "Monarch;" dam, "Victoria."

GEORGE DAVID DADHAM, The Lawn, Bulmer, Sudbury, Suffolk: SECOND PRIZE, 10*l.*, for "Emperor," chestnut; bred by Mr. Taylor, Earl's Colne, Halstead, Essex: sire, "Great Eastern;" sire of dam, "Heart of Oak."

JAMES ALGERNON PIGOT, Beckingham Hall, Witham, Essex: the *Reserve Number*, to "Patriot," chestnut; bred by himself; sire, Mr. J. Ward's "Young May Duke;" dam, "Tulip;" sire of dam, "Heart of Oak."

### *Thoroughbred Stallions, suitable for getting Hunters.*

JOSEPH CASSON, Burgh-by-Sands, Carlisle, Cumberland: FIRST PRIZE, 50*l.*, for "Sincerity," brown, 13 years-old; bred by Lord Naas; sire, "Red Hart;" dam, "Integrity;" sire of dam, "Van Tromp."

JOHN WATSON, Waresley, Hartlebury, Kidderminster, Worcestershire: SECOND PRIZE, 25*l.*, for "Blinkhoolie," bay, black legs, 7 years-old; bred by Mr. W. I'Anson, Spring Cottage, Malton, Yorkshire; sire, "Rataplan;" dam, "Queen Mary;" sire of dam, "Gladiator."

W. TAYLOR SHARPE, Baumber Park, Horncastle, Lincolnshire: THIRD PRIZE, 10*l.*, for "Suffolk," bay, 6 years-old; bred by Baron Rothschild, Mentmore, Bucks; sire, "North Lincoln;" dam, "Protection;" sire of dam, "Defence."

CHARLES and JAMES MOFFAT, Kirklinton Park, Carlisle: the *Reserve Number*, to "Laughing Stock," bay, 13 years-old; bred by Sir Charles Monk, Bart., Belsea Castle, Newcastle-on-Tyne; sire, "Stockwell;" dam, "Gaiety;" sire of dam, "Touchstone."

*Stallions, above* 14 *hands, but not exceeding* 15 *hands* 2 *inches, suitable for getting Hackneys.*

JAMES LOCKHART, Culmington, Bromfield, Salop: FIRST PRIZE, 20*l.*, for "Dick Turpin," dark bay, black legs, 4 years-old; bred by himself; sire, "Prescription;" dam, "Peggy;" sire of dam, "Topsail."

BENJAMIN MITCHELL, Sen., Crome Hall, Downham Market, Norfolk: SECOND PRIZE, 10*l.*, for "Fireaway the Second," chestnut, 3 years-old; bred by himself; sire, "Fireaway the First;" dam, "Rattler;" sire of dam, "Harkaway."

HENRY BULTITAFT, Bedwellhay Grange, Ely, Cambridgeshire: THIRD PRIZE, 5*l.*, for "Cleartheway," roan, 8 years-old; bred by Mr. Phypers, Cottenham, Cambridgeshire; sire, "Phenomenon;" sire of dam, "Shales."

CHARLES BEARTS, Stow Bardolph, Downham Market, Norfolk: the *Reserve Number*, to "Ambition," red roan, 8 years-old; bred by himself; sire, "Phenomenon;" sire of dam, "Performer."

*Pony Stallions, not exceeding* 14 *hands.*

HENRY ROUNDELL, Otley, Yorkshire: FIRST PRIZE, 15*l.*, for "Sir George," brown, 4 years-old: bred by Mr. W. Walker, Shadwell, Leeds; sire, "Sportsman."

CHARLES GROUCOCK, Stanfield Hall, Wymondham, Norfolk: SECOND PRIZE, 10*l.*, for "King Arthur," chestnut, aged, breeder unknown; sire, "Arthur."

WILLIAM DEW, Wellfield House, Bangor, Carnarvonshire: the *Reserve Number*, to "Llewelyn," brown, 2 years-old; bred by himself; sire, "The Hadji;" sire of dam, "Tom Steele."

*Agricultural Mares in foal, or with foal at foot.*

HENRY OVERMAN, Weasenham, Brandon, Norfolk: FIRST PRIZE, 20*l.*, for "Diamond," black, 10 years-old (in foal); bred by Mr. S. Thompson, Skipwith, Selby; sire, "Black Douglas."

EDMUND CROWE, Denver, Downham Market, Norfolk: SECOND PRIZE, 10*l.*, for "Smart," bay, 9 years-old (in foal to "Honest Tom"); bred by Mr. J. Betts, Downham Market.

WILLIAM WELCHER, Mouse Hall, West Tofts, Brandon, Norfolk: THIRD PRIZE, 5*l.*, for "Beauty," bay, 11 years-old (in foal); bred by Mr. R. Fitzjohn, March, Cambridgeshire; sire, "Emperor;" dam, "Smiler."

WILLIAM THOMAS LAMB, Welbourne, Grantham, Lincolnshire: the *Reserve Number*, to "Beauty," 8 years-old, bay (in foal), bred by Mr. J. C. Southern, Sutterton, Spalding; sire, Nutt's "Matchless."

*Clydesdale Mares, in foal or with foal at foot.*

THOMAS STATTER, Jun., Stand Hall, Whitefield, Manchester: FIRST PRIZE, 20*l.*, for "Princess," bay, 7 years-old (and foal by "Dundonald"); breeder unknown.

GEORGE HEAD HEAD, Rickerby, Carlisle, Cumberland: SECOND PRIZE, for "Deborah," dark bay, 4 years-old (in foal); bred by Mr. W. Sproat, Borness, Kirkcudbright, N. B.; sire, "Champion;" dam, "Jenny;" sire of dam, "Old Champion."

LIEUT.-COLONEL ROBERT LOYD LINDSAY, M.P., Lockinge Park, Wantage, Berks: the *Reserve Number*, to "Polly," dark bay, 8 years-old (in foal); breeder unknown.

*Suffolk Mares, in foal or with foal at foot.*

THE EXECUTORS of the late Thomas Capon, Dennington, Wickham Market, Suffolk: FIRST PRIZE, 20*l.*, for "Matchit," chestnut, 7 years-old (and foal by "Boxer"); bred by the executors; sire, Crisp's "Conqueror."

LIEUT.-COLONEL FULLER MAITLAND WILSON, Stowlangtoft Hall, Bury St. Edmund's, Suffolk: SECOND PRIZE, 10*l.* for "Bury Empress," chestnut, 5 years-old (in foal); bred by Mr. Frost, Stoke, Colchester; sire, "Harwich Emperor;" dam, "Darby;" sire of dam, "Britton."

HORACE WOLTON, Newbourn Hall, Woodbridge, Suffolk: THIRD PRIZE, 5*l.*, for "Diamond," chestnut, 6 years-old (in foal); bred by Mr. S. Wolton, Newbourn Hall; sire, "Wolton's Warrior;" dam, "Butley Abbey;" sire of dam, Catlin's "Royal Duke."

*Mares in foal, or with foal at foot, suitable for breeding Hunters.*

THOMAS HORROCKS MILLER, Singleton, Poulton-le-Fylde, Lancashire: FIRST PRIZE, 25*l.*, for "Lady Emily," brown (and foal); age and breeder unknown; sire, "Faugh-a-Ballagh;" dam, "Lunatic."

JOSEPH CLARKE, Beeston, Leeds: SECOND PRIZE, 15*l.*, for "Lady Byron," chestnut, 18 years-old (and foal by "Neptunus"); bred by Mr. J. Byron, Kirkby Green, Sleaford.

LEONARD LYWOOD, High Downs, Bridgnorth, Salop: THIRD PRIZE, 5*l.* for "Jassy," chestnut, aged (and foal by "Oreste"); breeder unknown; sire, "Voivode;" dam, "Lady Avon;" sire of dam, "Cossack."

JOHN THOMAS ROBINSON, Leckby Palace, Thirsk, Yorkshire: the *Reserve Number*, to "Go-a-head," dark bay, 13 years-old (and foal by "Ceylon"); breeder unknown; sire, "Sir William."

*Mares, above* 14 *hands, but not exceeding* 15 *hands* 1 *inch, in foal, or with foal at foot, suitable for breeding Hackneys.*

HENRY OVERMAN, Weasenham, Brandon, Norfolk: FIRST PRIZE, 20*l.*, for "Jenny Lind," chestnut, aged (and foal by Tice's "Prickwillow"); breeder unknown.

THOMAS TONES, Cross Lane Head, Bridgnorth, Salop: SECOND PRIZE, 10*l.*, for "Judy," grey, aged (and foal by "Balarnock"); breeder unknown; sire, "Little Tom."

THOMAS LATHAM, Little Wittenham, Abingdon, Berks: the *Reserve Number*, to "Miss Dodson," chestnut, about 20 years-old (and foal by "Young Hero"); breeder unknown.

*Pony Mares not exceeding* 14 *hands.*

WILLIAM COATES, Scarborough Farm, Winchcombe: FIRST PRIZE, 10*l.*, for "Kitey," chestnut, 5 years-old; bred by himself; sire, "Douglas."

RICHARD MILWARD, Thurgarton Priory, Southwell, Notts: SECOND PRIZE, 5*l.*, for "Brighteyes," bay, 4 years-old; breeder unknown.

GEORGE STOKES, Camp Farm, Kingsbury, Atherstone, Warwickshire: the *Reserve Number*, to "Polly," bay, 7 years-old; breeder unknown.

### *Hunter Geldings—Three Years Old.

WILLIAM ARMSTRONG, Kendal, Westmoreland: FIRST PRIZE, 20*l*., for "Banker," bay; bred by Mr. W. H. Wakefield, Prizet, Kendal; sire, "Best Returns;" dam, "Fanny;" sire of dam, "Emperor."

SIR WILFRID LAWSON, Bart., M.P., Brayton, Carlisle, Cumberland: SECOND PRIZE, 15*l*., for his brown; bred by himself; sire, "Judge;" dam, "Matty;" sire of dam, "British Yeoman."

GEORGE J. MITCHELL, Newton Mount, Burton-on-Trent, Staffordshire: THIRD PRIZE, 10*l*., for "Fenian," chestnut; breeder unknown.

CHARLES COOK, Taddington, Winchcombe, Gloucestershire: FOURTH PRIZE, 5*l*., for "The Admiral," iron-grey; bred by Mr. Sumner; sire, "Sharper."

GEORGE B. KEELING, Hampton House, Penkridge, Staffordshire: the *Reserve Number*, to "The Dean," bay, bred by himself; sire, "Balarnock;" dam, "Princess;" sire of dam, "King Cole."

### *Hunter Fillies—Three Years Old.

JAMES MOFFAT, Kirklinton Park, Carlisle, Cumberland: FIRST PRIZE, 20*l*., for "Luna," chestnut; bred by Mrs. Bogue, Westward Parks, Wigton; sire, "Laughing Stock;" sire of dam, "Charly Boy."

EDWARD PHILIMORE, Prestbury Park Farm, Cheltenham: SECOND PRIZE, 15*l*., for his chestnut; breeder unknown; sire, "Life Boat;" dam, "Lygonia;" sire of dam, "Pantaloon."

JOHN B. BOOTH, Killerby Hall, Catterick, Yorkshire: THIRD PRIZE, 10*l*., for "Duckling," bay; bred by Mr. J. Fielden, Dobroyd Castle, Todmorden; sire, "The Drake;" dam, "Beckey Sharpe:" sire of dam, "Sharston."

CHARLES BYRD, Littywood, Staffordshire: FOURTH PRIZE, 5*l*., for "Theodora," dark brown; bred by himself; sire, "Balarnock;" dam, "Lively Lassie;" sire of dam, "Monarch."

The STONETROUGH COLLIERY COMPANY, Ramsdell Hall, Lawton, Cheshire: the *Reserve Number*, to "Alice Grey," grey; bred by exhibitors; sire, "Solferino;" dam, "Star;" sire of dam, "Prime Minister."

### *Hunter Geldings or Fillies—Four Years old.

FREDERICK BARLOW, of Hasketon, Woodbridge, Suffolk: FIRST PRIZE, 30*l*., for "Tregothnan," brown gelding; bred by Lord Falmouth, Tregothnan, Truro; sire, "The Seneschal;" dam, "Madam."

FREDERICK BARLOW, Hasketon, Woodbridge: SECOND PRIZE, 20*l*., for "Beckford," brown gelding, bred by Mr. Maunder, Hazley Mills, North Molton; sire, "Hunting Horn."

CHARLES COOKE, Taddington, Winchcombe: THIRD PRIZE, 10*l*., for his chestnut filly; breeder unknown.

GEORGE JOHN MITCHELL, Newton Mount, Burton-on-Trent, Staffordshire: FOURTH PRIZE, 5*l*., for "Blankney," chestnut gelding; bred by Mr. H. Chaplin, M.P., Lincoln.

WILLIAM TUDGE, Coston Hall, Aston-on-Clun, Salop: the *Reserve Number*, to "Glendower," bay gelding; bred by himself; sire, "Skeffington;" dam, "Rosamond;" sire of dam, "Little Tommy."

### **Hunter Mares or Geldings, up to not less than* 15 *stones.*

JOHN B. BOOTH, Killerby Hall, Catterick, Yorkshire: FIRST PRIZE, 30*l.*, for "Banner Bearer," bay gelding, 5 years-old; breeder unknown; sire, "Ephenician;" sire of dam, "Royal William."

T. HARVEY D. BAYLY, Edwinstow House, Ollerton, Notts: SECOND PRIZE, 20*l.*, for "Borderer," chestnut gelding, 5 years-old; bred by Mr. Hudsmith, Cumberland; sire, "Clansman;" dam, "Galaor."

GEORGE VAN WART, The Shrubbery, Birmingham: THIRD PRIZE, 10*l.*, for "Loxley," bay gelding, 7 years-old; breeder unknown.

RICHARD BASNETT OSWELL, Shelvock, West Felton, Salop: FOURTH PRIZE, 5*l.*, for "Filbert," brown gelding, 5 years-old; bred by himself; sire, "Hazelnut;" dam, "Country Girl;" sire of dam, "Steamer."

JOHN GREGORY WATKINS, Woodfield, Ombersley, Droitwich, Worcestershire: the *Reserve Number*, to his brown gelding, 5 years-old; bred by himself; sire, "Umpire;" dam, "Endurance;" sire of dam, "Charles XII."

### **Hunter Mares or Geldings, up to not less than* 12 *stones.*

THE EARL OF COVENTRY, Croome Court, Severn Stoke, Worcestershire: FIRST PRIZE, 25*l.*, for "Bird on the Wing," black gelding, aged; breeder unknown.

SAMUEL JAMES WELFITT, Tathwell Hall, Louth, Lincolnshire: SECOND PRIZE, 15*l.*, for "Loiterer," bay gelding, 9 years-old; bred by Mr. Waite; sire, "Un. Oc.;" sire of dam, "Darnley."

WILLIAM ARMSTRONG, Kendal, Westmorland: THIRD PRIZE, 10*l.*, for "Lallah Rookh" bay mare, 5 years-old; bred by Mr. R. Faulder, Thursby Farm, Carlisle.

GEORGE SMITH, Ailston, Stratford-on-Avon, Warwickshire: FOURTH PRIZE, 5*l.*, for "Brenda," dark brown mare, 6 years-old; bred by himself; sire, "Oscar;" dam, "Kitty;" sire of dam, "Harkaway."

JOHN WILLIAMS GARDOM, Butterton Park, Newcastle, Staffordshire: the *Reserve Number*, to "Britannia," brown mare, 5 years-old; breeder unknown; sire, "Laughing Stock;" sire of dam, "British Yeoman."

### **Carriage Horses or Mares, in pairs, under Six Years old.*

JOHN THOMAS ROBINSON, Leckby Palace, Thirsk, Yorkshire: FIRST PRIZE, 25*l.*, for his roan horses, 3 and 4 years-old; bred by himself; sire, "Enderby;" dam, "Diamond;" sire of dam, "President, junior."

### **Roadster Mares or Geldings, above* 14 *hands* 1 *inch, and not exceeding* 15 *hands* 1 *inch.*

JAMES MOFFAT, Kirklinton Park, Carlisle, Cumberland: FIRST PRIZE, 20*l.*, for "Covet," bay mare, 4 years-old; bred by himself; sire, "Laughing Stock;" dam, "Crimea."

WILLIAM FELL, The Close, Lichfield, Staffordshire: SECOND PRIZE, 10*l.*, for "Mahomet," black gelding, 6 years-old; bred by Mr. Chandos Pole-Gell, Hopton Hall, Wirksworth; sire, "Sir Colin Campbell."

JAMES MOFFAT, Kirklinton Park, Carlisle: THIRD PRIZE, 5*l.*, for "Land Agent," bay gelding, 5 years-old; bred by Mr. W. Graham, Gap Shields, Gilstand, Carlisle; sire, "Laughing Stock."

RICHARD MILWARD, Thurgarton Priory, Southwell, Notts: the *Reserve Number*, to "Hilton," bay gelding, 6 years-old; breeder unknown.

### **Roadster Mares or Geldings, above* 15 *hands* 1 *inch.*

JOHN WARTH, Sutton Ely, Cambridgeshire: FIRST PRIZE, 20*l.*, for "The General," bright bay gelding, 5 years-old; bred by himself; sire, "Young Premier;" dam, "Jenny."

GEORGE DAVID BADHAM, The Lawn, Bulmer, Sudbury, Suffolk: SECOND PRIZE, 10*l.*, for "Tearaway," black-brown gelding, 4 years-old; bred by Mr. Green, Newton, Sudbury; sire, "Little Pippin;" dam, "Letitia," sire of dam, "Sir Hercules."

THOMAS HORROCKS MILLER, Singleton, Poulton-le-Fylde, Lancashire: THIRD PRIZE, 5*l.*, for his grey gelding, 5 years-old; bred by Mr. Crozier, Garstang; sire, "Pallister."

THOMAS SLATTER, junior, Stand Hall, Whitefield, Manchester: the *Reserve Number*, to "Maiden Hair," brown mare, 4 years-old; breeder unknown; sire, "Mr. Pill;" dam, "Troubadour;" sire of dam, "Claret."

### **Cob Mares or Geldings, above* 13 *hands and not exceeding* 14 *hands* 1 *inch.*

GEORGE SMITH, Ailston, Stratford-on-Avon, Warwickshire: FIRST PRIZE, 15*l.*, for "Dick," cream gelding, 9 years-old; breeder unknown.

WILLIAM EDWARD WILEY, Tamworth Road, Erdington, Birmingham: SECOND PRIZE, 10*l.*, for "Bob," bay gelding, 7 years-old; breeder unknown.

JOHN G. BORASTON, Kidderminster, Worcestershire: THIRD PRIZE, 5*l.*, for "Comet," bay gelding, 7 years-old; bred by Mr. J. Bowen, Combrayn, Knighton, Radnorshire; sire, "Comet."

RICHARD MILWARD, Thurgarton Priory, Southwell, Notts: the *Reserve Number*, to "Camperdown," bay gelding, 4 years-old; breeder unknown.

### **Ponies not exceeding* 13 *hands.*

FREDERICK BOWER, 10, Albion Street, Birmingham: FIRST PRIZE, 10*l.*, for "Jumney," grey, 7 years-old; breeder unknown.

WILLIAM TYLER, Friday Bridge, Birmingham: SECOND PRIZE, 5*l.*, for "Billy," bay, 8 years-old; breeder unknown; sire, "Little Tommy."

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: the *Reserve Number*, to "Queen Bee," brown, 4 years-old; breeder unknown.

### *Agricultural Fillies—Two Years old.*

JOHN LINTON, Westwick Hall, Cambridge: FIRST PRIZE, 15*l.*, for "Princess," brown; bred by himself; sire, "Honest Tom;" dam, "Trip."

JAMES HAWKESWORTH, Barton Fields, Barton Blount, Derbyshire: SECOND PRIZE, 10*l.*, for "Darling," bay; bred by himself; sire, "Champion;" dam, "Darling;" sire of dam, "Napoleon."

STEPHEN DAVIS, Woolashill, Pershore, Worcestershire: THIRD PRIZE, 5*l.*, for "Darling," red roan; bred by himself; dam, "Darling."

DAVID BRIDGWATER, Lower Porthamel, Glasbury, Breconshire; the *Reserve Number*, to his grey; bred by himself; sire, "Lincoln;" dam, "Bunton."

### *Clydesdale Fillies—Two Years old.*

THOMAS TOWNLEY PARKER, Charnock, Chorley, Lancashire: FIRST PRIZE, 15*l.*, for his bay; bred by Mr. D. D. Hamilton, Campbeltown, N.B.; sire, "Largs Jock."

HER MAJESTY the QUEEN, Windsor Castle: SECOND PRIZE, 10*l.*, for "Kate," brown; bred by Her Majesty, the Prince Consort's Shaw Farm, Windsor; sire, "The Don;" dam, "Jenny;" sire of dam, "Britain."

HER MAJESTY THE QUEEN, Windsor Castle: the *Reserve Number*, to "Charlotte," bay; bred by Her Majesty, The Prince Consort's Shaw Farm; sire, "The Don;" dam, "Young Mary;" sire of dam, "Britain."

### *Suffolk Fillies—Two Years old.*

WILLIAM THOMPSON, junior, Rose Cottage, Thorpe, Colchester, Essex: FIRST PRIZE, 15*l.*, for "The Despised," chestnut; bred by Mr. Cross, Ipswich; sire, "President."

### **Agricultural Geldings or Mares, in pairs—Of any age.*

CHARLES WILLIAM BRIERLEY, Rhodes House, Middleton, Manchester: FIRST PRIZE, 20*l.*, for "Champion," bay gelding, 5 years-old, and "Warwick," bay gelding, 7 years-old; breeders unknown.

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: SECOND PRIZE, 10*l.*, for "Fanny," chestnut mare, 6 years-old; bred by Mr. T. Upton, Pallathorpe, Tadcaster; sire, "Lincolnshire;" dam, "Diamond;" and "Diamond," chestnut mare, 11 years-old; breeder unknown.

CHARLES WILLIAM BRIERLEY, Rhodes House, Middleton, Manchester: THIRD PRIZE, 5*l.*, for "Sensation," grey mare, 6 years-old, and "Farmer," grey gelding, 7 years-old; both bred by Mr. Tennant, Selby; sire of both, "John Bull."

THE EARL OF DARTMOUTH, Patshull, Albrighton, Wolverhampton: the *Reserve Number*, to "Shirley," light-brown gelding, 10 years-old, and "Bowler," light-brown gelding, 7 years-old; both bred by himself; sire of both, Mr. Yeoman's "Merriman;" dam of both, "Smiler."

### **Agricultural Geldings or Mares, in pairs—Four Years old.*

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: FIRST PRIZE, 20*l.*, for "Smiler," bay, bred by himself; sire, "Nonpariel;" and "Boxer," bay; breeder unknown.

### **Agricultural Geldings or Mares, in pairs—Three Years old.*

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: FIRST PRIZE, 20*l.*, for "Thumper," bay gelding, and "Maggie," bay mare; breeders unknown.

CHARLES WILLIAM BRIERLEY, Rhodes House, Middleton, Manchester: SECOND PRIZE, 10*l.*, for "Bobby" and "Flirt," both grey geldings; breeders unknown.

### **Agricultural Geldings—Three Years old.*

EDWARD TONGUE, Manor House, Aldridge, Walsall, Staffordshire: FIRST PRIZE, 10*l.*, for "The Drummer," bright bay; breeder unknown.

### *Agricultural Geldings—Two Years old.

JAMES PERRY, Salters Hall, Claverley, Bridgnorth: FIRST PRIZE. 10*l.*, for "Captain," chestnut; bred by Mr. T. Wall, Wollaston, Stourbridge; sire, "Champion."

THOMAS W. D. HARRIS, Wootton, Northamptonshire: SECOND PRIZE, 5*l.*, for his brown; bred by himself.

GEORGE HEAD HEAD, Rickerby, Carlisle, Cumberland: the *Reserve Number*, to his dark bay; bred by himself; sire, "Young Champion;" dam, "Bonny;" sire of dam, "Clyde."

### *Agricultural Geldings—Yearlings.

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: FIRST PRIZE, 10*l.*, for "Thumper;" breeder unknown.

## CATTLE.

NOTE—Each animal entered in the Shorthorn Classes is certified by the exhibitor to have not less than four crosses of Shorthorn blood which are registered in the 'Herdbook.' In cases where the pedigree has not been fully given by the exhibitor, it has been completed from the 'Herdbook,' and the portion thus added included in brackets, thus [ ].

### Shorthorns—Bulls above Three Years old.

HENRY THOMPSON, Maiden Hill, Penrith, Cumberland: FIRST PRIZE, 30*l.*, for "Edgar," roan, 8 years, 6 months, 1 week, 3 days-old; bred by Mr. C. R. Saunders, Nunwick Hall, Penrith; sire, "Prince Patrick" (18,633); dam, "Young Emma" by "Mac Turk" (14,872); gr. d., "Countess Emma" by "Heir-at-law" (13,005); g. gr. d., "Baroness Emma" by "Baron of Ravensworth" (7811).

THE MARQUIS OF EXETER, Burghley Park, Stamford: SECOND PRIZE, 10*l.*, for "Telemachus" (27,603), roan, 3 years, 2 months, 2 weeks, 3 days-old; bred by himself; sire, "Nestor" (24,648); dam, "Louisa 9th" by "Prince Alfred" (18,579); gr. d., "Louisa 7th" by "Baron Farnley" (14,129); g. gr. d., "Louisa 2nd" by "Third Duke of York" (10,166).

The REV. WALTER SNEYD, Keele Hall, Newcastle-under-Lyme, Staffordshire: THIRD PRIZE, 15*l.*, for "Ironmaster," red, 3 years, 6 months, 5 days-old; bred by the late Mr. R. Sneyd, Keele Hall Farm; sire, "Heir of York" (21,915); dam, "Jane Eyre" by "Charlie" (17,546); gr. d. by "Walter" (12,279); g. gr. d. by "Lord Hill" (6146).

JOHN WRIGHT, Green Gill Head, Penrith, Cumberland: FOURTH PRIZE, 10*l.*, for "Man's Estate" (26,806), white, 3 years, 7 months, 3 weeks-old; bred by Mr. T. Bowstead, Edenhall, Penrith; sire, "Edgar" (19,680); dam, "Light Roan Twin" by "Squire Stuart" (20,981); gr. d., "Brenda" by "Bromptonio" (8907); g. gr. d. by "Arcanus" (7795).

RICHARD FOSTER SOFFE, Hams, Eastleigh, Southampton: the *Reserve Number*, to "Lord Morpeth," roan, 3 years, 10 months, 1 week-old; bred by Mr. G. Atkins, Barton Manor Farm, Southampton; sire, "Lord Carlisle" (22,128); dam, "Damsel" by "Socrates."

### *Shorthorns—Bulls above Two and not exceeding Three Years old.*

William Linton, Sherriff Hutton, York: First Prize, 25*l.*, for "Lord Irwin," white, 2 years, 5 months, 1 week-old; bred by himself; sire, "British Hope" (21,324); dam, "Handmaid" by "May Day" (20,323); gr. d., "White Rose" by "Magnus Troil" (14,880); [g. gr. d., "Miss Henderson" by "Magnus Troil" (14,880).]

John Outhwaite, Bainesse, Catterick, Yorkshire: Second Prize, 15*l.*, for "Royal Windsor," white, 2 years, 5 months, 3 weeks, 3 days-old; bred by Mr. T. Willis, Caperby, Bedale; sire, "Windsor Fitz Windsor" (25,458); dam, "Royal Lily" by "Fitz Clarence" (14,552); gr. d., "Water Lily," by the "Silkey Laddie" (10,947); g. gr. d., "Lily of Nile" by "Wilberforce" (9830).

Sir David Baird, Bart., New Blythe, Preston Kirk, Haddingtonshire: Third Prize, 10*l.*, for "Baron Lawrie 3rd," red, 2 years, 3 months, 3 weeks, 6 days-old; bred by Mr. G. R. Barclay, Keavil, Dumfermline, Fifeshire; sire, "Heir of Englishman" (24,122); dam, "Annie Laurie" by "Kalafat" (13,101); gr. d., "Artless" by "Lambton" (9273)); g. gr. d., "Arabella" by "General Washington" (6036).

Emily Lady Pigot, Branches Park, Newmarket: Fourth Prize, 5*l.*, for "Bythis," red and white, 2 years, 10 months, 1 day-old; bred by herself; sire, "Victorious" (25,378); dam, "Bellona" by "Sir Roger" (16,991); gr. d. "Bustle" by "Valiant" (10,989); g. gr. d. "Bonnet" by "Buckingham" (3239).

William and Henry Dudding, Panton House, Wragby, Lincolnshire: the *Reserve Number*, to "Standard Bearer," red, 2 years, 2 months, 2 days-old; bred by themselves; sire, "Ravenswood" (22,682); dam, "Soldier's Bride" by "Superior" (15,362)); gr. d. by "Baron Warlaby" (7813); g. gr. d. by "Leonard" (4210).

### *Shorthorns—Yearling Bulls above One and not exceeding Two Years old.*

Colonel Charles Towneley, Towneley, Burnley, Lancashire: First Prize, 25*l.*, for "Baron Hubback 2nd," red, 1 year, 4 months, 4 weeks-old; bred by himself; sire, "Baron Oxford" (23,373); dam, "Duchess 7th" by "Grand Duke of Lancaster" (19,883); [gr. d. "Duchess 6th," by "Royal Duke" (16,865); g. gr. d., "Duchess 5th" by "Brennus" (8902).]

Lord Sudeley, Toddington, Winchcombe, Gloucestershire: Second Prize, 25*l.*, for "Cherub," red, 1 year, 3 months-old; bred by himself; sire, "Baron Booth" (21,212); dam, "Seraphina 13th" by "John O'Gaunt" (16,322); g. d., "Seraphina 7th" by "Duke of Sussex" (12,772); g. gr. d., "Seraphina 2nd" by "Sweet William" (7571).

John Lamb, Burrell Green, Penrith, Cumberland: Third Prize, 10*l.*, for "Ignoramus," roan, 1 year, 2 months, 2 weeks, 4 days-old; bred by himself; sire, "Earl of Eglington" (23,832); dam by "Edgar" (19,680); gr. d. by "Nunwick" (16,635); g. gr. d. by "Sulyman" (12,157).

Joseph Meadows, Thornville, Wexford, Ireland: Fourth Prize, 5*l.*, for "Prince Charlie," roan, 1 year, 2 months, 1 week, 3 days-old; bred by himself; sire, "Prince of the Realm" (22,627); dam, "Chintz" by "Fugleman" (14,580); gr. d., "Chance" by "Prince Consort" (16,729); g. gr. d., "Chance" by "Prince Earnest" (7366).

George Garne, Churchill Heath, Chipping Norton, Oxfordshire: the *Reserve Number*, to "Earl of Warwickshire 3rd," roan, 1 year, 7 months, 3 weeks, 6 days-old; bred by Mr. H. J. Sheldon, Brailes House, Shipston-on-

Stour, Warwickshire; sire, "Duke of Brailes" (23,724); dam, "Lady Emily 2nd" by "Seventh Duke of York" (17,754); gr. d., "Lady Emily" by "Duke of Bolton" (12,738); g. gr. d., "Eugenie" by "Grey Friar" (9172).

### *Shorthorns—Bull Calves above Six and not exceeding Twelve Months old.*

WILLIAM and HENRY DUDDING, Panton House, Wragby, Lincolnshir : FIRST PRIZE, 15*l.*, for "British Flag," red and white, 10 months, 2 weeks, 3 days-old; bred by themselves; sire, "Robin" (24,968); dam, "Bloomer" by "Lord Panton" (22,204); gr. d., "Birthright" by "Royal Favourite" (15,200); [g. gr. d., "Daisy" by "Sylvan" (10,907)].

WILLIAM LINTON, Sheriff Hutton, York: SECOND PRIZE, 10*l.*, for "Leeman," red and white, 7 months, 3 weeks, 1 day-old; bred by himself; sire, Booth's "Serjeant-Major;" dam, "Mushroom" by "Earl Windsor" (17,788); gr. d., "Beauty 2nd" by "Magnus Troil" (14,880); g. gr. d., "Beauty" by "Bates" (12,451).

THOMAS GARNE and SON, Broadmoor, Northleach, Gloucestershire: THIRD PRIZE, 5*l.*, for "Red Prince," red, 9 months, 1 week, 4 days-old; bred by themselves; sire, "Royal Benedict" (27,348); dam, "Pansy" by "Cynric" (19,542); gr. d., "Young Pink" by "General Pelissier" (14,605); g. gr. d., "Pink" by "Marchmont" (9367).

### *Shorthorns—Cows above Three Years old.*

JAMES BEATTIE, Newbie House, Annan, Dumfriesshire: FIRST PRIZE, 20*l.*, for "Warrior's Plume," roan, 5 years, 5 months, 2 weeks, 4 days-old, in-milk; bred by Mr. W. Torr, Aylesby Manor, Grimsby; sire, "Breast Plate" (19,337); dam, "Warrior's Pride" by "Dr. McHale" (15,887); gr. d., "Warrior's Bride" by "Brideman" (12,493); g. gr. d., "Water Lady" by "Baron Warlaby" (7813).

ADAM DUGDALE, Rose Hill, Burnley, Lancashire: SECOND PRIZE, 10*l.*, for "Kent Cherry 2nd," roan, 5 years, 8 months, 2 days-old, in-calf; bred by himself; sire, "Duke of Bowland" (21,568); dam, "Kent Cherry" by "Cherry Duke 3rd" (15,763); gr. d., "Bonny Lass" by "Prince Duke" (13,507); [g. gr. d., "Bibby" by "Fourth Duke of York" (10,167)].

JAMES HOW, Broughton, Huntingdon: THIRD PRIZE, 5*l.*, for "Windsor Butterfly," red and white, 3 years, 4 months, 2 weeks, 1 day-old; bred by himself; sire, "Heir of Windsor" (26,364); dam, "Alice Butterfly" by "Master Butterfly" (13,311); gr. d., "Alice 2nd" by "Duke of Athol" (10,150); [g. gr. d., "Madeline" by "Marcus" (2262)].

WILLIAM LINTON, Sheriff Hutton, York: the *Reserve Number*, to "Carnation," roan, 7 years, 5 months-old, in-milk; bred by himself; sire, "Earl Windsor" (17,788); dam, "Yorkshire Lass" by "Magnus Troil" (14,880); gr. d., "Beauty" by "Bates" (12,451); g. gr. d., "Topsy" by "General Fairfax" (11,519).

### *Shorthorns—Heifers, in-milk or in-calf, not exceeding Three Years old.*

EMILY LADY PIGOT, Branches Park, Newmarket: FIRST PRIZE, 15*l.*, for "Dame Swift," white, 2 years, 3 months, 1 week, 3 days-old, in-calf; bred by herself; sire, "Prince of Buckingham" (27,161); dam, "Dame Quickly" by "Valasco" (15,443); gr. d., "Barmaid" by "Brit sh Prince" (14,197); g. gr. d., "Baroness" by "Baron Warlaby" (7813).

JAMES HOW, Broughton, Huntingdon: SECOND PRIZE, 10*l.*, for "Vesper Queen," red, 2 years, 5 months, 1 week, 2 days-old, in-milk; bred by himself; sire, "Victorious" (25,378); dam, "Jolly Queen" by "Prince of the Empire" (20,578); gr. d., "Vestal Queen" by "Prince Alfred" (13,494); [g. gr. d., "Vesta" by "Van" (13,934)].

F. J. SAVILE FOLJAMBE, M.P., Osberton Hall, Worksop, Notts: THIRD PRIZE, 5*l.*, for "Concert," roan, 2 years, 2 months, 2 weeks, 4 days-old, in-calf; bred by himself; sire, "Lord Lyons" (26,677); dam, "Concertina" by "May Duke" (16,553); gr. d., "Seraphim" by "Monarch" (13,347); g. gr. d., "Seraph" by "Lord of Brawith" (10,465).

WILLIAM HENRY HEWETT, Norton Court, Taunton, Somerset: the *Reserve Number*, to "Nelly," white, 2 years, 7 months, 5 days-old, in-calf; bred by himself; sire, "James 1st" (24,202); dam, "Maid of Athens" by "Moonraker" (22,383); gr. d., "Etiquette" by "Tenantry" (13,829); g. gr. d., "Eurydice" by "Red Duke" (8694).

### *Shorthorns—Yearling Heifers above One and not exceeding Two Years old.*

JOHN OUTHWAITE, Bainesse, Catterick, Yorkshire: FIRST PRIZE, 15*l.*, for "Lady Brough," roan, 1 year, 8 months, 2 weeks, 1 day-old, in-calf; bred by Mr. F. Robinson, Wintelow, Catterick; sire, "Baron Killerby;" dam, "Necklace" by "Lord Stanley" (16,452); gr. d. by "Rifleman" (15,163); g. gr. d. by "Young Hopewell" (14,719).

F. J. SAVILE FOLJAMBE, M.P., Osberton Hall, Worksop, Notts: SECOND PRIZE, 10*l.*, for "Fleur de Lis," roan, 1 year, 10 months, 1 day-old, in-calf; bred by himself; sire, "Lord Lyons" (26,677); dam, "Rose of Windsor" by "Imperial Windsor" (18,086); gr. d., "Blanche" by "Monarch" (13,347); g. gr. d., "Seraph" by "Lord of Brawith" (10,465).

COLONEL CHARLES TOWNELEY, Towneley, Burnley: THIRD PRIZE, 5*l.*, for "Baron Oxford's Duchess," red, 1 year, 10 months, 2 weeks, 1 day-old, in-calf; bred by himself; sire, "Baron Oxford" (23,375); dam, "Duchess of Lancaster 2nd" by "Precedent" (11,918); [gr. d., "Lancaster Belle" by "Louis Napoleon 2nd" (13,259); g. gr. d., "The Duchess of Lancaster" by "The Duke of Lancaster" (10,929)].

COLONEL CHARLES TOWNELEY, Towneley: the *Reserve Number*, to "Butterfly's Memento," roan, 1 year, 6 months, 1 week, 4 days-old; bred by himself; sire, "Baron Oxford" (23,375); dam, "Duchess of Lancaster 7th" by "Inglewood" (20,006).

### *Shorthorns—Heifer Calves, above Six and under Twelve Months old.*

ARTHUR GARFIT, Scothern, Lincoln: FIRST PRIZE, 10*l.*, for "Brilliant Rose 2nd," white, 10 months, 2 weeks, 3 days-old; bred by Mr. E. H. Cheney, Gaddesby Hall, Leicester; sire, "General Napier" (24,023); dam, "Brilliant" by "May Duke" (13,320); gr. d., "Blanche 3rd" by "Antinous" (12,401); g. gr. d., "Blanche" by "Diamond" (5918).

EMILY LADY PIGOT, Branches Park, Newmarket: SECOND PRIZE, 5*l.*, for "Victoria Victrix," roan, 9 months, 3 weeks, 5 days-old; bred by herself; sire, "Sidus;" dam, "Victoria Regia" by "British Prince" (14,197); gr. d., "Victoria" by "Hopewell" (10,332); g. gr. d., "Britannia" by "Albion" (7771).

WILLIAM and HENRY DUDDING, Panton House, Wragby, Lincolnshire: the *Reserve Number*, to "Lady Grace," white, 9 months, 2 days-old; bred by themselves; sire, "Robin" (24,968); dam, "Countess of Wragby" by "Sir Roger" (16,991); gr. d. by "Lambton" (9273); [g. gr. d., "Cactus" by "General Washington (6036)].

*Herefords—Bulls above Three Years old.*

WARREN EVANS, Llandowlais, Usk, Monmouthshire; FIRST PRIZE, 25*l.*, for "Monaughty 3rd," red, white face, 3 years, 6 months, 2 weeks, 2 days-old; bred by himself; sire, "Hopeful" (2045); dam, "Nena 3rd" by "Monaughty."

PHILIP TURNER, the Leen, Pembridge, Herefordshire: SECOND PRIZE, 15*l.*, for "Bachelor" (2941), red, white face, 4 years, 2 months, 1 week, 3 days-old; bred by Mr. S. Robinson, The Moor, Kington; sire, "Douglas" (2505); dam, "Spinster" by "Sir Thomas" (2228).

NATHANIEL BENJAFIELD, Short's Green Farm, Motcombe, Shaftesbury, Dorset, THIRD PRIZE, 5*l.*, for "Theodore," red, white face, 3 years, 3 months: 2 weeks, 1 day-old; bred by Mr. Eli Benjafield, Gummershea Farm, Stalbridge, Dorset: sire, "Matchless;" dam, "Tulip."

JOHN WALKER, Westfield House, Holmer, Hereford: the *Reserve Number*, to "Wonder," red, white face, about 4 years-old; bred by Mr. Jones, Teleglas, near Hay; sire, "Vainhope" (2853); dam, "Alice" by "Young Dewsall."

*Herefords—Bulls above Two and not exceeding Three Years old.*

JOHN WILLIAMS, Saint Mary's, Kingsland, Herefordshire: FIRST PRIZE, 25*l.*, for "Royal Head," red, white face, 2 years, 8 months, 4 days-old; bred by himself; sire, "Sir George" (2765); dam, "Flower of Kent" by "Sir Colin" (1390).

THE EARL OF SOUTHESK, Kinnaird Castle, Brechin, Forfarshire: SECOND PRIZE, 15*l.*, for "Ostorius" (3295), red, white face, 2 years, 10 months, 4 weeks, 1 day-old; bred by Mr. W. Tudge, Adforton, Leintwardine; sire, "Brandon" (2972); dam, "Philis" by "Sir Colin" (2216).

PHILIP TURNER, The Leen, Pembridge, Herefordshire: THIRD PRIZE, 5*l.*, for "Provost," red, white face, 2 years, 1 week, 1 day-old; bred by himself; sire, "Bachelor" (2941); dam, "Rhodia" by "Subaltern" (2794).

JOHN HARDING, Bicton, Shrewsbury: the *Reserve Number* to "Nobleboy," red, white face, 2 years, 3 months, 2 weeks-old; bred by himself; sire, "Symmetry" (2799); dam, "Noble" by "Garrick" (1248).

*Herefords—Yearling Bulls above One and not exceeding Two Years old.*

RICHARD HILL, Orleton Court, Ludlow, Salop: FIRST PRIZE, 25*l.*, for "Pearl Diver," red, white face, 1 year, 10 months, 2 weeks, 4 days-old; bred by himself; sire, "Triumph" (2837); dam, "Gift" by "Umpire" (2764).

GEORGE CHILD, Westonbury, Pembridge, Herefordshire: SECOND PRIZE, 15*l.*, for "Star of the West," red, white face, 1 year, 10 months, 1 week, 4 days-old; bred by the late Mr. J. S. Bannister, Weston, Pembridge; sire, "North Star" (2138); dam, "Pigeon" by "Young Treasurer" (1473).

JOHN CRANE, Benthall Ford, Shrewsbury: THIRD PRIZE, 5*l.*, for "Prince George," red, white face, 1 year, 10 months, 1 week, 3 days-old; bred by himself; sire, "The Colonel;" dam, "Gipsy" by "Cynips" (866).

John Harding, Bicton, Shrewsbury: the *Reserve Number*, to "Tom "Kinnersley," red, white face, 1 year, 4 months, 3 weeks, 4 days-old; bred by himself; sire, "Battenhall" (2406); dam, "Theora" by "Sebastopol" (1381).

### *Herefords—Bull Calves above Six and not exceeding Twelve Months old.*

Henry N. Edwards, Broadwood, Leominster: First Prize, 10*l.*, for "Alexander," red, white face, 9 months, 2 weeks, 1 day-old; bred by himself; sire, "Sir John;" dam, "Annie" by "Dan O'Connell" (2952).

William Taylor, Showle Court, Ledbury, Herefordshire: Second Prize, 5*l.*, for "The Wolverhampton Boy," red, white face, 8 months, 3 weeks, 2 days-old; bred by himself; sire, "Sir Frank" (2762); dam, "Duchess" by "Twin" (2284).

Henry N. Edwards, Broadward, Leominster: the *Reserve Number*, to "Albert," red, white face, 10 months, 5 days-old; bred by himself; sire, "Sir Hungerford" (3447); dam, "Amaranth 3rd" by "Philip" (3314).

### *Herefords—Cows above Three Years old.*

William B. Peren, Compton House, South Petherton, Somerset: First Prize, 20*l.*, for "Ivington Rose," red, white face, 6 years, 10 months, 3 days-old, in-calf; bred by Mr. T. Roberts, Ivington Bury, Leominster; sire, "Sir Thomas" (2228); dam, "Red Rose" by "Master Butterfly" (1313).

Philip Turner, The Leen, Pembridge, Herefordshire: Second Prize, 10*l.*, for "Livia," red, white face, 3 years, 9 months, 3 weeks, 6 days-old, in-milk; bred by himself; sire, "Franky" (1243); dam, "Dorcas 2nd" by "Bolingbroke" (1883).

Richard Tanner, Frodesley, Dorrington, Salop: Third Prize, 5*l.*, for "Queen," red, white face, 7 years, 10 months-old, in milk; bred by Mr. Tanner, Aintree House, Bromfield; sire, "Buckton" (1891); dam, "Moss Rose" by "Superior" (1751).

George Pitt, Chadnor Court, Dilwyn, Leominster, Herefordshire: the *Reserve Number*, to "High Lass 4th," red, white face, 4 years, 7 months-old, in-milk; bred by himself; sire, "Foxwhelp;" dam, "High Lass 3rd" by "Miliam."

### *Herefords—Heifers in-milk or in-calf, not exceeding Three Years old.*

Philip Turner, Leen, Pembridge, Leominster, Herefordshire: First Prize, 15*l.*, for "Rarity," red, white face, 2 years, 3 weeks, 5 days-old, in-calf; bred by himself; sire, "Bachelor" (2941); dam, "Rosamond" by "Demetrius" (2494).

John Harding, Bicton, Shrewsbury: Second Prize, 10*l.*, for "Dahlia," red, white face, 2 years, 8 months, 3 weeks, 3 days-old, in-calf; bred by himself; sire, "Symmetry" (2799); dam, "Burrington Daisy" by "Severus 2nd" (2747).

Thomas Fenn, Stonebrook House, Ludlow: Third Prize, 5*l.*, for "Duchess of Bedford 6th," red, white face, 2 years, 11 months, 1 week, 5 days-old, in-calf; bred by himself; sire, "Severus 2nd" (2747); dam, "Duchess of Bedford" by "Arthur Napoleon" (910).

George Pitt, Chadnor, Dilwyn, Leominster: the *Reserve Number*, to "Sunshine 2nd," red, white face, 2 years, 8 months-old, in calf; bred by himself; sire, "Montalembert; dam, "Sunshine" by "Luck's All."

### *Herefords—Yearling Heifers above One and not exceeding Two Years old.*

John Harding, Bickton, Shrewsbury: First Prize, 15*l.*, for "Lizzie Jeffreys," red, white face, 1 year, 11 months, 2 weeks, 3 days-old; bred by himself; sire, "Symmetry" (2799); dam, "Miss Jeffreys" by "Prince Alfred" (2169).

Philip Turner, The Leen, Pembridge, Herefordshire: Second Prize, 10*l.*, for "Plum," red, white face, 1 year, 8 months, 3 weeks, 6 days-old; bred by himself; sire, "Bachelor" (2941); dam, "Dorcas the 2nd" by "Bolingbroke" (1883).

Thomas Thomas, St. Hilary, Cowbridge, Glamorganshire: Third Prize, 5*l.*, for "Sunflower," red, white face, 1 year 11 months, 2 weeks, 3 days-old; bred by himself; sire, "Sir John;" dam, "Curly 2nd."

J. Hungerford Arkwright, Hampton Court, Leominster, Herefordshire: the *Reserve Number*, to "Miss Hungerford," red, white face, 1 year, 5 months, 3 weeks, 4 days-old; bred by himself; sire, "Sir Hungerford" (3447); dam, "Lady Leicester" by "Hampton Oliver."

### *Herefords—Heifer Calves above Six and under Twelve Months old.*

Thomas Fenn, Stonebrook House, Ludlow: First Prize, 10*l.*, for "Lady of the Teme," red, white face, 10 months, 3 weeks, 6 days-old; bred by himself; sire, "Severus 2nd" (2747); dam, "Victoria" by "Wilson."

John Morris, Town House, Madley, Hereford: Second Prize, 5*l.*, for "Madeline," red, white face, 11 months, 3 weeks, 5 days-old; bred by himself: sire, "Stowe" (3478); dam, "Pleasant 2nd" by "Little Tommy" (985).

Thomas Thomas, St. Hilary, Cowbridge, Glamorganshire: the *Reserve Number*, to "Rosalind," red, white face, 11 months, 1 week, 3 days-old; bred by himself; sire, "Sir John the 3rd;" dam, "Fairy" by "Shamrock."

### *Devons—Bulls above Three Years old.*

James Howard Buller, Downes, Crediton, Devon: First Prize, 25*l.*, for his red, 4 years, 9 months, 4 weeks, 1 day-old; bred by himself.

Viscount Falmouth, Tregothnan, Probus, Cornwall: Second Prize, 15*l.*, for "Narcissus," red, 3 years, 9 months-old; bred by himself; sire, "Sunflower" (937); dam, "Picture the 4th" (2224) by "Napoleon" (464).

James Davy, Flitton Barton, North Molton, Devon: Third Prize, 5*l.*, for "Duke of Flitton 4th" (827), red, 3 years, 5 months, 4 weeks, 2 days-old; bred by himself; sire, "Duke of Flitton 3rd" (826); dam, "Duchess of Plymouth" (2661) by "Gold Medal Duke of Flitton 1st" (613).

Her Majesty the Queen, Windsor Castle, Berkshire: the *Reserve Number*, to "Napier," red, 3 years, 8 months, 1 week, 3 days-old; bred by Mr. Walter Farthing, Stowey Court, Bridgwater; sire, "Tom;" dam, "Julia" by "Lord Quantock."

### *Devons—Bulls above Two and not exceeding Three Years old.*

JAMES DAVY, Flitton Barton, North Molton, Devon: FIRST PRIZE, 25*l.*, for "Duke of Flitton 5th," red, 2 years, 9 months, 3 weeks, 3 days-old; bred by himself; sire, "The President" (904); dam, "Actress" (1749) by "Palmerston" (476).

VISCOUNT FALMOUTH, Tregothnan, Probus, Cornwall: SECOND PRIZE, 15*l.*, for "Jonquil," red, 2 years, 8 months, 3 weeks, 5 days-old; bred by himself; sire, "Sunflower" (937); dam, "Picture the 4th" (2224), by "Napoleon" (464).

WILLIAM SMITH, Hoopern, Exeter, Devon: THIRD PRIZE, 5*l.*, for "Pensylvinia," red, 2 years, 9 months, 3 days-old; bred by himself; sire, "Eclipse" (835); dam, "Musk" (2883) by "Alabama" (774).

### *Devons—Yearling Bulls above One and not exceeding Two Years old.*

VISCOUNT FALMOUTH, Tregothnan, Probus, Cornwall: FIRST PRIZE, 25*l.*, for "Cinnaman," red, 1 year, 11 months, 2 weeks, 6 days-old; bred by himself; sire, "Sunflower" (937); dam, "Cinnaminta" (2572A) by "Protector" (711).

WALTER FARTHING, Stowey Court, Bridgwater, Somersetshire: SECOND PRIZE, 15*l.*, for "Master Harry," red, 1 year, 6 months, 3 weeks, 2 days-old; bred by himself: sire, "Master Arthur; dam, "Lofty" by "Sir Peregrine."

JAMES DAVY, Flitton Barton, North Molton, Devon: THIRD PRIZE, 5*l.*, for "Duke of Flitton 6th," red, 1 year, 8 months, 1 week, 5 days-old; bred by himself; sire, "Norfolk Champion" (892); dam, "Actress the 2nd" (2478) by "Duke of Flitton the 3rd" (826).

VISCOUNT FALMOUTH, Tregothnan, Probus, Cornwall: the *Reserve Number*, to "Kingcraft," red, 1 year, 11 months, 2 weeks, 2 days-old; bred by himself; sire, "Sunflower" (937); dam, "Peach" (2205A) by "Young Forester" (759).

### *Devons—Bull Calves above Six and not exceeding Twelve Months old.*

WALTER FARTHING, Stowey Court, Bridgwater, Somersetshire: FIRST PRIZE, 10*l.*, for "Marquis of Lorne," red, 11 months, 2 weeks, 3 days-old; bred by himself; sire, "Master Arthur;" dam, "Verbena."

JAMES DAVY, Flitton Barton, North Molton, Devon; SECOND PRIZE, 5*l.*, for "Conqueror," red, 7 months, 1 week, 1 day-old; bred by himself; sire, "Champion;" dam, "Actress 2nd" (2478) by "Duke of Flitton 3rd."

HER MAJESTY THE QUEEN, Windsor Castle: the *Reserve Number*, to "Prince Imperial," red, 10 months, 2 days-old; bred by Her Majesty, Norfolk Farm, Windsor; sire, "Napier;" dam, "Princess Beatrice" by "Prince Alfred."

### *Devons—Cows above Three Years old.*

WILLIAM TAYLOR, of Glynley, Westham, Eastbourne, Sussex: FIRST PRIZE, 20*l.*, for "Profit's Duchess" (2986), red, 5 years, 11 months, 1 week, 5 days-old, in-milk and in-calf; bred by himself; sire, "Duke of Flitton" (613); dam, "Profit" (2288) by "Nelson" (83).

WILLIAM TAYLOR, Glynley, Westham: SECOND PRIZE, 10*l.*, for "Frederica" (2714), red, 6 years, 7 months, 2 weeks, 5 days-old, in-milk and in-calf; bred by himself; sire, "Constitution;" dam, "Beauty" (1788) by "Napoleon 3rd" (464).

JAMES DAVY, Flitton Barton, North Molton, Devon: the *Reserve Number*, to "Lovely Queen" (2846), red, 5 years, 2 weeks, 2 days-old, in-calf; bred by himself; sire, "Admiral" (771); dam, "Princess the 2nd" (2276) by "Palmerston" (476).

### *Devons—Heifers in-milk or in-calf, not exceeding Three Years old.*

WILLIAM SMITH, Hoopern, Exeter, Devon: FIRST PRIZE, 15*l.*, for "Duchess," red, 2 years, 6 months, 3 weeks, 1 day-old, in-calf; bred by Mr. George Turner, Brampford Speke, Exeter; sire, "Albert Victor" (776); dam, "Duchess" (2655) by "Leotard" (886).

WILLIAM TAYLOR, Glynley, Westham, Eastbourne, Sussex: SECOND PRIZE, 10*l.*, for his red, 2 years, 9 months-old, in-calf; bred by himself; sire, "Alabama" (774); dam, "Frederica" (2714) by "Fusilier" (635).

TREVOR LEE SENIOR, of Broughton House, Aylesbury, Bucks: the *Reserve Number*, to "Young Daisey," dark red, 2 years, 9 months, 2 weeks, 6 days-old, in-calf; bred by Mr. J. A. Smith, Bradford Peverel, Dorchester; sire, "Sir Trio" (940); dam, "Daisey" (2621).

### *Devons—Yearling Heifers, above One and not exceeding Two Years old.*

JAMES DAVY, Flitton Barton, North Molton, Devon: FIRST PRIZE, 15*l.*, for "Gaylass," red, 1 year, 11 months, 3 weeks, 1 day-old; bred by himself; sire, "The President" (904); dam, "Princess Alice 2nd" (2791) by "Duke of Flitton 2nd" (825).

JAMES HOWARD BULLER, Downes, Crediton, Devon: SECOND PRIZE, 10*l.*, for his red, 1 year, 11 months, 2 weeks, 3 days-old; bred by himself.

WALTER FARTHING, Stowey Court, Bridgwater, Somersetshire: THIRD PRIZE, 5*l.*, for "First Fruit," red, 1 year, 11 months, 3 weeks, 4 days-old; bred by himself; sire, "Master Arthur;" dam, "Verbena."

GEORGE TURNER, Brampford Speke, Exeter, Devon: the *Reserve Number*, to "Princess Louise," red, 1 year, 11 months, 3 weeks, 2 days-old; bred by himself; sire, "Albert Victor;" dam, "Duchess 3rd" by "Champion."

### *Devons—Heifer-Calves above Six and under Twelve Months old.*

JAMES DAVY, Flitton Barton, North Molton, Devon: FIRST PRIZE, 10*l.*, for "Actress the 5th," red, 10 months, 1 week, 1 day-old; bred by himself; sire, "Duke of Flitton 4th" (827); dam, "Actress" (1749) by "Palmerston" (476).

WALTER FARTHING, Stowey Court, Bridgwater, Somersetshire: SECOND PRIZE, 5*l.*, for "Fair Rosamond," red, 10 months, 2 weeks, 6 days-old; bred by himself; sir, "Sir George;" dam, "Prettymaid" by "St. Audries."

HER MAJESTY THE QUEEN, Windsor Castle, Berkshire: the *Reserve Number*, to "Princess Frederica," red, 11 months, 4 days-old; bred by Her Majesty, Norfolk Farm, Windsor; sire, "Napier;" dam, "Lavender" by "Clarendon."

### *Jerseys—Bulls above One Year old.*

WALTER GILBEY, Hargrave Park, Stanstead, Essex: FIRST PRIZE, 10*l.*, for "Banboy," fawn, 2 years, 2 months, 3 weeks, 1 day-old; bred by himself; sire, "Rioter;" dam, "Ban" by "Dolphin."

George Simpson, Wray Park, Reigate, Surrey: Second Prize, 5*l.*, for "Prince," grey fawn, 5 years, 5 months, 1 day-old; bred by himself; sire, "Grand Duke;" dam, "Beauty."

Frederick Simpson, Sion House, Bellbroughton, near Stourbridge, Worcestershire: the *Reserve Number*, to "Beauty, Junior," fawn, brown and white, 2 years, 3 months, 1 week, 1 day-old; bred by himself.

### *Jerseys—Cows above Three Years old.*

Walter Gilbey, Hargrave Park, Stanstead, Essex; First Prize, 10*l.*, for "Duchess," light fawn, 3 years, 5 months-old, in-milk; bred by Mr. H. J. Le Feuvre, St. Peter's, Jersey: sire, "Cardinal;" dam, "Queen Mab."

George Digby Wingfield-Digby, Sherborne Castle, Dorsetshire: Second Prize, 5*l.*, for "Julia," fawn and white, 4 years, 5 months, 1 week, 5 days-old, in-milk and in-calf; bred by himself; dam, "Bro.vn Bess."

Walter Gilbey, Hargrave Park, Stanstead, Essex: the *Reserve Number*, to "Milkmaid," fawn, 4 years, 3 months, 3 weeks, 1 day-old, in-milk; bred by Mr. G. A. Fuller, Dorking, Surrey; sire, "Jack Weller;" dam, "Grasshopper," by "St. Peter."

### *Jerseys—Heifers, in-milk or in-calf, not exceeding Three Years old.*

George Digby Wingfield-Digby, Sherborne Castle, Dorsetshire: First Prize, 10*l.*, for "Miss Edith," fawn and white, 2 years, 1 month-old, in-calf; bred by himself; sire, "Sir Jerry;" dam, "Julia."

John Gellibrand Hubbard, Addington Manor, Winslow, Bucks: Second Prize, 5*l.*, for "Belle," fawn, 2 years, 8 months, 3 weeks, 6 days-old, in-calf; bred by himself; sire, "Bradwell;" dam, "Bluebell."

George Simpson, Wray Park, Reigate, Surrey: the *Reserve Number*, to "Myrtle," light fawn, 2 years, 1 week-old, in-milk; bred by himself; sire, "Lowndes;" dam, "Dudley."

### *Guernseys—Bulls above One Year old.*

The Rev. Joshua Rundle Watson, Le Bocage, Guernsey: First Prize, 10*l.*, for "Trumpeter," fawn and white, 2 years, 4 months, 2 weeks, 2 days-old; bred by Mr. Wakeford, Foulon, Guernsey.

Charles Le Page, Les Naftiaux, Guernsey: Second Prize, 5*l.*, for "Billy," red and white, 1 year, 5 months, 2 weeks, 1 day-old; bred by Mr. Henry F. de Putron, Pierre Percée, Guernsey; sire, "Champion;" dam, "Fanny."

Edward Andrew Sanders, Stoke House, Exeter: the *Reserve Number*, to "Victor Emanuel," yellow and white, 1 year, 11 months, 3 weeks, 3 days-old; bred by himself; dam, "Elegance."

### *Guernseys—Cows above Three Years old.*

The Rev. Joshua Rundle Watson, Le Bocage: First Prize, 10*l.*, for "Stella," fawn, 7 years, 8 months, 2 weeks, 3 days-old, in-milk; bred by Mr. Mahy, Cobo, Guernsey.

Thomas Blondel Le Page, Maison de Bas, St. Andrew's, Guernsey: Second Prize, 5*l.*, for "Daisy," yellow and white, 5 years, 2 months-old, in-calf; bred by himself; sire, "Old Duke."

Thomas Statter, Jun., Stand Hall, Whitefield, Manchester: the *Reserve Number*, to his smoky, in-milk; age and breeder unknown.

*Guernsey Heifers, in-milk or in-calf, not exceeding Three Years old.*

Charles Le Page, Les Naftieux, Guernsey: First Prize, 10*l*., for his red and white, 2 years, 8 months, 6 days-old, in-calf, bred by Mr. John Naftel, Les Ruettes, Guernsey; sire, "Jimmy;" dam, "Guernsey Lily."

Thomas Blondel Le Page, Maison de Bas, St. Andrews, Guernsey: Second Prize, 5*l*., for "Beauty," red and white, 2 years, 2 months-old, in-calf; bred by himself; sire, "Young Duke."

Thomas Blondel Le Page, Maison de Bas, St. Andrews, Guernsey; the *Reserve Number*, to "Lily of Guernsey," yellow and white, 2 years, 1 month-old, in-calf; bred by himself; "sire, "Old Duke;" dam, "Lily."

*Norfolk and Suffolk Polled—Bulls above One Year old.*

Benjamin Brown, Thursford, Thetford, Norfolk: First Prize, 10*l*., for "Norfolk Duke," red (Norfolk), 6 years, 4 days-old; bred by Mr. N. Powell, Little Snoring, Fakenham.

Jeremiah James Colman, M.P., Carrow House, Norwich: Second Prize, 5*l*., for "Cherry Duke," red, 3 years, 4 months-old (Norfolk and Suffolk); bred by Mr. H. Wolton, Newbourn Hall, Woodbridge; sire, "Esquire;" dam, "Beauty."

Thomas Brown, Marham Hall Farm, Downham Market: the *Reserve Number*, to "Bailiff," red (Norfolk), 2 years, 7 months-old; bred by himself; sire, "Tenant Farmer;" dam, "Strawberry."

*Norfolk and Suffolk Polled—Cows above Three Years old.*

Benjamin Brown, Thursford, Thetford, Norfolk: First Prize, 10*l*., for "Duchess," red (Norfolk), 5 years, 3 weeks, 3 days-old, in-milk; bred by himself; sire, "Tenant Farmer;" dam, "Hansom."

*Norfolk and Suffolk Polled—Heifers, in-milk or in-calf, not exceeding Three Years old.*

Benjamin Brown, Thursford, Thetford: First Prize, 10*l*., for "Countess," red (Norfolk), 2 years, 3 months, 1 day-old, in-calf; bred by himself; sire, "Norfolk Duke;" dam, "Hansom" by "Tenant Farmer."

John Hammond, Bale, Thetford, Norfolk: Second Prize, 5*l*., for "Davy the 4th," red (Norfolk), 2 years, 11 months-old, in-calf; bred by himself; sire, "Norfolk Duke;" dam, "Davy the 2nd."

Lord Sondes, Elmham Hall, Thetford, Norfolk: the *Reserve Number*, to his red (Norfolk), 2 years, 8 months-old; bred by Mr. B. Brown, Thursford, Thetford.

*Other Established Breeds—Bulls above One Year old.*

The Duke of Buckingham and Chandos, Stowe, Buckingham: First Prize, 10*l*., for "Young Conqueror," dark brown (Longhorn), 3 years, 11 months-old; bred by himself; sire, "Conqueror;" dam, "Luna."

John Godfrey, Wigston Parva, Hinckley, Leicestershire: Second Prize, 5*l*., for "Samson 2nd," red and white (Longhorn), 5 years, 5 months-old; bred by himself; sire, "Samson 1st;" dam, "Rollwright 2nd" by "Perfection."

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: the *Reserve Number*, to his "Aberdeenshire Hero" black (Angus), 4 years-old; bred by Mr. McCombie, M.P., Tillyfour, Aberdeen, N.B.

### *Other Established Breeds—Cows above Three Years old.*

JOHN GODFREY, Wigston Parva, Hinckley, Leicestershire: FIRST PRIZE, 10*l.*, for "Buttercup," red and white (Longhorn), 7 years, 2 months-old, in-milk and in-calf; bred by himself; sire, "Bosworth Sparkenhoe;" dam, "Bright Eye" by "Perfection."

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: SECOND PRIZE, 5*l.*, for "Princess of Aberdeen" black (Angus), 6 years-old, in-calf; bredeer unknown.

RICHARD HEMMING CHAPMAN, Upton, Nuneaton, Warwickshire: the *Reserve Number*, to "The Light of other Days," coloured and white (Longhorn), 9 years, 3 months, 2 weeks, 2 days-old, in-calf; bred by himself; sire, "Sparkenhoe 1st;" dam, "Brindled Beauty" by "Lord Rollwright."

### *Other Established Breeds—Heifers, in-milk or in-calf, not exceeding Three Years old.*

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: FIRST PRIZE, 10*l.*, for "Black Bess," black (Angus), 2 years, 11 months-old, in-calf; bred by himself.

THE DUKE OF BUCKINGHAM AND CHANDOS, Stowe, Buckingham: SECOND PRIZE, 5*l.*, for "Lady Mary," red and white (Longhorn), 1 year, 10 months, 1 week-old, in-calf; bred by exhibitor; sire, "Young Conqueror;" dam, "Venus."

JOHN GODFREY, Wigston Parva, Hinckley: the *Reserve Number*, to "Beauty," coloured and white (Longhorn), 2 years, 13 months-old, in-calf; bred by himself; sire, "Samson 2nd;" dam, "Bright Eye" by "Bosworth Sparkenhoe."

### **Dairy Cattle—Pairs of Heifers in-milk, under Three Years and Eight Months old.*

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: FIRST PRIZE, 30*l.*, for "Rose" and "Beauty" (Ayrshires), just over 3 years-old; breeders unknown.

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: SECOND PRIZE, 10*l.*, for "Buttercup" and "Dairymaid" (Ayrshires), about 3 years-old; breeders unknown.

JOHN JERVIS SHARP, Broughton, Kettering: THIRD PRIZE, 5*l.*, for his "Julia 4th," roan (Shorthorn), 3 years, 5 months-old; bred by himself: "Julia 9th," red (Shorthorn); bred by Mr. R. Wood, Clapton, Thrapstone.

### **Dairy Cattle—Pairs of Cows in-milk, over Three Years and Eight Months old.*

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: FIRST PRIZE, 20*l.*, for "Maid of Ayr" and "Maid of Midlothian" (Ayrshires), ages and breeders unknown.

THOMAS STATTER, junior, Stand Hall, Whitefield, Manchester: SECOND PRIZE, 10*l.*, for "Maid of May" and "Maid of Craven," roan (Crossbreds); ages and breeders unknown.

HENRY CROSSLEY, Watkinson Hall Farm, Halifax: THIRD PRIZE, 5*l.*, for his roan (Yorkshire cross), 6 years old; breeder unknown.

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## SHEEP.

### *Leicesters—Shearling Rams.*

GEORGE TURNER, junior, Alexton Hall, Uppingham: FIRST PRIZE, 20*l.* for his 1 year, 3 months, 1 week-old; bred by himself.

The REV. GEORGE INGE, Thorpe Constantine, Tamworth, Staffordshire: SECOND PRIZE, 10*l.*, for his 1 year 4 months-old; bred by himself.

The REV. GEORGE INGE, Thorpe Constantine: THIRD PRIZE, 5*l.*, for his 1 year, 4 months-old; bred by himself.

GEORGE HENRY SANDAY, Holme-Pierrepont, Nottinghamshire: the *Reserve Number,* to his 1 year, 4 months-old; bred by himself.

### *Leicesters—Rams of any other Age.*

GEORGE TURNER, junior, Alexton Hall, Uppingham: FIRST PRIZE, 20*l.*, for his 2 years, 3 months, 1 week-old; bred by himself.

GEORGE HENRY SANDAY, Holme-Pierrepont: SECOND PRIZE, 10*l.*, for his 3 years, 4 months old; bred by himself.

JOHN BORTON, Barton House, Barton-le-Street, Malton: THIRD PRIZE, 5*l.*, for his 2 years 3 months-old; bred by himself.

The REV. GEORGE INGE, Thorpe Constantine: the *Reserve Number*, to his 2 years, 4 months-old; bred by the late Lieut.-Colonel Inge, Thorpe Constantine.

### *Leicesters—Pens of Five Shearling Ewes of the same Flock.*

TEASDALE HILTON HUTCHINSON, Manor House, Catterick, Yorkshire: FIRST PRIZE, 15*l.*, for his 1 year, 3 months, 2 weeks-old; bred by himself.

JOHN BORTON, Barton House, Barton-le-Street, Malton: SECOND PRIZE, 10*l.*, for his 1 year 3 months-old; bred by himself.

The REV. GEORGE INGE, Thorpe Constantine, Tamworth: THIRD PRIZE, 5*l.*, for his 1 year, 4 months-old; bred by himself.

### *Cotswolds—Shearling Rams.*

THOMAS BROWN, Marham Hall Farm, Downham Market, Norfolk: FIRST PRIZE, 20*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

THOMAS BROWN, Marham Hall Farm: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

THOMAS BROWN, Marham Hall Farm: THIRD PRIZE, 5*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

THOMAS BROWN, Marham Hall Farm: the *Reserve Number* to his 1 year, 4 months 2 weeks-old; bred by himself.

*Cotswolds—Rams of any other Age.*

THE EXECUTORS of the late THOMAS GILLETT, Kilkenny Farm, Faringdon: FIRST PRIZE, 20*l.*, for their 2 years, 4 months, 1 week-old; bred by the late Thomas Gillett.

THOMAS BROWN, Marham Hall Farm, Downham Market: SECOND PRIZE, 10*l.*, for his 3 years 4 months 2 weeks-old; bred by himself.

THOMAS BROWN, Marham Hall Farm: THIRD PRIZE, 5*l.*, for his 2 years, 4 months, 2 weeks-old; bred by himself.

The EXECUTORS of the late JOHN GODWIN, Troy Farm, Deddington, Oxfordshire: the *Reserve Number* to their 3 years, 4 months, 1 week-old: bred by the late John Godwin.

*Cotswolds—Pens of Five Shearling Ewes of the same Flock.*

RUSSELL SWANWICK, the Royal Agricultural College Farm, Cirencester, Gloucestershire; FIRST PRIZE, 15*l.*, for his between 1 year, 2 months, 2 weeks, and 1 year, 3 months, 2 weeks-old; bred by himself.

RUSSELL SWANWICK, the Royal Agricultural College Farm, Cirencester, Gloucestershire: SECOND PRIZE, 10*l.*, for his between 1 year, 2 months, 2 weeks, and 1 year, 3 months, 2 weeks-old; bred by himself.

CHRISTOPHER SPENCER, Gileston, Cowbridge, Glamorganshire: the *Reserve Number*, to his 1 year, 3 months, 2 weeks-old; bred by himself.

*Lincolns—Shearling Rams.*

WILLIAM F. MARSHALL, Branston, Lincoln: FIRST PRIZE, 20*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

THOMAS CARTWRIGHT, Dunston Pillar, Dunston, Lincolnshire: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

WILLIAM and HENRY DUDDING, Panton House, Wragby, Lincolshire: THIRD PRIZE, 5*l.*, for their 1 year, 3 months, 2 weeks-old; bred by themselves.

ROBERT JOHNSON, Kirkireton, Wirksworth, Derbyshire: the *Reserve Number* to his 1 year, 3 months, 2 weeks-old; bred by himself.

*Lincolns—Rams of any other Age.*

WILLIAM and HENRY DUDDING, Panton House, Wragby: FIRST PRIZE, 20*l.*, for their 3 years, 3 months, 2 weeks-old; bred by themselves.

ALGERNON HACK, Buckminster, Grantham, Lincolnshire: SECOND PRIZE, 10*l.*, for his 3 years, 4 months-old; bred by himself.

JOHN PEARS, Mere, Lincoln: THIRD PRIZE, 5*l.*, for his 3 years, 4 months-old; bred by himself.

WILLIAM and HENRY DUDDING, Panton House, Wragby: the *Reserve Number* to their 3 years, 3 months, 2 weeks-old; bred by themselves.

*Lincolns—Pens of Five Shearling Ewes of the same Flock.*

THOMAS GUNNELL, Willow House, Milton, Cambridge: FIRST PRIZE, 15*l.*, for his 1 year, 4 months-old; bred by himself.

THOMAS CARTWRIGHT, Dunston Pillar, Lincoln: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

JOHN PEARS, Mere, Lincoln: THIRD PRIZE, 5*l.*, for his 1 year, 4 months-old; bred by himself.

RICHARD NEWCOMBE MORLEY, Leadenham, Grantham, Lincolnshire: the *Reserve Number*, to his 1 year, 4 months-old; bred by himself.

### *Oxfordshire Downs—Shearling Rams.*

JOHN TREADWELL, Upper Winchendon, Aylesbury: FIRST PRIZE, 20*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

GEORGE WALLIS, Old Shifford, Bampton, Faringdon: SECOND PRIZE, 10*l.*, for his 1 year, 5 months, 2 weeks-old; bred by himself.

GEORGE WALLIS, Old Shifford, Bampton, Faringdon: THIRD PRIZE, 5*l.*, for his 1 year, 5 months, 2 weeks-old; bred by himself.

GEORGE WALLIS, Old Shifford, Bampton, Faringdon: *Reserve Number*, to his 1 year, 5 months, 2 weeks-old; bred by himself.

### *Oxfordshire Downs—Rams of any other Age.*

JAMES LONGLAND, Grendon, Northampton: FIRST PRIZE, 20*l.*, for his 4 years, 3 months, 3 weeks-old; bred by himself.

A. F. MILTON DRUCE, Burghfield, Reading: SECOND PRIZE, 10*l.*, for his 3 years, 5 months-old; bred by himself.

GEORGE WALLIS, Old Shifford: THIRD PRIZE, 5*l.*, for his 2 years, 5 months, 2 weeks-old; bred by himself.

GEORGE WALLIS, Old Shifford: *Reserve Number*, to his 2 years, 5 months, 2 weeks-old; bred by himself.

### *Oxfordshire Downs—Pens of five Shearling Ewes of the same Flock.*

A. F. MILTON DRUCE, Burghfield, Reading: FIRST PRIZE, 15*l.*, for his 1 year, 5 months-old; bred by himself.

CHARLES HOWARD, Biddenham, Bedford: SECOND PRIZE, 10*l.*, for his 1 year, 4 months-old; bred by himself.

FREDERICK STREET, Harrowden, Bedford: the *Reserve Number*, to his 1 year, 5 months-old; bred by himself.

### *Ryland and other Long-woolled Breeds—Shearling Rams.*

JOHN LYNN, Church Farm, Stroxton, Grantham: FIRST PRIZE, 15*l.*, for his Lincoln and Leicester, 1 year, 4 months-old; bred by himself.

JOHN LYNN, Church Farm, Stroxton, Grantham: SECOND PRIZE, 5*l.*, for his Lincoln and Leicester, 1 year, 4 months-old; bred by himself.

THOMAS W. D. HARRIS, Wootton, Northamptonshire: the *Reserve Number*, to his Lincoln and Leicester, 1 year, 4 months, 1 week-old; bred by himself.

### *Ryland and other Long-woolled Breeds—Pens of five Shearling Ewes of the same Flock.*

THOMAS W. D. HARRIS, Wootton: FIRST PRIZE, 10*l.*, for his Lincoln and Leicester, 1 year, 4 months, 2 weeks-old; bred by himself.

*Southdowns—Shearling Rams.*

Sir William Throckmorton, Bart., Buckland, Faringdon: First Prize, 20*l.*, for his 1 year, 4 months-old; bred by himself.

Sir William Throckmorton, Bart., Buckland, Faringdon: Second Prize, 10*l.*, for his 1 year, 4 months-old; bred by himself.

William Rigden, Hove, Brighton: Third Prize, 5*l.*, for his 1 year, 4 months-old; bred by himself.

The Duke of Richmond, K.G., Goodwood, Chichester: the *Reserve Number*, to his 1 year, 4 months-old; bred by himself.

*Southdowns—Rams of any other Age.*

Sir William Throckmorton, Bart., Buckland, Faringdon: First Prize, 20*l.*, for his 2 years, 4 months-old; bred by himself.

William Rigden, Hove, Brighton: Second Prize, 10*l.*, for his 2 years, 4 months-old; bred by himself.

William Rigden, Hove, Brighton: Third Prize, 5*l.*, for his 2 years, 4 months-old; bred by himself.

H.R.H. The Prince of Wales, K.G, Sandringham, King's Lynn: the *Reserve Number*, to his 2 years, 4 months-old; bred by His Royal Highness.

*Southdowns—Pens of five Shearling Ewes of the same Flock.*

The Duke of Richmond, K.G., Goodwood, Chichester: First Prize, 15*l.*, for his 1 year, 4 months-old; bred by himself.

Lord Sondes, Elmham Hall, Thetford, Norfolk: Second Prize, 10*l.*, for his 1 year, 4 months-old; bred by himself.

Colonel Kingscote, M.P., Kingscote Park, Wootton-under-Edge, Gloucestershire: Third Prize, 5*l.*, for his 1 year, 4 months-old; bred by himself.

Sir William Throckmorton, Bart., Buckland, Faringdon: the *Reserve Number*, to his 1 year, 4 months-old; bred by himself.

*Shropshires—Shearling Rams.*

Charles Byrd, Littywood, Stafford: First Prize, 20*l.*, for his 1 year, 4 months, 5 days-old; bred by himself.

Thomas Mansell, Adcott Hall, Baschurch, Salop: Second Prize, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

John Stubbs, Burston, Stone, Stafford: Third Prize, 5*l.*, for his 1 year, 4 months-old; bred by himself.

John Evans, Uffington, Shrewsbury: the *Reserve Number*, to his 1 year, 3 months, 3 weeks-old; bred by himself.

*Shropshires—Rams of any other Age.*

Thomas Mansell, Adcott Hall, Baschurch, Salop: First Prize, 20*l.*, for his 2 years, 4 months, 2 weeks-old; bred by himself.

John Evans, Uffington, Shrewsbury: Second Prize, 10*l.*, for his 2 years, 3 months, 1 week-old; bred by himself.

John Coxon, Freeford Farm, Lichfield: Third Prize, 5*l.*, for his 2 years, 3 months, 2 weeks-old; bred by himself.

THOMAS NOCK, Sutton Maddock, Shifnal: the *Reserve Number*, to his 3 years, 4 months, 3 weeks-old; bred by Mr. T. Mansell.

### *Shropshires—Pens of Five Shearling Ewes of the same Flock.*

SARAH BEACH, The Hattons, Brewood, Stafford: FIRST PRIZE, 15*l*., for her 1 year, 3 months, 2 weeks-old; bred by herself.

LORD CHESHAM, Latimer, Chesham, Bucks: SECOND PRIZE, 10*l*., for his 1 year, 3 months, 2 weeks-old; bred by himself.

LORD CHESHAM, Latimer, Chesham, Bucks: THIRD PRIZE, 5*l*., for his 1 year, 3 months, 2 weeks-old; bred by himself.

W. O. FOSTER, Apley Hall, Shifnal, Salop: the *Reserve Number*, to his 1 year, 3 months-old; bred by himself.

### **Shropshires—Ten Ewe Lambs.*

JOHN HANBURY BRADBURNE, Pipe Place, Lichfield; FIRST PRIZE, 15*l*., for his 4 months, 2 weeks-old; bred by himself.

SARAH BEACH, The Hattons, Brewood, Stafford: SECOND PRIZE, 10*l*., for her 3 months 3 weeks-old; bred by herself.

LORD CHESHAM, Latimer, Chesham, Bucks: THIRD PRIZE, 5*l*., for his 4 months-old; bred by himself.

### **Shropshires—Five Ram Lambs.*

SARAH BEACH, The Hattons, Brewood, Stafford: FIRST PRIZE, 15*l*., for her 3 months, 3 weeks-old; bred by herself.

THOMAS NOCK, Sutton Maddock, Shifnal, Salop: SECOND PRIZE, 10*l*., for his 3 months, 3-weeks-old; bred by himself.

HENRY SMITH, New House, Sutton Maddock, Shifnal: THIRD PRIZE, 5*l*., for his 4 months, 1 week-old; bred by himself.

LORD CHESHAM, Latimer, Chesham: the *Reserve Number*, to his 4 months-old; bred by himself.

A SILVER CUP, value 10*l*., given by R. H. Masfen, Esq., and other breeders of Shropshire sheep, to the exhibitor taking the greatest number of prizes in all the Shropshire classes, was awarded to Mrs. SARAH BEACH, The Hattons, Brewood.

### *Hampshire and other Short-woolled Breeds—Shearling Rams.*

JAMES RAWLENCE, Bulbridge, Wilton, Salisbury: FIRST PRIZE, 20*l*., for his Hampshire Down, 1 year, 5 months, 2 weeks-old; bred by himself.

ALFRED MORRISON, Fonthill House, Tisbury, Wilts: SECOND PRIZE, 10*l*., for his Hampshire Down, 1 year, 5 months-old; bred by himself.

ALFRED MORRISON, Fonthill House, Tisbury, Wilts: THIRD PRIZE, 5*l*., for his Hampshire Down, 1 year, 4 months-old; bred by himself.

ROBERT and JOHN RUSSELL, Horton Kirby, Dartford, Kent: the *Reserve Number*, to their Hampshire Down, 1 year, 5 months, 2 weeks-old; bred by themselves.

### *Hampshire and other Short-woolled Breeds—Rams of any other Age.*

JAMES RAWLENCE, Bulbridge, Wilton, Salisbury: FIRST PRIZE, 20*l*., for his Hampshire Down, 2 years, 5 months, 2 weeks-old; bred by himself.

*Hampshire and other Short-woolled Breeds—Pens of Five Shearling Ewes of the same Flock.*

JAMES RAWLENCE, Bulbridge, Wilton: FIRST PRIZE, 15*l*., for his Hampshire Down, 1 year, 5 months, 2 weeks-old; bred by himself.

JAMES RAWLENCE, Bulbridge, Wilton: SECOND PRIZE, 10*l*., for his Hampshire Down, 1 year, 5 months, 2 weeks-old; bred by himself.

The REV. THOMAS JOSEPH TORR, Dummer House, Basingstoke: the *Reserve Number*, to his Hampshire Down, 1 year, 4 months old; bred by himself.

*Dorsets—Shearling Rams.*

HENRY MAYO, Cokers Frome, Dorchester: FIRST PRIZE, 15*l*., for his 1 year, 6 months, 3 weeks, 3 days-old; bred by himself.

HENRY MAYO, Cokers Frome, Dorchester: SECOND PRIZE, 5*l*., for his 1 year, 5 months, 2 weeks-old; bred by himself.

*Cheviots—Rams of any Age.*

JOHN ROBSON, Bymess, Rochester, Northumberland: FIRST PRIZE, 15*l*., for his 3 years, 3 months-old; bred by himself.

JOHN ROBSON, Bymess, Rochester, Northumberland: SECOND PRIZE, 5*l*., for his 2 years, 3 months-old; bred by himself.

JOHN ROBSON, Bymess, Rochester, Northumberland: the *Reserve Number*, to his 2 years, 3 months-old; bred by himself.

*Cheviots—Pens of Five Ewes of any Age.*

JOHN ROBSON, Bymess, Rochester, Northumberland: FIRST PRIZE, 10*l*., for his 1 year, 3 months-old; bred by himself.

ALEXANDER ROXBURGH, Caerllo, Llanrwst, Denbighshire: SECOND PRIZE, 5*l*., for his 2 years, 3 months-old; bred by himself.

ALEXANDER ROXRURGH, Caerllo, Llanrwst, Denbighshire: the *Reserve Number*, to his 1 year, 3 months-old; bred by himself.

*Mountain—Pens of Five Ewes of any Age.*

JONATHAN PEEL, Knowlmere Manor, Clitheroe, Yorkshire: FIRST PRIZE, 10*l*., for his Lonk, about 2 years, and 3 years-old; bred by himself.

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## PIGS.

*Large White Breed—Boars above Twelve Months old.*

PETER EDEN, Cross Lane, Salford, Manchester: FIRST PRIZE, 20*l*., for "Victor 2nd," 3 years, 1 week, 1 day-old; bred by Messrs. J. and F. Howard, Bedford; sire, "Victor I.;" dam, "Longville;" sire of dam, "Gold Spur."

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey, Lincolnshire: SECOND PRIZE, 5*l*,, for his 2 years, 3 months, 1 week-old; bred by himself; sire, "Cultivator 6th;" dam, "Countess of Leicester."

HENRY GOODALL, Arcted, Sandbach, Cheshire: the *Reserve Number*, to "Young Casswell." 1 year, 11 months, 1 week, 2 days-old; bred by himself.

### *Large White Breed—Boars above Six and not exceeding Twelve Months old.*

FRANCIS H. EVERETT, Bridgham, Thetford: FIRST PRIZE, 10*l*., for "Sir Robert," 11 months, 2 weeks, 1 day-old; bred by himself: sire, "Samson 2nd;" dam, "Mrs. Samson;" sire of dam, "Samson 1st."

JOHN WHEELER, Long Compton, Shipston-on-Stour, Warwickshire: SECOND PRIZE, 5*l*., for "General," 10 months, 1 week-old; bred by himself; sire, "Admiral;" dam, "Miss Juvenile;" sire of dam, "Dreadnought 2nd."

FRANCIS H. EVERETT, Bridgham, Thetford: the *Reserve Number* to "The Duke," 9 months, 2 weeks-old; bred by himself; sire, "Samson 2nd;" dam, "Duchess; sire of dam, "Samson 1st."

### *Large White Breed—Breeding Sows.*

PETER EDEN, Cross Lane, Salford, Manchester: FIRST PRIZE, 10*l*., for "Great Western," 3 years, 4 months, 4 days-old; bred by himself; sire, "Hero;" dam, "Lucy;" sire of dam, "Victory."

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey: SECOND PRIZE, 5*l*., for his 1 year, 10 months-old, in-pig; bred by himself.

EDWARD DAVIS, Old Mill Street, Wolverhampton: the *Reserve Number*, to his 3 years, 6 months, 2 weeks, 4 days-old, in-pig; bred by himself.

### *Large White Breed—Pens of Three Breeding Sow Pigs of the same Litter, above Four and under Eight Months old.*

PETER EDEN, Cross Lane, Salford, Manchester: FIRST PRIZE, 10*l*., for his 7 months, 3 weeks, 2 days-old: bred by himself; sire, "Ranger;" dam, "Moss Rose;" sire of dam, "Madman."

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey: SECOND PRIZE, 5*l*., for his 7 months, 3 weeks-old; sire, "Victor;" bred by himself.

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey: the *Reserve Number*, to his 7 months, 3 weeks-old; bred by himself; sire, "Victor;" dam, "Victress."

### *Small White Breed—Boars above Twelve Months old.*

PETER EDEN, Cross Lane, Salford, Manchester: FIRST PRIZE, 10*l*., for his "Young Prince," 1 years, 10 months, 2 weeks, 3 days-old; bred by himself; sire, "Old Prince;" dam, "Violet;" sire of dam, "King Lear 1st."

JOHN SAGAR, Lister Hills, Bradford, Yorkshire: SECOND PRIZE, 5*l*., for "Premier," 2 years, 8 months-old; bred by himself; sire, "Prince Consort;" dam, "Beauty;" sire of dam, "Prince of Wales."

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey: the *Reserve Number*, to his 1 year, 9 months, 1 day-old; bred by himself; sire, "The Hermit."

### *Small White Breed—Boars above Six and not exceeding Twelve Months old.*

MATTHEW WALKER, Stockley Park, Anslow, Burton-on-Trent, : FIRST PRIZE, 10*l*., for "Little John," 10 months, 3 weeks, 2 days-old; bred by Mr. Eden, Cross Lane, Salford; sire, "Young King."

JOHN EDWARD FOX, Mansion House, Great Horton, Bradford: SECOND PRIZE, 5*l.*, for "Master McGrath," 11 months, 1 week, 5 days-old; bred by Mr. T. Holmes, Keighley, Yorkshire; sire, "Airedale Champion."

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey: the *Reserve Number*, to his 10 months, 2 days-old; bred by himself; sire "Peter;" dam, "Topsey."

### *Small White Breed—Breeding Sows.*

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey: FIRST PRIZE, 10*l.*, for "Topsey," 2 years, 2 months, 2 weeks-old; bred by himself; sire, "Jaspar."

CHARLES ROBERTS, Wakefield, Yorkshire: SECOND PRIZE, 5*l.*, for his "Annie," 1 year, 11 months, 4 weeks, 1 day-old; bred by Mr. J. Sagar, Lister Hills, Bradford; sire, "Pretender;" dam, "Alpha;" sire of dam, "King of the West."

CLEMENT R. N. BESWICK-ROYDS, Pyke House, Littleborough, Lancashire: "Wharfedale Queen," 1 year, 9 months, 1 week, 3 days-old, in-pig; bred by Mr. W. Parker, Bradford.

### *Small White Breed—Pens of Three Breeding Sow Pigs of the same Litter, above Four and under Eight Months old.*

PETER EDEN, Cross Lane, Salford, Manchester: FIRST PRIZE, 10*l.*, for his 7 months, 3 weeks, 1 day-old; bred by himself; sire, "British Workman;" dam, "Lancashire Maid;" sire of dam, "Hedgehog."

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey: SECOND PRIZE, 5*l.*, for his 7 months, 3 weeks, 2 days-old; bred by himself; sire, "Peter;" dam, "Rose."

JOHN CLARK ANDREW, Crewkerne, Somerset; the *Reserve Number*, to his 6 months, 1 week, 2 days-old; bred by himself; sire, "Brutus;" dam, "Lily."

### *Small Black Breed—Boars above Twelve Months old.*

WILLIAM MORTIMER WARE, Newham House, Helston, Cornwall: FIRST PRIZE, 10*l.*, for "Gem," 2 years, 3 months, 3 weeks-old; bred by Mr. T. Roberts, St. Levan, Penzance; sire, "Tancred;" dam, "Bessie."

HENRY CROSSLEY, Broomfield, Halifax, Yorkshire: SECOND PRIZE, 5*l.*, for "Black Prince," 2 years, 1 month-old; bred by Mr. Wormald, Dewsbury, Yorkshire.

HENRY CROSSLEY, Watkinson Hall Farm, Halifax, Yorkshire: the *Reserve Number*, to his 2 years, 3 months-old; breeder unknown.

### *Small Black Breed—Boars above Six and not exceeding Twelve Months old.*

W. MORTIMER WARE, Newham House, Helstone, Cornwall: FIRST PRIZE, 10*l.*, for "Ebony," 9 months, 1 week-old; bred by the Earl of Portsmouth, Eggesford House, Wemworthy, Devon; sire, "Bitter Beer;" sire of dam, "Bredalbane."

GEORGE MUMFORD SEXTON, Wherstead Hall, Ipswich: SECOND PRIZE, 5*l.*, for "Bothwell," 11 months, 4 days-old; bred by himself; sire, "Adventurer;" dam, "Achievement;" sire of dam, "Stockwell."

George Mumford Sexton, Wherstead Hall, Ipswich: the *Reserve Number*, to "Cremorne," 11 months, 1 day-old; bred by himself; sire, "Adventurer';" dam, "Queen of Trumps."

*Small Black Breed—Breeding Sows.*

George Mumford Sexton, Wherstead Hall, Ipswich, Suffolk: First Prize, 10*l.*, for "Hannah," 2 years, 11 months, 1 week, 4 days-old; bred by himself; sire, "Gladiateur;" dam, "Expectation;" sire of dam, "Negro."

William Hope, Parsloes, Barking, Essex: Second Prize, 5*l.*, for "Aunt Hannah," 2 years, 5 months-old, in-pig; bred by Mr. Biddle, Playford, Woodbridge.

Peter Eden, Cross Lane, Salford, Manchester: the *Reserve Number*, to "Sally," age and breeder unknown.

*Small Black Breed—Pens of Three Breeding Sow Pigs of the same Litter, above Four and under Eight Months old.*

George Mumford Sexton, Wherstead Hall, Ipswich, Suffolk: First Prize, 10*l.*, for his 7 months, 2 weeks, 2 days-old; bred by himself; sire, "Adventurer;" dam, "Hippia;" sire of dam, "Stockwell."

George Mumford Sexton, Wherstead Hall, Ipswich: Second Prize, 5*l.*, for his 6 months, 3 weeks, 5 days-old; bred by himself; sire, "Lord Lyons;" dam, "Hannah;" sire of dam, "Gladiateur."

Thomas Comber, Redcliffe, Newton-le-Willows, Lancashire: the *Reserve Number*, to his 4 months, 5 days-old; bred by himself; sire, "Young Black Prince;" dam, "Norma."

*Berkshire Breed—Boars above Twelve Months old.*

Russell Swanwick, Royal Agricultural College Farm, Cirencester, Gloucestershire: First Prize, 10*l.*, for his "Sambo 2nd," 2 years, 1 month-old; bred by himself; sire, "Othello;" dam, "Sally 3rd;" sire of dam, "2nd Duke of Gloucester."

Arthur Stewart, Saint Bridge, Gloucester: Second Prize, 5*l.*, for "King of the Valley," 1 year, 1 month, 1 week, 6 days-old; bred by himself; sire, "Sampson;" dam, "Bobtail 2nd;" sire of dam, "Tim Whiffler."

Heber Humfrey, Kingstone Farm, Shrivenham, Berkshire: the *Reserve Number*, to "Maple Grove," 1 year, 3 weeks, 6 days-old; bred by himself; sire, "Royal Oak;" dam, "Beauty Bewitched;" sire of dam, "Souse Genteel."

*Berkshire Breed—Boars above Six and not exceeding Twelve Months old.*

Russell Swanwick, Royal Agricultural College Farm, Cirencester: First Prize, 10*l.*, for "Sambo 4th," 10 months-old; bred by himself; sire, "H;" dam, sister to "Sally 4th;" sire of dam, "D."

Russell Swanwick, Royal Agricultural College Farm, Cirencester: Second Prize, 5*l.*, for "J 3," 11 months, 1 week, 6 days-old; bred by himself; sire, "H;" dam, "Topsy 3rd;" sire of dam, "D."

The Marquis of Westminster, Moat House, Tarporley, Cheshire: the *Reserve Number*, to his 7 months, 5 days-old; bred by himself; sire, "Bismark;" dam, "Black Diamond;" sire of dam, "Tippoo Saib,"

### *Berkshire Breed—Breeding Sows.*

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: FIRST PRIZE, 10*l.*, for sister to "Sally 5th," 2 years, month-old; bred by himself; sire, "Othello;" dam, "Sally 3rd;" sire of dam, "Second Duke of Gloucester."

LORD CLERMONT, Ravensdale Park, Newry, Ireland: SECOND PRIZE, 5*l.*, for "Octoroon," 1 year, 2 months, 2 weeks, 4 days-old, in-pig; bred by himself; sire, "Joe Hog;" dam, "Octoroon:" sire of dam, "Sampson."

RUSSELL SWANWICK, Royal Agricultural College, Cirencester: the *Reserve Number*, to "Sally 6th," 10 months-old, in-pig; bred by himself; sire, "H;" dam, sister to "Sally 4th;" sire of dam, "D."

### *Berkshire Breed—Pens of Three Breeding Sow Pigs, above Four and under Eight Months old.*

THE REV. HENRY G. BAILY, Swindon, Wilts: FIRST PRIZE, 10*l.*, for his 6 months, 3 weeks, 4 days-old; bred by himself; sire, "Malcolm;" dam, "Exquisite 5th;" sire of dam, "Harlequin."

JOHN GILBERT, Half-way Farm, Perry Bar, Birmingham: SECOND PRIZE, 5*l.*, for his 6 months, 1 week-old; bred by himself; sire, "Duke of Berks;" dam, "No. 5;" sire of dam, "Henley Lad."

RUSSELL SWANWICK, Royal Agricultural College Farm, Cirencester: the *Reserve Number*, to "A 2 Family," 7 months, 1 week-old; bred by himself; sire, "Sambo 2nd;" dam, "Sally 5th;" sire of dam, "Othello."

### *Other Breeds—Boars.*

JOHN EDWARD FOX, Mansion House, Horton, Bradford: FIRST PRIZE, 10*l.*, for "Young Prince of Airedale," 2 years, 8 months, 6 days-old; bred by Sir C. Tempest, Bart., Broughton Hall, Skipton; sire, "Young Prince of Airedale."

PETER EDEN, Cross Lane, Salford, Manchester: SECOND PRIZE, 5*l.*, for "Jackey;" age and breeder unknown.

THOMAS BANTOCK, Merridale House, Wolverhampton: the *Reserve Number*, to "Young Robin Hood," 6 months, 1 day-old; bred by himself; sire, "Old Robin Hood;" dam, "Pride of Merridale 2nd;" sire of dam, "Bedford Joe."

### *Other Breeds—Breeding Sows.*

PETER EDEN, Cross Lane, Salford, Manchester: FIRST PRIZE, 10*l.*, for "Busy Bee," 4 years, 5 months, 4 days-old; bred by himself; sire, "King Lear 1st;" dam, "Pride of the Village;" sire of dam, "King Lear 1st."

WILLIAM PARKER, Bradford: SECOND PRIZE, 5*l.*, for "Lady Sarah," 1 year, 10 months, 3 weeks, 1 day-old, in-pig; bred by Mr. J. Pickerdyke, Bradford; sire, "Young Longback;" dam, "Alice;" sire of dam, "Old Longback."

RICHARD E. DUCKERING, Northorpe, Kirton-Lindsey; the *Reserve Number*, to his 2 years, 5 months, 1 day-old; bred by himself; sire, "Cultivator 6th."

*Other Breeds—Pens of Three Breeding Sow Pigs, of the same Litter, above Four and under Eight Months old.*

Clement, R. U., Beswick-Royds, Pyke House, Littleborough, Lancashire; First Prize, 10*l.*, for "Rose," "Shamrock," and "Thistle," 7 months, 3 weeks-old; bred by Mr. Hatton, Addingham, Otley; sire, "Young Dutchman;" dam, "Miss Lucy;" sire of dam, "Joseph 2nd."

Thomas Bantock, Merridale House, Wolverhampton: Second Prize, 5*l.*, for his 7 months, 4 weeks, 1 day-old, in-pig; bred by himself; sire, "Old Robin Hood;" dam, "Black Nose;" sire of dam, "Bedford Joe."

Matthew Walker, Anslow, Burton-on-Trent: the *Reserve Number*, to "Three Lilies," 7 months, 3 weeks-old; bred by himself; sire, "Forest Boy;" dam, "Duchess;" sire of dam, "Bolivar."

## *WOOL.

*Six Shropshire Fleeces.*

Lord Chesham, Latimer, Chesham, Bucks: First Prize, 6*l.*
Charles R. Keeling, Yew Tree Farm, Penkridge, Staffordshire: Second Prize, 5*l.*
Sarah Beach, The Hattons, Brewood, Staffordshire: Third Prize, 4*l.*
Sir J. N. L. Chetwode, Bart., Oakley, Market-Drayton, Salop: Fourth Prize, 3*l.*
T. S. T. Carrington, Eaton, Doveridge, Derbyshire: Fifth Prize, 2*l.*
Sir J. N. L. Chetwode: the *Reserve Number.*

## *BUTTER.

*Six Pounds, to be made up in Pounds.*

Lord Chesham, Latimer, Chesham, Bucks: First Prize, 6*l.*
Sarah May Bartlam, The Downs, Much-Wenlock, Salop: Second Prize, 5*l.*
John Marson, Acton Mill, Stafford: Third Prize, 4*l.*
Edward Sharratt, jun., Dark Lane Farm, Longdon, Rugeley: Fourth Prize, 3*l.*
William P. Hammond, Pool Hall, Picton, Wolverhampton: Fifth Prize, 2*l.*
Thomas W. Peake, Compton, Wolverhampton: the *Reserve Number.*

## *CHEESE, the Produce of 1871.

*Coloured, over 6 inches thick.*

William Dudleston, New Lodge, Lilleshall, Newport, Salop: First Prize, 15*l.*
Thomas Simon, Tern Hill, Market Drayton: Second Prize, 10*l.*
Maria Barrs, Odstone Hall, Atherstone: Third Prize, 5*l.*
John Clay, Kinsall, Oswestry: the *Reserve Number.*

### *Coloured, under 6 inches thick.*

Ralph Arnold, Shakerstone, Atherstone: First Prize, 15*l.*
Maria Barrs, Odstone Hall, Atherstone: Second Prize, 10*l.*
William Smith, Rangemoor Farm, Burton-on-Trent: Third Prize, 5*l.*,
Henry Wood, Pucknall Farm, Romsey, Hants: the *Reserve Number.*

### *Uncoloured, over 6 inches thick.*

Henry Wood, Pucknall Farm, Romsey: First Prize, 15*l.*
George W. Prescott, Minshull Vernon, Middlewich, Cheshire: Second Prize, 10*l.*
George Gibbons, Tunley Farm, Bath: Third Prize, 5*l.*
George W. Prescott, Minshull Vernon: the *Reserve Number.*

### *Uncoloured, under 6 inches thick.*

James Harris, Fletchampstead, Coventry: First Prize, 15*l.*
William Smith, Rangemore Farm, Burton-on-Trent: Second Prize, 10*l.*
John Clubb, Tatenhill, Burton-on-Trent: Third Prize, 5*l.*
Henry Wood, Pucknall Farm, Romsey; the *Reserve Number.*

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## *DAIRYMAIDS.

To the maker of the Prize Butter and Cheese in each class, First, Second, and Third Prizes, in five classes, viz., 3*l.*, 2*l.*, and 1*l.* in each class.

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## FARM PRIZES.

### *For the Best Managed Arable Farm.*

George Townsend Forester, High Ercall, Wellington, Salop: First Prize, 100*l.*; given by the Landowners in Staffordshire and Shropshire.
Thomas Winterton, Alrewas Hays, Lichfield: Second Prize, 50*l.*; given by the Society.
William Brewster, Balderton Hall, Middle, Wem, Salop: Special Prize, 25*l.*; given by the Subscribers.
Elizabeth Sankey, Bratton Farm, Wellington, Salop: Special Prize, 25*l.*; given by the Subscribers.

### *For the Best Managed Dairy Farm.*

John Clay, Kinsale, Oswestry: First Prize, 100*l.*; given by the Landowners in Staffordshire and Shropshire.
Matthew Walker, Stockley Park, Anslow, Burton-on-Trent: Second Prize, 50*l.*; given by the Society.

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## IMPLEMENTS.

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### *Steam-Cultivating Machinery.*

John Fowler and Co., Leeds: First Prize, 100*l.*, for their 12-Horse-Power Double Set of Steam Ploughing and Cultivating Machinery, invented, improved, and manufactured by themselves.

JOHN FOWLER and Co.: SECOND PRIZE, 50*l.*, for their 20-Horse-Power Set of Steam Ploughing and Cultivating Machinery, invented, improved, and manufactured by themselves.

JOHN FOWLER and Co.: FIRST PRIZE, 50*l.*, for their 12-Horse-Power Single Set of Steam Ploughing and Cultivating Machinery, invented, improved, and manufactured by themselves. Total weight under 10 tons.

The RAVENSTHORPE ENGINEERING COMPANY, Ravensthorpe, Mirfield, Yorkshire: SECOND PRIZE, 5*l.*, for their Complete Set of Steam-Ploughing Tackle, invented by Messrs. Fisken, manufactured by themselves. Total weight not exceeding 10 tons.

JOHN FOWLER and Co.: FIRST PRIZE, 50*l.*, for their Combination of Machinery for the Cultivation of the Soil by an ordinary Agricultural Engine.

J. and F. HOWARD, Bedford: SECOND PRIZE, 25*l.*, for their Combination of Machinery for the Cultivation of the Soil by an ordinary Agricultural Engine.

TUXFORD and SONS, Boston, Lincolnshire: THE PRIZE of 20*l.* for their Cultivating Windlass, with Expanding Friction Couplings and Automatic Friction Brakes, invented, improved, and manufactured by themselves.

AMIES, BARFORD and Co., Peterborough: THE PRIZE of 10*l.* for their Anchor for Steam-CULTIVATION, invented by S. Campain, Deeping St. Nicholas, Spalding; improved and manufactured by themselves.

JOHN FOWLER and Co.: THE PRIZE of 25*l.* for their 4-Furrow Balance Plough, invented, improved, and manufactured by themselves.

JOHN FOWLER and Co.: THE PRIZE of 20*l.* for their Subsoil Plough, invented, improved, and manufactured by themselves.

JOHN FOWLER and Co.: THE PRIZE of 25*l.* for their 4-Furrow Balance Digger, invented and manufactured by themselves.

JOHN FOWLER and Co.: THE PRIZE of 25*l.* for their 5-Tine Light-Land Cultivator, invented and manufactured by themselves.

JOHN FOWLER and Co.: THE PRIZE of 20*l.* for their 11-Tine Turning Cultivator, invented and manufactured by themselves.

AMIES, BARFORD, and Co., Peterborough: THE PRIZE of 10*l.* for their Press-Wheel Roller or Clod-Crusher, invented and manufactured by themselves.

JAMES and FREDERICK HOWARD, Bedford: THE PRIZE of 10*l.* for their Set of Harrows, invented, improved, and manufactured by themselves.

JAMES and FREDERICK HOWARD: a PRIZE of 10*l.* for their Improved Drill, improved and manufactured by themselves.

JAMES COULTAS, Spittlegate, Grantham: a PRIZE of 10*l.* for his 8 ft. 6 in. 14-Row Corn and Seed Drill.

JOHN FOWLER and Co.: THE PRIZE of 10*l.* for their Set of Patent Root and Stone Eradicating Machinery, invented, improved, and manufactured by themselves.

JAMES and FREDERICK HOWARD: a PRIZE of 10*l.* for their Patent Combined Steam Ridging and Subsoil Plough.

JOHN FOWLER and Co.: a PRIZE of 10*l.* for their Patent Turning Harrows, with frame, fitted with ridging bodies.

AVELING and PORTER, Rochester: THE PRIZE of 50*l.* for their 10-Horse-Power Agricultural Locomotive Engine; invented and improved by Thomas Aveling, Rochester, and manufactured by themselves.

AVELING and PORTER, Rochester: HIGHLY COMMENDED for their 6-Horse-Power Agricultural Locomotive Engine; invented and improved by Thomas Aveling, and manufactured by themselves.

CHARLES BURRELL, Thetford: COMMENDED, for his 8-Horse-Power Traction Engine for Agricultural purposes, improved and manufactured by himself.

AVELING and PORTER: THE PRIZE of 20*l.* for their Low-sided Trolley for Agricultural purposes, to be drawn by an Agricultural Locomotive Engine; invented, improved, and manufactured by themselves.

HAYES and SON, Stamford: COMMENDED, for their Agricultural Waggon, to be drawn by an Agricultural Locomotive Engine; invented, improved, and manufactured by themselves.

JOHN FOWLER and Co.: the SILVER CUP, value 100*l.*, given by the Right Hon. Lord Vernon, President of the Society, for the best Combination of Machinery for the Cultivation of the Soil by Steam Pewer, the cost of which shall not exceed 700*l.*; the Engine to be Locomotive, and adapted for Thrashing and other Farm purposes.

## HOP MACHINERY.

COLEMAN and MORTON, Chelmsford: The PRIZE of 10*l.* for their Hop-Syringing Engine, with Branch Pipe and Delivery Hose, invented and manufactured by themselves.

WILLIAM WEEKS and SON, Maidstone: the PRIZE of 10*l.* for their Hop-Presser, with Case, improved and manufactured by themselves.

WILLIAM WEEKS and SON: the PRIZE of 10*l.* for their Sulphurating Machine, improved and manufactured by themselves.

## MISCELLANEOUS AWARDS.

MELLARD'S TRENT FOUNDRY, Rugeley: a SILVER MEDAL for the adaptation of the principle of the rotating disc mould-board, as shown on the American Plough entered among the Hop-cultivating Implements, invented by J. Godfrey; improved and manufactured by themselves.

JOHN FOWLER and Co.: a SILVER MEDAL for their Ditching Plough, for cutting open Ditches 20 inches wide and 18 inches deep, invented, improved, and manufactured by themselves.

RANSOMES, SIMS, and HEAD, Ipswich: a SILVER MEDAL for their 8-Horse-Power Agricultural Locomotive Engine, fitted with Thomson's patent elastic Tyres, invented by R. W. Thomson and John Head; improved and manufactured by themselves.

AVELING and PORTER: a SILVER MEDAL for their 6-Horse-Power Agricultural Locomotive Engine, fitted with internal Indiarubber Tyres, invented and improved by Thomas Aveling; mannfactured by themselves.

# AGRICULTURAL EDUCATION.

## *Examination Papers,* 1871.

### EXAMINATION IN AGRICULTURE.

Maximum Number of Marks, 200. Pass Number, 100.

*Tuesday, April* 18*th. Morning,* 10 *a.m. till* 1 *p.m.*

1. A farm of 300 acres of arable land is delivered over to an incoming tenant at Michaelmas, with 100 acres after a wheat crop, 90 acres after barley, 30 acres after beans, the remainder in clover of one year's ley, and swedes.

The incoming tenant desires to manage it on the four-field system; illustrate the cropping for the first three years, whereby this end may be obtained with the least loss of production.

2. Given a farm of 500 acres of arable land and 50 acres of pasture. The arable land is of the following character:—200 acres of thin weak soil resting on the chalk; 200 acres of deeper land with greater substance; and the remainder a mixture of marly clay resting on the green sand. Give systems of cropping adapted to each variety of soil, and showing the area of corn of different varieties, pulse and root crops to be grown each year.

In the above cases the farms are assumed to be in the neighbourhood of Cirencester, so as to give data of climate and elevation.

2. State the quantity and character of stock which should be kept on the preceding farm.

4. What should be a proper expenditure per acre in manual labour on a farm of the above character, distinguishing the amount incident to the horse labour and cultivation, harvesting and converting the produce; and the amount which may be reasonably expended in incidentals?

5. What modifications should be made in the rotation and management if these farms were in South Wales or the Eastern Counties?

6. What soil should be selected and management adopted to secure the largest possible crop of mangold wurzel?

7. Give the proportion of corn crops and pulse under the ordinary application of the 3-, 4-, and 5-field courses.

8. Give an estimate in detail of the cost of cultivation per acre for a crop of swedes and a crop of wheat on an average loam worth 30*s.* per acre.

*Afternoon,* vivâ voce *examination commencing at* 2 *o'clock.*

## EXAMINATION IN CHEMISTRY.

MAXIMUM NUMBER OF MARKS, 200. PASS NUMBER, 100.

### I. GENERAL CHEMISTRY.

*Wednesday, April 19th; Morning,* 10 *a.m. till* 1 *p.m.*

1. Explain fully one method of determining the proportion of aqueous vapour present in the atmosphere at any given time.

2. Describe the preparation of chlorine and of chloride of lime, and explain the chemistry of the processes. Give an account of the chief characters of those substances. What is the action of carbonic acid on the latter?

3. When two volumes of one gas (A) unite with one volume of another gas (B) to produce a compound (C), what is the general relation between the volume of C and the volume of A employed to produce it? Give some examples.

4. Name some common mineral substances containing sulphur, and give the chemical formula for each of them. Of what organic substances is sulphur a constituent? How can you demonstrate its presence in such substances?

5. What sort of impurities will a charcoal filter remove from water? What explanation do you give of the action of such a filter?

6. State in equations, or otherwise, the action of soda, lime, iron, and silver-nitrate respectively, with hydrochloric acid. Hence explain what is meant by chemical equivalence and quantivalence.

7. Explain how to find the proportion of carbon in an organic compound. 4·83 parts of an organic compound containing no nitrogen gave 9·23 of $CO^2$ and 5·61 of $H^2O$: find its formula.

8. State the composition of urea, and explain how it is readily converted into ammoniacal salts.

9. An infusion of malt contains a large quantity of sugar: state what variety of sugar it is, and what you know of the action by which it is produced. Is the quantity of sugar produced affected by using boiling water for the infusion? Give the reason for your answer. By what other means may a production of sugar from grain or other similar materials be effected?

### II. IN AGRICULTURAL CHEMISTRY.

*Wednesday, April 19th; Afternoon* 2 *p.m. till* 5 *p.m.*

1. Contrast the chemical properties of light sandy soils and heavy clay-land.

2. What are the best chemical means for raising the fertility of poor sandy soils and of heavy clay-soils?

3. Upon what soils and for what crops are potash-manures likely to be useful?

4. How do you determine the amount of potash in kainite or crude potash-salts?

5. Mention the conditions as regards soil, manures, and climate favourable or unfavovrable to the production of a large percentage of sugar in beet-roots.

6. How do you distinguish cane-sugar from grape-sugar; and how do you determine the amount of crystallizable sugar in beet-roots?

7. What is the composition of beet-root pulp and its nutritive value in comparison with ordinary mangold-wurzel?

8. What is the composition of raw and of boiled bones, and how do you ascertain whether bone-dust is genuine or adulterated?

9. Explain the chemical functions of the leaves of plants.

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## EXAMINATION IN MECHANICS AND NATURAL PHILOSOPHY.

Maximum Number of Marks 200. Pass Number 100.

*Thursday, April 20th, from* 10 *a.m. till* 1 *p.m.*

1. State the meaning of the terms *mass, density, specific gravity, force, accelerative effect of force.* When the accelerative effect of gravity near the earth's surface is stated to be 32·2, what units are used?

2. When a cart is drawn along a horizontal road what resistances have to be overcome? Why can a horse draw a greater weight on a tramway than on an ordinary macadamized road?

3. State the conditions which a good balance ought to satisfy. What is meant by the sensitiveness of a balance? What points in the arrangement of a balance must be attended to in order to render it sensitive?

4. A bottle when empty weighs 1000 grains, when full of water 2015 grains, when full of spirit 1873 grains. What is the specific gravity of the spirit? Explain how a correction is applied for the weight of the air displaced when it is required to make an accurate determination of specific gravity by means of the bottle.

5. State the conditions that must be fulfilled when a body is in equilibrium in still water.

State also the condition that the equilibrium be *stable.*

5. A body containing 50 lbs. of matter is acted on by a constant force. It is observed to move from rest, and in five seconds to describe a distance of 80·5 feet. Determine the magnitude of the force. How many pounds of matter would the force just support at a place where the accelerative effect of gravity is 32·2?

7. What is meant by the "dew point"? A room in a house has been kept without a fire through a long frost; if a sudden thaw comes

on it will probably be found that moisture is deposited on the inside of the walls of the room. Why is this so?

8. If the piston of a steam-engine is 2 feet in diameter and makes 20 strokes per minute, each 3 feet long; what must be the mean pressure of the steam per square inch if the engine work at the rate of 20-horse power?

9. Describe the piece of mechanism in an ordinary double-acting steam-engine, called "the parallel motion." And state what end it is designed to answer.

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## EXAMINATION IN MENSURATION AND LAND SURVEYING.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

*Thursday, April 20th, from 2 p.m. till 5 p.m.*

1. State the rule for finding the area of a triangle: (A) when the base and perpendicular are known, (B) when the three sides are known. Find the number of square feet in a triangular area whose sides are 3,501, 3,607, and 3,598 feet respectively.

2. State what is the relation between the circumference and diameter of a circle.

A block of wood is a perfect cylinder, and is found to be 127 inches in circumference, (A) find the diameter of the block. (B) When the block is cut square what is the length of one side of the square end?

3. The diameter of the bore of a cast-iron pipe is 4 inches, the thickness of the metal 1 inch. Given that the specific gravity of the metal is 7·2, find the weight of the pipe per foot.

4. State the steps by which you would find the centre of a circular grass plot, if you had pickets and ropes only.

5. Let ABCD be a rectangular piece of ground, and a point F is taken anywhere in the side AB, show how to draw through F a line, to a point in the opposite side CD, which shall divide the rectangle into two parts such that the area of one is twice that of the other.

6. Plot the following notes, and assuming that the first station is 9 feet above the level of a pond, find how much the last station is above the level of the same pond.

| DISTANCE. | BACK-SIGHT. | FORE-SIGHT. |
|---|---|---|
| 100 | 3·75 | 6·81 |
| 200 | 3·51 | 5·68 |
| 350 | 8·03 | 1·09 |
| 110 | 2·74 | 7·35 |
| 172 | 6·91 | 5·38 |

7. A, B, C, D, E, are five stations inclosing a wooded area. It is found by measurement that AB, BC, CD, and DE, are respectively 110, 96, 81, and 85 chains in length, also that at A, the bearing of B is 31° N. of E.; at B that of C is 63° S. of E.; at C that of D is 71° S. of W.; at D that of E is due west. Plot these points and determine from your figure the number of acres in the enclosure ABCDE. Also if EA were measured to test the work what length would it be, if the other measurements were all right?

8. ABC is an equilateral triangle, each side being a mile long. A station P is placed in the prolongation of AB and it is found that the angle subtended at P by BC is 21° 15′, find the distance of P from C.

9. In a triangle two sides are respectively 2107 yards, and 1563 yards, and they contain an angle of 34° 18′. Find the remaining angles of the triangle.

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## EXAMINATION IN BOOKKEEPING.

Maximum Number of Marks, 200. Pass Number, 100.

*Friday, April 21st, from 10 a.m. till 1 p.m.*

Journalise and post into a ledger, in proper technical language, the following series of facts and transactions; and from such ledger make out a Trial Balance, a Profit and Loss Account, and a Balance Sheet.

Liabilities and assets of John Holmes, Corn Merchant, at 31st December, 1870:—

| | | £ | s. | d. |
|---|---|---|---|---|
| Liabilities. | | | | |
| | Amount due B. Jones .. .. .. .. .. .. | 175 | 0 | 0 |
| | Bill payable, due January 31, 1871 .. .. .. | 150 | 0 | 0 |
| Assets. | | | | |
| | Stock of corn in hand .. .. .. .. .. .. | 1300 | 0 | 0 |
| | Amount in deposit at Alliance Bank .. .. .. | 750 | 0 | 0 |
| | J. Brown's promissory note due 14th January, 1871 | 150 | 0 | 0 |
| | Cash in current banking account .. .. .. .. | 320 | 0 | 0 |
| | Business premises and stores, valued at .. .. | 560 | 0 | 0 |
| 1871. | | | | |
| Jan. | 4. Drawn from bank for petty cash .. .. | 25 | 0 | 0 |
| ,, | 6. Bought for cash 40 quarters corn, at 49*s.* per quarter .. .. .. .. .. .. .. | 98 | 0 | 0 |
| ,, | 9. Sold corn for cash .. .. .. .. .. .. | 750 | 0 | 0 |
| ,, | 12. Bought of J. Smith, corn value .. .. .. | 300 | 0 | 0 |
| ,, | 13. Accepted J. Smith's draft at 3 months, being in payment of above purchase .. .. .. | 300 | 0 | 0 |
| ,, | 15. J. Brown's promissory note due 14th inst. returned dishonoured .. .. .. .. .. | 150 | 0 | 0 |
| ,, | Paid out of Petty cash for noting ditto .. | 0 | 1 | 6 |
| ,, | 16. Sold to B. Jones, corn value .. .. .. | 235 | 0 | 0 |

| Assets. | | | £ | s. | d. |
|---|---|---|---|---|---|
| Jan. | 17. | Consigned to D. Bell to be sold by him for my account and risk, corn invoiced at .. | 435 | 0 | 0 |
| ,, | 18. | Received from J. Brown composition of 18s. in the £ .. .. .. .. .. .. | 135 | 0 | 0 |
| | | and wrote off as a bad debt the balance at his debit .. .. .. | | | |
| ,, | 19. | Transferred from current to deposit account at Alliance Bank .. .. .. .. .. | 250 | 0 | 0 |
| ,, | 20. | Received from D. Bell advice that he had sold the corn consigned to him to L. Brook for .. .. .. .. .. .. .. | 505 | 0 | 0 |
| ,, | 21. | Paid cash for insurance of business premises | 12 | 10 | 0 |
| ,, | 23. | Received from L. Brook his promissory note, being in payment of corn sold to him by D. Bell on my account .. .. | 505 | 0 | 0 |
| ,, | 24. | Discounted L. Brook's promissory note, receiving in cash .. .. .. .. .. .. | 498 | 10 | 0 |
| | | And allowed for discount .. .. | 6 | 10 | 0 |
| ,, | 25. | Bought corn valued at .. .. .. .. .. | 315 | 0 | 0 |
| | | and paid in cash .. .. .. .. | 310 | 0 | 0 |
| | | discount allowed me .. .. .. | 5 | 0 | 0 |
| ,, | 27. | Sold to J. Smith, corn value .. .. .. | 300 | 0 | 0 |
| | | and received in exchange my acceptance cancelled | | | |
| ,, | 28. | Amount drawn from bank for private expenses .. .. .. .. .. .. .. .. | 25 | 0 | 0 |
| ,, | 31. | Paid bill due this day .. .. .. .. .. | 150 | 0 | 0 |
| ,, | | Paid salary of clerk .. .. .. .. .. .. | 15 | 0 | 0 |
| ,, | | Paid out of petty cash this month for stationery, &c. .. .. .. .. .. .. .. | 5 | 15 | 0 |
| ,, | | Estimated wear and tear of premises for month .. .. .. .. .. .. .. .. | 2 | 0 | 0 |
| ,, | | Interest allowed by Alliance Bank on cash in deposit, and added to the amount of principal .. .. .. .. .. .. .. | 2 | 3 | 6 |
| ,, | | Stock of corn in hand .. .. .. .. .. | 400 | 0 | 0 |

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## EXAMINATION IN GEOLOGY.

Maximum Number of Marks, 100. Pass Number, 50.

*Friday, April 21st, from 2 p.m. till 5 p.m.*

1. Give a classification of rocks according to their various modes of *origin.* Mention some examples.

2. Draw a rough map of England showing the general position of the mining and the manufacturing districts, and point out how far the industry of each has been determined by its geological structure.

3. Name the geological formation which frequently overlies uncon-

formably the regular stratified deposits of central and eastern England. State its general character, mode of occurrence, and probable origin.

4. Construct a table of the sub-divisions of the cretaceous rocks, indicating the arenaceous, argillaceous, and calcareous beds.

5. Give the general distribution of the cretaceous rocks, and mention any facts as to their agricultural character, and to the economical substances obtained from them.

6. In what counties are the fen-lands of England situated? Name the geological formation which immediately underlies them in the different districts.

7. Give the palæontological characteristics of the Palæozoic, Mesozoic, and Cainzoic rocks.

8. What is the general character of the carboniferous flora?

9. Define briefly and illustrate by diagrams the following terms:—dip, strike, outcrop, fault, and unconformability.

10. Draw a geological section across any part of England and Wales from west to east.

11. In the deep vales of Somerset and Gloucestershire, rich pastures cover the lower levels, while arable lands extend along the sides. Is there any connection between these facts and the geological structure of the valleys in question?

12. Name the specimens on the table.

## EXAMINATION IN BOTANY.

Maximum Number of Marks, 100. Pass Number, 50.

*Saturday, April 22nd, from* 10 *a.m. till* 1 *p.m.*

1. What are the distinctive characters between roots and stems? Define the following:—corm, bulb, tuber, tubercule, rhizome, parasite, and epiphyte.

2. Distinguish between determinate and indeterminate inflorescences. Define a spike, spikelet, amentum, raceme, panicle, and cyme.

3. What is the carpel? Describe its parts; and enumerate and explain the different kinds of placentation.

4. Describe the manner in which seeds germinate; mention the conditions favourable to that process, and state the differences between the germination of dicotyledonous and monocotyledonous seeds.

5. What are the substances required for the support of plant-life; and in what manner are they taken up by plants?

6. Give the botanical names and natural orders of the following plants:—mustard, medick, sainfoin, carrot, buckwheat, and mangold-wurzel.

7. Name the natural orders to which the plants marked B C D respectively belong; and give your reasons for so referring them.

8. Describe the plant marked A, in English technical language, and in the proper sequence of its organs.

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## EXAMINATION IN ANATOMY AND ANIMAL PHYSIOLOGY.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

*Saturday, April 22nd, from 2 p.m. till 5 p.m.*

1. Describe the differences which exist in the appearance of the fibres of a voluntary and an involuntary muscle when magnified, and give familiar examples of each.

2. Name the uses to which involuntary muscles are applied.

3. Describe the means by which the body is supported in an erect position when perfectly quiescent.

4. State the number of the ribs—true and false—met with in the horse, ox, and sheep respectively, and describe the differences in the attachment of the true ribs to the sternum in the ox and sheep, compared with the horse.

5. Describe the general form of the sternum of the ox, and name some of the advantages arising from its shape, and its peculiar attachment to the ribs.

6. Name the organs and their uses which are placed in the cavity of a quadruped, formed by the spine above, the sternum below, and the ribs on either side.

7. State whether the blood is of the same colour in both sides of the heart, and the causes why a difference exists—if any.

# MEMORANDA.

ADDRESS OF LETTERS.—The Society's office being situated in the postal district designated by the letter W. members in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

GENERAL MEETING in London, in December, 1871.

GENERAL MEETING in London, May 22nd, 1872, at 12 o'clock.

MEETING at Cardiff, July 15th and four following days, 1872.

MONTHLY COUNCIL (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council and Governors of the Society.

ADJOURNMENTS.—The Council adjourn over Passion and Easter weeks, when those weeks do not include the first Wednesday of the month; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to the first Wednesday in February.

OFFICE HOURS.—10 to 4. From the Council Meeting in August until the Council Meeting in April, on Saturdays, 10 to 2.

DISEASES of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society; and of sending animals to the Royal Veterinary College, on the same terms as if they were subscribers to the College.—(A statement of these privileges will be found in the Appendix.)

CHEMICAL ANALYSIS.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in the Appendix to the present volume.

BOTANICAL PRIVILEGES.—The Botanical Privileges enjoyed by Members of the Society will be found stated in the Appendix to the present volume.

SUBSCRIPTIONS.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10. Members who have paid their annual subscription for 20 years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single payment of £5.

PAYMENTS.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the office of the Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post-offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin can be remitted by post, unless the letter be registered.

NEW MEMBERS.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

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:—One Halfpenny for every two ounces or fractional part of that weight.

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*** Members may obtain on application to the Secretary copies of an Abstract of the Charter and Bye-laws, of a Statement of the General Objects, &c., of the Society, of Chemical, Botanical, and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

# Members' Veterinary Privileges.

## I.—Serious or Extensive Diseases.

No. 1. Any Member of the Society who may desire professional attendance and special advice in cases of serious or extensive disease among his cattle, sheep, or pigs, and will address a letter to the Secretary, will, by return of post, receive a reply stating whether it be considered necessary that Professor Simonds, the Society's Veterinary Inspector, should visit the place where the disease prevails.

No. 2. The remuneration of the Inspector will be 2*l.* 2*s.* each day as a professional fee, and 1*l.* 1*s.* each day for personal expenses; and he will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. The fees will be paid by the Society, but the travelling expenses will be a charge against the applicant. This charge may, however, be reduced or remitted altogether at the discretion of the Council, on such step being recommended to them by the Veterinary Committee.

No. 3. The Inspector, on his return from visiting the diseased stock, will report to the Committee, in writing, the results of his observations and proceedings, which Report will be laid before the Council.

No. 4. When contingencies arise to prevent a personal discharge of the duties confided to the Inspector, he may, subject to the approval of the Committee, name some competent professional person to act in his stead, who shall receive the same rates of remuneration.

## II.—Ordinary or Other Cases of Disease.

Members may obtain the attendance of the Veterinary Inspector on any case of disease by paying the cost of his visit, which will be at the following rate, viz., 2*l.* 2*s.* per diem, and travelling expenses.

## III.—Consultations without visit.

| | |
|---|---|
| Personal consultation with Veterinary Inspector .. .. | 5*s.* |
| Consultation by letter .. .. .. .. .. .. | 5*s.* |
| Consultation necessitating the writing of three or more letters. | 10*s.* |
| Post-mortem examination, and report thereon .. .. .. | 10*s.* |

A return of the number of applications during each half-year being required from the Veterinary Inspector.

## IV.—Admission of Diseased Animals to the Veterinary College Investigations, Lectures, and Reports.

No. 1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the same terms as if they were Members of the College; viz., by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs "a small proportionate charge to be fixed by the Principal according to circumstances."

No. 2. The College has also undertaken to investigate such particular classes of disease, or special subjects connected with the application of the Veterinary art to cattle, sheep, and pigs, as may be directed by the Council.

No. 3. In addition to the increased number of lectures now given by Professor Simonds—the Lecturer on Cattle Pathology—to the pupils in the Royal Veterinary College, he will also deliver such lectures before the Members of the Society, at their house in Hanover Square, as the Council shall decide.

No. 4. The Royal Veterinary College will from time to time furnish to the Council a detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary.

By order of the Council,

H. M. JENKINS, *Secretary.*

# Members' Privileges of Chemical Analysis.

The Council have fixed the following rates of Charge for Analyses to be made by the Consulting Chemist for the *bonâ-fide* use of Members of the Society; who (to avoid all unnecessary correspondence) are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens, must be paid to him by members at the time of their application.

| | |
|---|---|
| No. 1.—An opinion of the genuineness of Peruvian guano, bone-dust, or oil-cake (each sample) .. .. .. .. .. .. | 5*s.* |
| ,, 2.—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts, and ammonia .. .. .. .. .. .. | 10*s.* |
| ,, 3.—An estimate of the value (relatively to the average of samples in the market) of sulphate and muriate of ammonia, and of the nitrates of potash and soda .. .. | 10*s.* |
| ,, 4.—An analysis of superphosphate of lime for soluble phosphates only .. .. .. .. .. .. | 10*s.* |
| ,, 5.—An analysis of superphosphate of lime, showing the proportions of moisture, organic matter, sand, soluble and insoluble phosphates, sulphate of lime, and ammonia .. | £1. |
| ,, 6.—An analysis (sufficient for the determination of its agricultural value) of any ordinary artificial manure .. .. | £1. |
| ,, 7.—Limestone:—the proportion of lime, 7*s.* 6*d.*; the proportion of magnesia, 10*s.*; the proportion of lime and magnesia .. .. .. .. .. .. .. | 15*s.* |
| ,, 8.—Limestone or marls, including carbonate, phosphate, and sulphate of lime, and magnesia with sand and clay .. | £1. |
| ,, 9.—Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime .. .. | £1. |
| ,, 10.—Complete analysis of a soil .. .. .. .. .. | £3. |
| ,, 11.—An analysis of oil-cake, or other substance used for feeding purposes; showing the proportion of moisture, oil, mineral matter, albuminous matter, and woody fibre; as well as of starch, gum, and sugar, in the aggregate | £1. |
| ,, 12.—Analyses of any vegetable product .. .. .. .. | £1. |
| ,, 13.—Analyses of animal products, refuse substances used for manure, &c. .. .. .. .. .. from 10*s.* to | 30*s.* |
| ,, 14.—Determination of the "hardness" of a sample of water before and after boiling .. .. .. .. . | 10*s.* |
| ,, 15.—Analysis of water of land drainage, and of water used for irrigation .. .. .. .. .. .. .. | £2. |
| ,, 16.—Determination of nitric acid in a sample of water .. .. | £1. |

N.B.—*The above Scale of Charges is not applicable to the case of persons commercially engaged in the Manufacture or Sale of any Substance sent for Analysis.*

The Address of the Consulting Chemist of the Society is, Dr. Augustus Voelcker, F.R.S., 11, Salisbury Square, London, E.C., to which he requests that all letters and parcels (postage and carriage paid) should be directed.

By order of the Council,

H. M. JENKINS, *Secretary.*

# INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil silk, about 3 ozs. of the well-mixed sample, and send it to 11, SALISBURY SQUARE, FLEET STREET, E.C., by sample post: or place the mixed manure in a small wooden or tin box, which may be tied by string, but must not be sealed, and send it by sample post. If the manure be very wet and lumpy, a larger boxful, weighing from 12 to 15 ozs., should be sent either by sample post or railway.

There must be no writing or printing in the packet or its cover in addition to the address: DR. AUGUSTUS VOELCKER, 11, SALISBURY SQUARE, FLEET STREET, LONDON, E.C., and the address of the sender of the parcel, and the number or mark of the article sent.

These particulars must in all cases be given not on loose pieces of paper but on small labels attached to the samples or packages containing them.

The samples must be sent in covers, open at the ends or in boxes, bags of linen or other materials, which may be fastened by string, but must not be sealed, so as to be easily examined. No parcel sent by sample post must exceed 12 ozs. in weight, or 2 feet in length, or 1 foot in width or depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel train to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 ozs., should be sent enclosed in small linen bags, or wrapped in paper.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by sample post. The piece should weigh from 12 to 15 ozs. If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 ozs. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by sample post.

On forwarding samples, separate letters should be sent by post to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

H. M. JENKINS, *Secretary.*

# Members' Botanical Privileges.

The Council have provisionally fixed the following rates of Charge for the examination of Plants and Seeds for the *bonâ fide* use of Members of the Society, who are particularly requested, when applying to the Consulting Botanist, to mention the kind of examination they require, and to quote its number in the subjoined Schedule. The charge for examination must be paid to the Consulting Botanist at the time of application, and the carriage of all parcels must be prepaid.

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|---|---|---|
| No. 1. | —A general opinion as to the genuineness and age of a sample of clover-seed (each sample) .. .. .. | 5*s*. |
| ,, 2. | —A detailed examination of a sample of dirty or impure clover-seed, with a report on its admixture with seeds of dodder or other weeds (each sample) .. .. .. | 10*s*. |
| ,, 3. | —A test examination of turnip or other cruciferous seed, with a report on its germinating power, or its adulteration with 000 seed (each sample) .. .. .. | 10*s*. |
| ,, 4. | —A test examination of any other kind of seed, or corn, with a report on its germinating power (each sample) .. | 10*s*. |
| ,, 5. | —Determination of the species of any indigenous British plant (not parasitic), with a report on its habits (each species) .. .. .. .. .. .. .. | 5*s*. |
| ,, 6. | —Determination of the species of any epiphyte or vegetable parasite, on any farm-crop grown by the Member, with a report on its habits, and suggestions (where possible) as to its extermination or prevention (each species) .. | 10*s*. |
| ,, 7. | —Report on any other form of plant-disease not caused by insects .. .. .. .. .. .. .. | 10*s*. |
| ,, 8. | —Determination of the species of a collection of natural grasses indigenous to any district on one kind of soil (each collection) .. .. .. .. .. .. | 10*s*. |

## INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES.

In sending seed or corn for examination the utmost care must be taken to secure a fair and honest sample. If anything supposed to be injurious or useless exists in the corn or seed, selected samples should also be sent.

In collecting specimens of plants, the whole plant should be taken up, and the earth shaken from the roots. If possible the plants must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. Place them in a bottle, or pack them in tin-foil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

N.B.—*The above Scale of Charges is not applicable in the case of Seedsmen requiring the services of the Consulting Botanist.*

Parcels or letters (Carriage or Postage prepaid) to be addressed to Mr. W. Carruthers, F.R.S., 25, Wellington Street, Islington, London.

H. M. Jenkins, *Secretary.*

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