DAIRY
CALENDAR
1895

F. W. WOLL

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THE UNIVERSITY OF CHICAGO
 

1895

DAIRY CALENDAR

FOR

1895.

*A REFERENCE-BOOK FOR DAIRYMEN,
BUTTER AND CHEESE MAKERS.*

BY

F. W. WOLL,

ASSISTANT PROFESSOR OF AGRICULTURAL CHEMISTRY,
UNIVERSITY OF WISCONSIN.

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51/91. Aug. 16/12
H. G. H.

PREFACE.

IN order to thoroughly master their business, dairy farmers, as well as butter and cheese makers, must possess a good deal of special knowledge as regards the properties and constitution of milk and dairy products, the feeding of dairy cows, the composition of feeding-stuffs, etc., besides the mere technical part of their profession. I have in this little volume endeavored to gather in a condensed form the main facts furnishing information on these points, and, to increase the usefulness of the book, have sought the co-operation of well-known specialists who have discussed subjects in their particular line of study in a comprehensive, but concise manner. The secretaries of the various dairy-breed associations were invited to prepare short articles on the origin, characteristics, and peculiar merits of their respective breeds, and a majority of them availed themselves of the opportunity to introduce their favorites to the readers of the Calendar; others found it impossible to respond to the invitation in the time set. My colleagues, Messrs. Russell, Richter, Decker, and Clark, have discussed topics in their special lines, and Mr. H. B. Gurler, the well-known Illinois dairyman and author of "American Dairy-ing," has explained Modern Butter-making.

The value of the book has been greatly increased by the articles furnished by these gentlemen, and I desire to tender them my thanks for their kind assistance. My thanks are also due to the many who have furnished me with information embodied in the Directory part of the Calendar. I do not claim completeness for the Directory;

it is only a first effort in the way of binding together to some extent various State institutions and organizations working for the same ends.

The tables given have been carefully selected and verified where it was practicable to do so; due credit has been given where the authors were known, or where the tables were taken from other works of reference. The discussions and explanations entered upon are intended to be suggestive, rather than exhaustive. No dairyman, butter- or cheese-maker will be likely to master the theoretical part of the subject by even a close study of the information given in this book, but having studied his profession at a dairy school or an agricultural college, he will be in a position to derive great benefit from consulting the data presented, and to draw from them many lessons of value to him in his daily work. In the competition and the constant struggle for improvement of our times, dairying and the manufacture of dairy products can no longer be expected to yield fair profits for the labor spent, unless the worker brings to his work a well-trained mind and a clear understanding of the principles underlying his profession. Only where this is the case will this small volume be of the greatest assistance.

I shall be very glad to be informed of any mistakes which may have crept in, and to receive any suggestions aiming toward the improvement of the Calendar.

F. W. WOLL.

WISCONSIN EXPERIMENT STATION,
MADISON, WIS., Dec. 1894.

ERRATA.

OWING to the fact that the author did not proof-read the last fifty pages of the Calendar, a number of typographical and other errors are found in this part; the most important ones are given below:

- Page 288, line 18 from below, *millimeters*, read *milliliters*.
308, line 5 from above, *G. E. Morrow*, read *E. Davenport*.
312, after line 3 from below, add *South Dakota, A. H. Wheaton, Brookings, Pres.*
313, lines 1-6 from below go on page 314, after line 21 from above.
315, line 11 from below, read *Mr. H. B. Gurler*.
316, line 11 from above, read *Prof. H. J. Detmers*.
318, line 7 from above, read *Prof. T. L. Haecker*.
320, lines 7-12 from above, go on p. 319, after line 13 from above.
321, line 1 from above, read *Kleinhof-Tapiau; Memmingen*.
321-23. All the institutes given are in the Province of Ontario, Canada. Institutes in various parts of the United States left out by mistake. See *Agricultural Calendar* for 1895, by the author.
322, line 1 from above, read *Dufferin*.
322, line 19 from above, read *Blenheim*.
325, line 17 from below, add *weekly*, after *Chicago, Ill.*
327, line 5 from above, read *Fleischmann*.
" 10 from above, read *Eugling*.
" 13 from above, read *du*.

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CALENDAR FOR 1895.

	SUNDAY.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
Jan.....	6 13 20 27	7 14 21 28	1 8 15 22 29	2 9 16 23 30	3 10 17 24 31	4 11 18 25	5 12 19 26
Feb.....	3 10 17 24	4 11 18 25	5 12 19 26	6 13 20 27	7 14 21 28	1 8 15 22	2 9 16 23
March ..	3 10 17 24 31	4 11 18 25	5 12 19 26	6 13 20 27	7 14 21 28	1 8 15 22 29 30	2 9 16 23
April....	7 14 21 28	8 15 22 29	9 16 23 30	10 17 24	11 18 25	12 19 26 27	13 20
May.....	5 12 19 26	6 13 20 27	7 14 21 28	1 8 15 22 29 30	2 9 16 23 31	3 10 17 24	4 11 18 25
June....	2 9 16 23 30	3 10 17 24	4 11 18 25	5 12 19 26	6 13 20 27 28	7 14 21 22	1 8

	SUNDAY.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
July.....	7 14 21 28	8 15 22 29	9 16 23 30	10 17 24 31	11 18 25	12 19 26	13 20 27
Aug.....	4 11 18 25	5 12 19 26	6 13 20 27	7 14 21 28	1 8 15 22 29 30	2 9 16 23	3 10 17 24
Sept....	1 8 15 22 29	2 9 16 23 30	3 10 17 24	4 11 18 25	5 12 19 26 27 28	6 13 20	7 14
Oct.....	6 13 20 27	7 14 21 28	8 15 22 29	9 16 23 30	10 17 24 31	11 18 25	12 19
Nov.....	3 10 17 24	4 11 18 25	5 12 19 26	6 13 20 27	7 14 21 28	8 15 22 29	9 16 23 30
Dec.....	1 8 15 22 29	2 9 16 23 30	3 10 17 24 31	4 11 18 25	5 12 19 26 27 28	6 13 20	7 14

ECLIPSES, 1895.

Five Eclipses occur this year, two of the Moon and three of the Sun, as follows :

I. A Total Eclipse of the Moon, March 10, visible in North and South America, Europe and Western Asia.

II. A Partial Eclipse of the Sun, March 26, invisible in the United States ; visible in Western Europe, England and Western Spain, Portugal and France ; also in the north-eastern provinces of British America.

III. A Partial Eclipse of the Sun, Aug. 20, invisible in America ; visible in Northwestern Asia and Europe east of St. Petersburg.

IV. A Total Eclipse of the Moon, Sept. 3 and 4, visible in North and South America, Western Europe and Africa.

V. A Partial Eclipse of the Sun, Sept. 18, visible in Northern Australia, New Zealand and the Pacific Ocean.

MORNING AND EVENING STARS.

VENUS, morn., after September 19 ; ev., until September 18.

MARS, morn., after October 11 ; ev., until October 11.

JUPITER, morn., from July 10 to October 12 ; ev., until July 10 and after October 12.

SATURN, morn., until February 5 and after November 2 ; ev., from February 5 to November 2.

FIXED AND MOVABLE FEASTS OR FESTIVALS.

Septuagesima Sun.	Feb. 10	Easter Sunday	Apr. 14
Sexagesima " . . . "	17	Low Sunday	" 21
Quinquagesima Sun.	" 24	Rogation Sunday	May 19
Shrove Tuesday	" 26	Ascension Day	" 23
Ash Wednesday	" 27	Whit-Sunday (Pent.)	June 2
Quadragesima Sun.	Mar. 3	Trinity "	" 9
St. Patrick's Day	" 17	Corpus Christi	" 13
Mid-Lent Sunday	" 24	Michaelmas	Sept. 29
Palm Sunday	Apr. 7	Advent Sunday	Dec. 1
Good Friday	" 12	Christmas Day	" 25

INTEREST TABLES.

4%	\$1	\$2	\$3	\$4	\$5	\$6	\$7	\$8	\$9	\$10	\$100	\$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	5	45
8 "	0	0	0	0	0	0	0	0	1	1	9	89
12 "	0	0	0	0	0	1	1	1	1	2	13	1.34
16 "	0	0	0	0	1	1	1	2	2	2	18	1.78
20 "	0	0	0	1	1	2	2	2	2	2	22	2.22
24 "	0	0	1	1	2	2	2	2	3	3	27	2.67
28 "	0	0	1	1	2	2	2	3	3	3	31	3.11
1 MO..	0	0	1	2	2	2	3	3	3	3	33	3.34
2 "	0	2	2	3	4	4	5	6	6	7	67	6.67
3 "	1	2	3	4	5	6	7	8	9	10	1.00	10.00
6 "	2	4	6	8	10	12	14	16	18	20	2.00	20.00
1 YR..	4	8	12	16	20	24	28	32	36	40	4.00	40.00

5%	\$1	\$2	\$3	\$4	\$5	\$6	\$7	\$8	\$9	\$10	\$100	\$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	6	56
8 "	0	0	0	0	0	0	1	1	1	1	11	1.11
12 "	0	0	0	0	1	1	1	2	2	2	17	1.67
16 "	0	0	0	1	1	2	2	2	2	2	22	2.22
20 "	0	0	1	1	2	2	2	2	3	3	27	2.74
24 "	0	0	1	2	2	2	3	3	3	3	33	3.34
28 "	0	1	1	2	2	3	3	3	4	4	38	3.84
1 MO..	0	1	2	2	2	3	3	4	4	4	42	4.17
2 "	1	2	3	4	4	5	6	7	8	9	83	8.34
3 "	2	3	4	5	6	7	9	10	11	13	1.25	12.50
6 "	3	5	8	10	13	15	18	20	23	25	2.50	25.00
1 YR..	5	10	15	20	25	30	35	40	45	50	5.00	50.00

6%	\$1	\$2	\$3	\$4	\$5	\$6	\$7	\$8	\$9	\$10	\$100	\$1000
4 DAY.	0	0	0	0	0	0	0	1	1	1	7	67
8 "	0	0	0	1	1	1	1	1	1	1	13	1.33
12 "	0	0	1	1	1	1	1	2	2	2	20	2.00
16 "	0	1	1	1	1	2	2	2	2	3	27	2.67
20 "	1	1	1	2	2	2	2	3	3	3	33	3.33
24 "	1	1	1	2	2	2	3	3	4	4	40	4.00
1 MO..	1	1	2	2	3	3	4	4	5	5	50	5.00
2 "	1	2	3	4	5	6	7	8	9	10	1.00	10.00
3 "	2	3	5	6	8	9	11	12	14	15	1.50	15.00
6 "	3	6	9	12	15	18	21	24	27	30	3.00	30.00
1 YR..	6	12	18	24	30	36	42	48	54	60	6.00	60.00

7%	\$1	\$2	\$3	\$4	\$5	\$6	\$7	\$8	\$9	\$10	\$100	\$1000
4 DAY.	0	0	0	0	0	0	0	0	0	0	8	77
8 "	0	0	0	0	0	0	1	1	1	1	15	1.55
12 "	0	0	0	0	1	1	1	1	2	2	23	2.31
16 "	0	0	0	1	1	1	2	2	2	3	31	3.10
20 "	0	0	1	1	1	2	2	3	3	4	38	3.84
24 "	0	0	1	1	2	2	3	3	4	5	46	4.62
1 MO..	0	1	2	2	3	3	4	4	5	6	58	5.83
2 "	1	2	3	5	6	7	8	9	10	12	1.17	11.67
3 "	2	3	5	7	9	10	12	14	16	18	1.75	17.50
6 "	4	7	11	14	18	21	25	28	32	35	3.50	35.00
1 YR..	7	14	21	28	35	42	49	56	63	70	7.00	70.00

4 TABLES OF WAGES BY THE WEEK AND THE DAY.

TABLE OF WAGES BY THE WEEK.

(Computed on a basis of ten hours' labor per day.)

Wages.	1 Hr.	2 Hrs.	5 Hrs.	8 Hrs.	9 Hrs.	1 Day.	2 Days.	3 Days.	4 Days.	5 Days.	6 Days.
\$3	.05	.10	.25	.40	.45	.50	1.00	1.50	2.00	2.50	3.00
4	.06 ² ₃	.13 ¹ ₃	.33 ¹ ₃	.53 ¹ ₃	.60	.66 ² ₃	1.33 ¹ ₃	2.00	2.66 ² ₃	3.33 ¹ ₃	4.00
5	.08 ¹ ₃	.16 ² ₃	.41 ² ₃	.66 ² ₃	.75	.83 ¹ ₃	1.66 ² ₃	2.50	3.33 ¹ ₃	4.16 ² ₃	5.00
6	.10	.20	.50	.80	.90	1.00	2.00	3.00	4.00	5.00	6.00
7	.11 ² ₃	.23 ¹ ₃	.58 ¹ ₃	.93 ¹ ₃	1.05	1.16 ² ₃	2.33 ¹ ₃	3.50	4.66 ² ₃	5.83 ¹ ₃	7.00
8	.13 ² ₃	.26 ² ₃	.66 ² ₃	1.06 ² ₃	1.20	1.33 ¹ ₃	2.66 ² ₃	4.00	5.33 ¹ ₃	6.66 ² ₃	8.00
9	.15	.30	.75	1.20	1.35	1.50	3.00	4.50	6.00	7.50	9.00
10	.16 ² ₃	.33 ¹ ₃	.83 ¹ ₃	1.33 ¹ ₃	1.50	1.66 ² ₃	3.33 ¹ ₃	5.00	6.66 ² ₃	8.33 ¹ ₃	10.00
11	.18 ² ₃	.36 ² ₃	.91 ² ₃	1.46 ² ₃	1.65	1.83 ¹ ₃	3.66 ² ₃	5.50	7.33 ¹ ₃	9.16 ² ₃	11.00
12	.20	.40	1.00	1.60	1.80	2.00	4.00	6.00	8.00	10.00	12.00
13	.21 ² ₃	.43 ¹ ₃	1.08 ¹ ₃	1.73 ¹ ₃	1.95	2.16 ² ₃	4.33 ¹ ₃	6.50	8.66 ² ₃	10.83 ¹ ₃	13.00
14	.23 ² ₃	.46 ² ₃	1.16 ² ₃	1.86 ² ₃	2.10	2.33 ¹ ₃	4.66 ² ₃	7.00	9.33 ¹ ₃	11.66 ² ₃	14.00
15	.25	.50	1.25	2.00	2.25	2.50	5.00	7.50	10.00	12.50	15.00
16	.26 ² ₃	.53 ¹ ₃	1.33 ¹ ₃	2.13 ¹ ₃	2.40	2.66 ² ₃	5.33 ¹ ₃	8.00	10.66 ² ₃	13.33 ¹ ₃	16.00
17	.28 ² ₃	.56 ² ₃	1.41 ² ₃	2.26 ² ₃	2.55	2.83 ¹ ₃	5.66 ² ₃	8.50	11.33 ¹ ₃	14.16 ² ₃	17.00
18	.30	.60	1.50	2.40	2.70	3.00	6.00	9.00	12.00	15.00	18.00
19	.31 ² ₃	.63 ¹ ₃	1.58 ¹ ₃	2.53 ¹ ₃	2.85	3.16 ² ₃	6.33 ¹ ₃	9.50	12.66 ² ₃	15.83 ¹ ₃	19.00
20	.33 ² ₃	.66 ² ₃	1.66 ² ₃	2.66 ² ₃	3.00	3.33 ¹ ₃	6.66 ² ₃	10.00	13.33 ¹ ₃	16.66 ² ₃	20.00
24	.40	.80	2.00	3.20	3.60	4.00	8.00	12.00	16.00	20.00	24.00

TABLE OF WAGES BY THE DAY.

(Computed on a basis of ten hours' labor per day.)

	25c.	37½c.	50c.	62½c.	75c.	87½c.	\$1.00	\$1.12½	\$1.25
½ hour..	.01 ¹ ₄	.01 ⁷ ₈	.02 ¹ ₂	.03 ¹ ₈	.03 ³ ₈	.04 ³ ₈	.05	.05 ⁵ ₈	.06 ¹ ₄
1 " "	.02 ¹ ₄	.03 ¹ ₄	.05	.06 ¹ ₄	.07 ¹ ₄	.08 ¹ ₄	.10	.11 ¹ ₄	.12 ¹ ₄
2 " "	.05	.07 ¹ ₄	.10	.12 ¹ ₄	.15	.17 ¹ ₄	.20	.22 ¹ ₄	.25
5 " "	.12 ¹ ₄	.18 ³ ₈	.25	.31 ¹ ₄	.37 ¹ ₄	.43 ¹ ₄	.50	.56 ¹ ₄	.62 ¹ ₄
8 " "	.20	.30	.40	.50	.60	.70	.80	.90	\$1.00
9 " "	.22 ³ ₄	.33 ³ ₄	.45	.56 ¹ ₄	.67 ¹ ₄	.78 ³ ₄	.90	1.01 ¹ ₄	1.12 ¹ ₄
1 day...	.25	.37 ¹ ₄	.50	.62 ¹ ₄	.75	.87 ¹ ₄	\$1.00	1.12 ¹ ₄	1.25
2 days..	.50	.75	\$1.00	\$1.25	\$1.50	\$1.75	2.00	2.25	2.50
3 " "	.75	\$1.12 ¹ ₄	1.50	1.87 ¹ ₄	2.25	2.62 ¹ ₄	3.00	3.37 ¹ ₄	3.75
4 " "	\$1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
5 " "	1.25	1.87 ¹ ₄	2.50	3.12 ¹ ₄	3.75	4.37 ¹ ₄	5.00	5.62 ¹ ₄	6.25
6 " "	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50

	\$1.37½	\$1.50	\$1.62½	\$1.75	\$1.87½	\$2.00	\$2.12½	\$2.25	\$2.37½
½ hour..	.06 ⁷ ₈	.07 ¹ ₂	.08 ¹ ₈	.08 ³ ₈	.09 ⁵ ₈	.10	.10 ⁵ ₈	.11 ¹ ₂	.11 ⁷ ₈
1 " "	.13 ³ ₄	.15	.16 ¹ ₂	.17 ¹ ₂	.18 ³ ₄	.20	.21 ¹ ₂	.22 ¹ ₂	.23 ¹ ₄
2 " "	.27 ¹ ₂	.30	.32 ¹ ₂	.35	.37 ¹ ₂	.40	.42 ¹ ₂	.45	.47 ¹ ₂
5 " "	.68 ³ ₄	.75	.81 ¹ ₄	.87 ¹ ₄	.93 ³ ₄	\$1.00	\$1.06 ¹ ₄	\$1.12 ¹ ₄	\$1.18 ³ ₄
8 " "	\$1.10	\$1.20	\$1.30	\$1.40	\$1.50	1.60	1.70	1.80	1.90
9 " "	1.23 ³ ₄	1.35	1.46 ¹ ₄	1.57 ¹ ₄	1.68 ³ ₄	1.80	1.91 ¹ ₄	2.02 ¹ ₄	2.13 ³ ₄
1 day...	1.37 ¹ ₂	1.50	1.62 ¹ ₂	1.75	1.87 ¹ ₂	2.00	2.12 ¹ ₂	2.25	2.37 ¹ ₂
2 days..	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75
3 " "	4.12 ¹ ₂	4.50	4.87 ¹ ₂	5.25	5.62 ¹ ₂	6.00	6.37 ¹ ₂	6.75	7.12 ¹ ₂
4 " "	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50
5 " "	6.87 ¹ ₂	7.50	8.12 ¹ ₂	8.75	9.37 ¹ ₂	10.00	10.62 ¹ ₂	11.25	11.87 ¹ ₂
6 " "	8.25	9.00	9.75	10.50	11.25	12.00	12.75	13.50	14.25

DOMESTIC POSTAGE.

FIRST CLASS.—Letters and all written matter, whether sealed or unsealed, and all other matter sealed, nailed, sewed, tied, or fastened in any manner, so that it cannot be easily examined, *two cents per ounce* or fraction thereof. A “Special Delivery” ten-cent stamp when attached to a letter, in addition to the lawful postage, shall entitle the letter to immediate delivery at or within one mile of any post-office. Postal cards, one cent each; with paid reply, two cents each.

SECOND CLASS.—All regular newspapers, magazines and other periodicals issued at intervals not exceeding three months; the postage is *one cent for each four ounces*, payable by postage stamps.

THIRD CLASS.—Embraces *printed books*, pamphlets, circulars, engravings, lithographs, proof-sheets and manuscript accompanying the same, and all matter of the same general character, and not having the character of personal correspondence. Circulars produced by hektograph or similar process, or by electric pen, are rated as third class. The limit of weight for mail matter of the third class is four pounds, except in the case of single books exceeding that weight. The rate of postage on mail matter of the third class is *one cent for each two ounces* or fraction thereof.

FOURTH CLASS.—All mailable matter not included in the three preceding classes, which is so prepared for mailing as to be easily taken from the wrapper and examined. Rate, *one cent per ounce* or fraction thereof, except seeds, roots, cuttings, bulbs, plants, and scions, which are one cent per two ounces. Limit of weight, 4 lbs. Full prepayment compulsory. Liquids and other like injurious matter not admitted except under conditions which may be learned at any post-office.

Registry fee, eight cents, which, with the postage, must be fully prepaid. The name and address of sender must be given on the outside of the envelope or wrapper.

POSTAL NOTE AND MONEY ORDER FEES.—Postal notes, 3c. each, in denominations of \$4.99 and less, payable to bearer. Such notes are invalid upon the expiration of three months from the last day of the month of issue, but the holder can after that time get it renewed at the Department at Washington, upon payment of a fee of three cents. For Money Orders in denominations of \$100 or less, the following fees are charged: Orders not exceeding \$5, 5c.; over \$5 to \$10, 8c.; \$10 to \$15, 10c.; \$15 to \$30, 15c.; \$30 to \$40, 20c.; \$40 to \$50, 25c.; \$50 to \$60, 30c.; \$60 to \$70, 35c.; \$70 to \$80, 40c.; \$80 to \$100, 45c.

FOREIGN POSTAGE.

To all parts of the Universal Postal Union (embracing nearly every civilized country):

ON LETTERS, *five cents for each half ounce* or fraction thereof; prepayment optional. Double rates are collected on delivery of unpaid or short-paid letters.

On newspapers, books, pamphlets, photographs, sheet music, maps, engravings, and similar printed matter, *one cent for each two ounces* or fraction thereof.

To CANADA (including Nova Scotia, New Brunswick, Manitoba, and Prince Edward Island): LETTERS, *two cents for each ounce* or fraction thereof; Books, Circulars, and similar printed matter, *one cent for each two ounces* or fraction thereof; SECOND CLASS MATTER, same as in the United States; SAMPLES AND MERCHANDISE, *one cent per ounce*. Packages must not exceed 4 lbs. 6 oz. in weight; prepayment compulsory.

To MEXICO: Letters, Postal Cards, and printed matter, same rates as in the United States. SAMPLES, *one cent per ounce*; MERCHANDISE other than Samples can only be sent by Parcel Post.

INTERNATIONAL OR FOREIGN MONEY-ORDER FEES.

On Algeria, Belgium, British India, Cape Colony, Constantinople, Denmark, Dominion of Canada, Egypt, England, France, German Empire, Hong Kong, Ireland, Italy, Jamaica, Japan, Newfoundland, New South Wales, New Zealand, Portugal, Sandwich Islands, Scotland, Shanghai, Sweden, Switzerland, Tasmania, Victoria.

For Orders of \$10, or less, 10c.	Over \$50, not exceeding \$60, 60c.
Over \$10, not exceeding \$20, 20c.	Over \$60, not exceeding \$70, 70c.
Over \$20, not exceeding \$30, 30c.	Over \$70, not exceeding \$80, 80c.
Over \$30, not exceeding \$40, 40c.	Over \$80, not exceeding \$90, 90c.
Over \$40, not exceeding \$50, 50c.	Over \$90, not exceeding \$100, \$1.

Orders can also be obtained on Austria and the East Indies by remittance through the Postal Department of Switzerland, subject to the rates of the Swiss Department to those countries. Also on Norway and the Netherlands, through the Postal Department of the German Empire, subject to the rates of the German Department to those countries.

GESTATION CALENDAR. (WOLFF.)

Average Gestation Period.

Mares, 48½ weeks (340 days, extremes 307 and 412 days).

Cows, 40½ " (284 " " 240 " 311 ").

Ewes, 22 " (152 " " 146 " 157 ").

Sows, 16 " (116 " " 112 " 120 ").

Date of Serving.	Mares, 340 Days.	Cows, 284 Days.	Ewes, 152 Days.	Sows, 116 Days.
1 Jan.	6 Dec.	11 Oct.	1 June.	26 April.
6 "	11 "	16 "	6 "	
11 "	16 "	21 "	11 "	1 May.
16 "	21 "	26 "	16 "	6 "
21 "	26 "	31 "	21 "	11 "
26 "	31 "		26 "	16 "
31 "		5 Nov.		21 "
	5 Jan.	10 "	1 July.	26 "
5 Feb.	10 "	15 "	6 "	31 "
10 "	15 "	20 "	11 "	
15 "	20 "	25 "	16 "	5 June.
20 "	25 "	30 "	21 "	10 "
25 "	30 "		26 "	15 "
		5 Dec.	31 "	20 "
2 March.	4 Feb.	10 "		25 "
7 "	9 "	15 "	5 Aug.	30 "
12 "	14 "	20 "	10 "	
17 "	19 "	25 "	15 "	6 July.
22 "	24 "	30 "	20 "	11 "
27 "			25 "	16 "
	1 March.	4 Jan.	30 "	22 "
1 April.	6 "	9 "		26 "
6 "	11 "	14 "	4 Sept.	31 "
11 "	16 "	19 "	9 "	
16 "	21 "	24 "	14 "	5 Aug.
21 "	26 "	29 "	19 "	10 "
26 "	31 "		24 "	15 "
		3 Feb.	29 "	19 "
1 May.	5 April.	8 "		25 "
6 "	10 "	13 "	4 Oct.	30 "
11 "	15 "	18 "	9 "	
16 "	20 "	23 "	14 "	4 Sept.
21 "	25 "	28 "	19 "	9 "
26 "	30 "		24 "	14 "
31 "		5 March.	29 "	19 "
	5 May.	10 "		24 "
5 June.	10 "	15 "	3 Nov.	29 "
10 "	15 "	20 "	8 "	
15 "	20 "	25 "	13 "	4 Oct.
20 "	25 "	30 "	18 "	8 "
25 "	30 "		23 "	14 "
30 "		4 April.	28 "	18 "
	4 June.	9 "		23 "

GESTATION CALENDAR.—(Continued.)

Date of Serving.	Mares, 340 Days.	Cows, 284 Days.	Ewes, 152 Days.	Sows, 116 Days.
5 July.	9 June.	14 April.	3 Dec.	28 Oct.
10 "	14 "	19 "	8 "	3 Nov.
15 "	19 "	24 "	13 "	8 "
20 "	24 "	29 "	18 "	14 "
25 "	29 "		23 "	18 "
30 "		4 May.	28 "	22 "
	4 July.	9 "		28 "
4 Aug.	9 "	14 "	2 Jan.	
9 "	14 "	19 "	7 "	
14 "	19 "	24 "	12 "	3 Dec.
19 "	24 "	29 "	17 "	8 "
24 "	29 "		22 "	13 "
29 "		3 June.	27 "	18 "
	3 Aug.	8 "		23 "
3 Sept.	8 "	13 "	1 Feb.	27 "
8 "	13 "	18 "	6 "	
13 "	18 "	23 "	11 "	1 Jan.
18 "	23 "	28 "	16 "	6 "
23 "	28 "		21 "	11 "
28 "		3 July.	26 "	16 "
	2 Sept.	8 "		21 "
3 Oct.	7 "	13 "	3 March.	26 "
8 "	12 "	18 "	7 "	31 "
13 "	17 "	23 "	13 "	
18 "	22 "	28 "	18 "	5 Feb.
23 "	27 "		23 "	11 "
28 "		2 Aug.	28 "	16 "
	2 Oct.	7 "		21 "
2 Nov.	7 "	12 "	2 April.	26 "
7 "	12 "	17 "	7 "	
12 "	17 "	22 "	12 "	2 March.
17 "	22 "	27 "	17 "	7 "
22 "	27 "		22 "	12 "
27 "		1 Sept.	27 "	17 "
	1 Nov.	6 "		22 "
2 Dec.	6 "	11 "	2 May.	28 "
7 "	11 "	16 "	7 "	
12 "	16 "	21 "	12 "	2 April.
17 "	21 "	26 "	17 "	7 "
22 "	26 "		22 "	12 "
27 "		1 Oct.	27 "	17 "
31 "	1 Dec.	6 "		22 "
	5 "	11 "	1 June.	27 "

1.	Tuesday, January 1, 1895.	365
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2.	Wednesday, January 2.	364
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3.	Thursday, January 3.	363
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10

CALENDAR FOR 1895.

4. Friday, January 4, 1895.

362

5. Saturday, January 5.

361

6. Sunday, January 6.

360

7.	Monday, January 7, 1895.	359
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8.	Tuesday, January 8.	358
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9.	Wednesday, January 9.	357
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10.	Thursday, January 10, 1895.	356
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11.	Friday, January 11.	355
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12.	Saturday, January 12.	354
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13

Sunday, January 13, 1895.

353

14

Monday, January 14.

352

15

Tuesday, January 15.

351

14

CALENDAR FOR 1895.

16

Wednesday, January 16, 1895.

350

17

Thursday, January 17.

349

18

Friday, January 18.

348

19	Saturday, January 19, 1895.	347
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20	Sunday, January 20.	346
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21	Monday, January 21.	345
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16

CALENDAR FOR 1895.

22

Tuesday, January 22, 1895.

344

23

Wednesday, January 23.

343

24

Thursday, January 24.

342

25.	Friday, January 25, 1895.	341
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26.	Saturday, January 26.	340
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27.	Sunday, January 27.	339
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18

CALENDAR FOR 1895.

28.

Monday, January 28, 1895.

338

29.

Tuesday, January 29.

337

30.

Wednesday, January 30.

336

31.	Thursday, January 31, 1895.	335
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32.	Friday, February 1.	334
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33.	Saturday, February 2.	333
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34.	Sunday, February 3, 1895.	332
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35.	Monday, February 4.	331
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36.	Tuesday, February 5.	330
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37.	Wednesday, February 6, 1895.	329
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38.	Thursday, February 7.	328
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39.	Friday, February 8.	327
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40.	Saturday, February 9, 1895.	326
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41.	Sunday, February 10.	325
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42.	Monday, February 11.	324
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43.	Tuesday, February 12, 1895.	323
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44.	Wednesday, February 13.	322
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45.	Thursday, February 14.	321
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46.	Friday, February 15, 1895.	320
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47.	Saturday, February 16.	319
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48.	Sunday, February 17.	318
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49.	Monday, February 18, 1895.	317
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50.	Tuesday, February 19.	316
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51.	Wednesday, February 20.	315
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52.	Thursday, February 21, 1895.	314
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53.	Friday, February 22.	313
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54.	Saturday, February 23.	312
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55.	Sunday, February 24, 1895.	311
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56.	Monday, February 25.	310
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57.	Tuesday, February 26.	309
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58.	Wednesday, February 27, 1895.	308
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59.	Thursday, February 28.	307
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60.	Friday, March 1.	306
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61.	Saturday, March 2, 1895.	305
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62.	Sunday, March 3.	304
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63.	Monday, March 4.	303
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30

CALENDAR FOR 1895.

64.

Tuesday, March 5, 1895.

302

65.

Wednesday, March 6.

301

66.

Thursday, March 7.

300

67.	Friday, March 8, 1895.	299
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68.	Saturday, March 9.	298
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69.	Sunday, March 10.	297
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70.

Monday, March 11, 1895.

296

71.

Tuesday, March 12.

295

72.

Wednesday, March 13.

294

73.	Thursday, March 14, 1895.	293
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74.	Friday, March 15.	292
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75.	Saturday, March 16.	291
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34

CALENDAR FOR 1895.

76

Sunday, March 17, 1895.

290

77.

Monday, March 18.

289

78.

Tuesday, March 19.

288

79.	Wednesday, March 20, 1895.	287
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80.	Thursday, March 21.	286
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81.	Friday, March 22.	285
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82.	Saturday, March 23, 1895.	284
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83.	Sunday, March 24.	283
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84.	Monday, March 25.	282
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85.	Tuesday, March 26, 1895.	281
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86.	Wednesday, March 27.	280
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87.	Thursday, March 28.	279
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88.

Friday, March 29, 1895.

278

89.

Saturday, March 30.

277

90.

Sunday, March 31.

276

91.	Monday, April 1, 1895.	275
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92.	Tuesday, April 2.	274
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93.	Wednesday, April 3.	273
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40

CALENDAR FOR 1895.

94.

Thursday, April 4, 1895.

272

95.

Friday, April 5.

271

96.

Saturday, April 6.

270

97.	Sunday, April 7, 1895.	269
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98.	Monday, April 8.	268
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99.	Tuesday, April 9.	267
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100.

Wednesday, April 10, 1895.

266

101.

Thursday, April 11.

265

102.

Friday, April 12.

264

103.	Saturday, April 13, 1895.	263
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104.	Sunday, April 14.	262
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105.	Monday, April 15.	261
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106.

Tuesday, April 16, 1895.

260

107.

Wednesday, April 17.

259

108.

Thursday, April 18.

258

109.	Friday, April 19, 1895.	257
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110.	Saturday, April 20.	256
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111.	Sunday, April 21.	255
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112.

Monday, April 22, 1895.**254**

113.

Tuesday, April 23.**253**

114.

Wednesday, April 24.**252**

115.	Thursday, April 25, 1895.	251
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116.	Friday, April 26.	250
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117.	Saturday, April 27.	249
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118.

Sunday, April 28, 1895.**248**

119.

Monday, April 29.**247**

120.

Tuesday, April 30.**246**

121.	Wednesday, May 1, 1895.	245
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122.	Thursday, May 2.	244
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123.	Friday, May 3.	243
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124.

Saturday, May 4, 1895.

242

125.

Sunday, May 5.

241

126.

Monday, May 6,

240

127.	Tuesday, May 7, 1895.	239
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128.	Wednesday, May 8.	238
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129.	Thursday, May 9.	237
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130.

Friday, May 10, 1895.

236

131.

Saturday, May 11.

235

132.

Sunday, May 12.

234

133.

Monday, May 13, 1895.

233

134.

Tuesday, May 14.

232

135.

Wednesday, May 15.

231

136.

Thursday, May 16, 1895.

230

137.

Friday, May 17.

229

138.

Saturday, May 18.

228

139.	Sunday, May 19, 1895.	227
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140.	Monday, May 20.	226
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141.	Tuesday, May 21.	225
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142.	Wednesday, May 22, 1895.	224
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143.	Thursday, May 23.	223
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144.	Friday, May 24.	222
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145.

Saturday, May 25, 1895.

221

146.

Sunday, May 26.

220

147.

Monday, May 27.

219

148.

Tuesday, May 28, 1895.

218

149.

Wednesday, May 29.

217

150.

Thursday, May 30.

216

151.	Friday, May 31, 1895.	215
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152.	Saturday, June 1.	214
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153.	Sunday, June 2.	213
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154.

Monday, June 3, 1895.

212

155.

Tuesday, June 4.

211

156.

Wednesday, June 5.

210

157.	Thursday, June 6, 1895.	209
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158.	Friday, June 7.	208
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159.	Saturday, June 8.	207
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160.

Sunday, June 9, 1895.

206

161.

Monday, June 10.

205

162.

Tuesday, June 11.

204

163.	Wednesday, June 12, 1895.	203
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164.	Thursday, June 13.	202
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165.	Friday, June 14.	201
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166.

Saturday, June 15, 1895.**200**

167.

Sunday, June 16.**199**

168.

Monday, June 17.**198**

169.	Tuesday, June 18, 1895.	197
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170.	Wednesday, June 19.	196
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171.	Thursday, June 20.	195
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172.

Friday, June 21, 1895.

194

173.

Saturday, June 22.

193

3

Sunday, June 23.

192

175.	Monday, June 24, 1895.	191
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176.	Tuesday, June 25.	190
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177.	Wednesday, June 26,	189
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178.

Thursday, June 27, 1895.

188

179.

Friday, June 28.

187

180.

Saturday, June 29.

186

181.

Sunday, June 30, 1895.

185

182.

Monday, July 1.

184

183.

Tuesday, July 2.

183

184.

Wednesday, July 3, 1895.

182

185.

Thursday, July 4.

181

186.

Friday, July 5.

180

187.

Saturday, July 6, 1895.

179

188.

Sunday, July 7.

178

189.

Monday, July 8.

177

190.

Tuesday, July 9, 1895.

176

191.

Wednesday, July 10.

175

192.

Thursday, July 11.

174

193.

Friday, July 12, 1895.

173

194.

Saturday, July 13.

172

195.

Sunday, July 14.

171

196.

Monday, July 15, 1895.

170

197.

Tuesday, July 16.

169

198.

Wednesday, July 17.

168

199.

Thursday, July 18, 1895.

167

200.

Friday, July 19.

166

201.

Saturday, July 20.

165

202.

Sunday, July 21, 1895.

164

203.

Monday, July 22.

163

204.

Tuesday, July 23.

162

205.

Wednesday, July 24, 1895.

161

206.

Thursday, July 25.

160

207.

Friday, July 26.

159

208.	Saturday, July 27, 1895.	158
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209.	Sunday, July 28.	157
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210.	Monday, July 29.	156
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211.

Tuesday, July 30, 1895.

155

212.

Wednesday, July 31.

154

213.

Thursday, August 1.

153

214. Friday, August 2, 1895. 152

215. Saturday, August 3. 151

216. Sunday, August 4. 150

217.

Monday, August 5, 1895.

149

218.

Tuesday, August 6.

148

219.

Wednesday, August 7.

147

220.	Thursday, August 8, 1895.	146
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221.	Friday, August 9.	145
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222.	Saturday, August 10,	144
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223.

Sunday, August 11, 1895.

143

224.

Monday, August 12.

142

225.

Tuesday, August 13.

141

226.	Wednesday, August 14, 1895.	140
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227.	Thursday, August 15.	139
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228.	Friday, August 16.	138
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229.

Saturday, August 17, 1895.

137

230.

Sunday, August 18.

136

231.

Monday, August 19.

135

232.	Tuesday, August 20, 1895.	134
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233.	Wednesday, August 21.	133
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234.	Thursday, August 22.	132
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235.

Friday, August 23, 1895.

131

236.

Saturday, August 24.

130

237.

Sunday, August 25.

129

238.	Monday, August 26, 1895.	128
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239.	Tuesday, August 27.	127
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240.	Wednesday, August 28.	126
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241.	Thursday, August 29, 1895.	125
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242.	Friday, August 30.	124
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243.	Saturday, August 31.	123
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244.

Sunday, September 1, 1895.

122

245.

Monday, September 2.

121

246.

Tuesday, September 3.

120

247.	Wednesday, September 4, 1895.	119
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248.	Thursday, September 5.	118
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249.	Friday, September 6.	117
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250.	Saturday, September 7, 1895.	116
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251.	Sunday, September 8.	115
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252.	Monday, September 9.	114
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253. Tuesday, September 10, 1895. 113

254. Wednesday, September 11. 112

255. Thursday, September 12. 111

256.	Friday, September 13, 1895	110
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257.	Saturday, September 14.	109
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258.	Sunday, September 15.	108
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259.	Monday, September 16, 1895.	107
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260.	Tuesday, September 17.	106
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261.	Wednesday, September 18.	105
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262.	Thursday, September 19, 1895.	104
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263.	Friday, September 20.	103
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264.	Saturday, September 21.	102
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265.	Sunday, September 22, 1895.	101
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266.	Monday, September 23.	100
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267.	Tuesday, September 24.	99
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268. Wednesday, September 25, 1895. 98

269. Thursday, September 26. 97

270. Friday, September 27. 96

271.	Saturday, September 28, 1895.	95
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272.	Sunday, September 29.	94
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273.	Monday, September 30.	93
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274.	Tuesday, October 1, 1895.	92
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275.	Wednesday, October 2.	91
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276.	Thursday, October 3.	90
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277.

Friday, October 4, 1895.

89

278.

Saturday, October 5.

88

279.

Sunday, October 6.

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280.	Monday, October 7, 1895.	86
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281.	Tuesday, October 8.	85
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282.	Wednesday, October 9.	84
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283.	Thursday, October 10, 1895.	83
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284.	Friday, October 11.	82
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285.	Saturday, October 12.	81
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286.	Sunday, October 13, 1895.	80
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287.	Monday, October 14.	79
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288.	Tuesday, October 15.	78
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289.	Wednesday, October 16, 1895.	77
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290.	Thursday, October 17.	76
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291.	Friday, October 18.	75
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292.

Saturday, October 19, 1895.

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293.

Sunday, October 20.

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Monday, October 21.

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295.	Tuesday, October 22, 1895.	71
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296.	Wednesday, October 23.	70
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297.	Thursday, October 24.	69
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298.	Friday, October 25, 1895.	68
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299.	Saturday, October 26.	67
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300.	Sunday, October 27.	66
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301.	Monday, October 28, 1895.	65
302.	Tuesday, October 29.	64
303.	Wednesday, October 30.	63

304.	Thursday, October 31, 1895.	62
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305.	Friday, November 1.	61
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306.	Saturday, November 2.	60
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307. Sunday, November 3, 1895. 59

308. Monday, November 4. 58

309. Tuesday, November 5. 57

310. Wednesday, November 6, 1895. 56

311. Thursday, November 7. 55

312. Friday, November 8. 54

313.	Saturday, November 9, 1895.	53
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314.	Sunday, November 10.	52
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315.	Monday, November 11.	51
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316. Tuesday, November 12, 1895. 50

317. Wednesday, November 13. 49

318. Thursday, November 14. 48

319.	Friday, November 15, 1895.	47
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320.	Saturday, November 16.	46
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321.	Sunday, November 17.	45
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322.	Monday, November 18, 1895.	44
323.	Tuesday, November 19.	43
324.	Wednesday, November 20.	42

325. Thursday, November 21, 1895. 41

326. Friday, November 22. 40

327. Saturday, November 23. 39

328.

Sunday, November 24, 1895.

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329.

Monday, November 25.

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330.

Tuesday, November 26.

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331. Wednesday, November 27, 1895. 35

332. Thursday, November 28. 34

333. Friday, November 29. 33

334.	Saturday, November 30, 1895.	32
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335.	Sunday, December 1.	31
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336.	Monday, December 2,	30
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337.	Tuesday, December 3, 1895.	29
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338.	Wednesday, December 4.	28
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339.	Thursday, December 5.	27
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340.

Friday, December 6, 1895.

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Saturday, December 7.

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342.

Sunday, December 8.

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343. Monday, December 9, 1895. 23

344. Tuesday, December 10. 22

345. Wednesday, December 11. 21

346.	Thursday, December 12, 1895.	20
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347.	Friday, December 13.	19
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348.	Saturday, December 14.	18
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349.	Sunday, December 15, 1895.	17
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350.	Monday, December 16.	16
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351.	Tuesday, December 17.	15
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352.	Wednesday, December 18, 1895.	14
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353.	Thursday, December 19.	13
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354.	Friday, December 20.	12
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355.	Saturday, December 21, 1895.	11
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356.	Sunday, December 22.	10
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357.	Monday, December 23.	9
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358.	Tuesday, December 24, 1895.	8
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359.	Wednesday, December 25.	7
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360.	Thursday, December 26.	6
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361.	Friday, December 27, 1895.	5
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362.	Saturday, December 28.	4
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363.	Sunday, December 29.	3
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130

CALENDAR FOR 1895.

364.	Monday, December 30, 1895.	2
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365.	Tuesday, December 31.	1
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[illegible]

[illegible]

	Received	Paid
Cash on hand, January 1.....		
JANUARY.....		
FEBRUARY.....		
MARCH.....		
APRIL.....		
MAY.....		
JUNE.....		
JULY.....		
AUGUST.....		
SEPTEMBER.....		
OCTOBER.....		
NOVEMBER.....		
DECEMBER.....		
Total.....		
Balance to new account.....		

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DAIRY CALENDAR.

I. MILK.

YIELD OF MILK AND FAT FROM COWS.

A good dairy cow should give at least 5000 pounds of milk during a whole period of lactation. As the quality of milk given by different cows varies greatly, however, as will be apparent from the tables given in the following, the yield of fat produced during a lactation period is a better standard to go by than that of the milk; three-fourths of a pound of fat per day for an average of 200 days may be considered a good yield (total 225 pounds). Many dairy farmers aim to have all mature cows in their herds produce a pound of fat, on the average, for every day in the year. To do this, a cow whose milk tests about 4 per cent. must give 25 pounds of milk a day (3 gallons) as an average for the whole year; a cow producing 3 per cent milk must give $33\frac{1}{3}$ pounds of milk daily, and one producing 5 per cent milk must yield 20 pounds of milk daily, on the average, etc.

The flow of milk is usually at its highest some time after calving, and then gradually decreases, the rate of decrease being determined by the inbred milking qualities of the cow and the system of feeding practised. The average decrease in milk yield for good dairy cows on good feed is from one half to three fourths of a pound per head per ten

days. Where cows are not fed liberally and receive but little concentrated feed, the decrease will be more marked, and often exceed one pound of milk per head per ten days. The decrease is more marked during the latter stages of the period of lactation than in the earlier ones, and is also more marked in cows with poorly developed milking qualities than in good dairy cows. A cow is considered at her best when from five to seven years old; the constitutional strength of the animal, the system of feeding practised, and the general treatment given the cow will determine her period of usefulness.

The quality of the milk produced by individual cows generally remains fairly uniform through the greater portion of the lactation period, and is not permanently influenced in any marked manner by feed or any external conditions. During the last couple of months, when the yield of milk is decreasing more rapidly than before, the quality is generally improved to some extent, the variation being, as a rule, within 1 per cent. Variations of several per cents of fat may sometimes occur from day to day, or milking to milking, in the milk from single cows; variations amounting to 1 per cent are common. Herd milk varies much less, the percentages of fat on subsequent days being as a rule within two tenths of one per cent, and only exceptionally near one per cent.

GUERNSEY CATTLE.

By Prof. W. H. CALDWELL, Peterboro, N. H., Sec'y American Guernsey Cattle Club.

In the Guernseys we have a breed that represents years of careful conservative breeding and handling, for the one sole purpose of establishing a race of dairy animals that would give a heavy flow of the highest natural-colored milk which would show a large per cent of butter-fat. To-day it is undisputed that the Guernsey butter has the highest natural color of that of any breed, and that they are the most economical butter producers.

The breed takes its name from the Island of Guernsey, one of the Channel, or sometimes termed Alderney Islands.

The cattle on these islands came originally from stock mainly from the French provinces of Normandy and Brittany. While all have certain features in common, those of each island have been bred until there are points of superiority in each one. The Guernsey the world over has the rich, yellow skin which old-time dairy people always said indicated a good butter cow.

With this most remarkable characteristic of *richness* they combine good size and constitution, a particularly quiet, gentle, and tractable temperament, with a mild and contented expression, free from nervousness. In appearance they are rangy, deep, business-looking animals, characterized by plenty of udder development, good teats, with soft, silky texture of skin and creamy color, the prevailing color being a delicate shade of lemon or orange fawn with white markings, cream nose, with rich, golden color around the eye, on udder and teats, at base of horn and end of the bone of the tail.

Perhaps no breed has as honestly won its high rank as butter producers as have the Guernseys. Never forced for high records, they have stood upon the work they would do at the pail or churn. It is especially gratifying to notice how they are received in the sections where they have been introduced. Go into New England, down the Hudson in New York, into Eastern Pennsylvania, Delaware, New Jersey, and Wisconsin, and you find not only fine herds of thoroughbreds, but you will notice that the dairymen of those sections have been impressed with their substantial, business-like appearance and golden-colored products, and have drawn on the breed for the grading-up and improving the dairy stock of the section.

Their ability to produce butter-fat and butter at a low cost demands the careful attention of all dairymen. At the New York experiment station several of the dairy breeds are being carefully tested. The annual report of the director, which was recently issued, gives the result of the first two periods of lactation. In both instances the Guernseys produced butter-fat at the least cost, as the following shows:

COST OF BUTTER-FAT PER POUND.

	1st Period.	2d Period.
Guernsey	18.4 cts.	15.6 cts.
Jersey	20.0 "	18.5 "
Devon	23.0 "	19.0 "
Ayrshire	24.3 "	24.8 "
Am. Holderness	26.3 "	22.8 "
Holstein Friesian	26.3 "	26.4 "

This agrees with the work done at the New Jersey experiment station and with the average results of the butter tests at the World's Fair.

COST PER POUND OF BUTTER PRODUCED.

	New Jersey.	World's Fair.
Guernsey	15.3 cts.	13.1 cts.
Jersey	17.9 "	13.3 "
Ayrshire	20.6 "	.....
Shorthorn	20.8 "	15.8 "
Holstein	22.4 "	.....

This shows the Guernseys to be the most economical producers of butter; and such golden-yellow butter, too! There is no mottled color to it. This true, golden, cow-color is the most attractive feature on the market.

The best records reported of Guernseys are those of Lily of Alexander, No. 1059, and Sup. Bretonne, No. 3660. Lily of Alexander gave 12,855½ pounds of milk in one year; and two months before calving tested 7.2 per cent. of butter-fat. Bretonne gave, in the year ending October 20, 1894, 11,219 pounds of milk. Her milk was tested carefully once a month by taking a composite sample of eight consecutive milkings. The lowest test was 5.2 per cent, and highest 6.1 per cent butter-fat. Her milk yielded 602 $\frac{91}{100}$ pounds of butter-fat, or equivalent to 753 $\frac{5}{10}$ pounds of butter containing 80 per cent butter-fat. She is a large, well-built cow, and weighed at the close of her year's work 1150 pounds. It is truly said, the Guernseys have but to be known to be appreciated.

The *Herd Register* is published by the American Guernsey

Cattle Club, whose headquarters are at Peterboro, N. H. It contains the pedigrees of about 11,000 animals. The breeders of Guernseys have always been harmonious in letting their favorites win their way by their own straightforward efforts in the dairy. By addressing the secretary of the club at Peterboro, N. H., further information will cheerfully be furnished.

HOLSTEIN-FRIESIAN CATTLE.

By S. HOXIE, Yorkville, N. Y., Supt. Advanced Registry Holstein-Friesian Association of America.

This is our American representative of the Lowland, race, native to the low, rich lands of Belgium, Holland, and Northern Germany. Its origin is ascribed to the Friesians—a tribe of people mentioned by Roman historians before the opening of the Christian era as peaceable cattle-breeders dwelling on the shores of the North Sea. The present dairy farmers of the provinces of North Holland and Friesland are the lineal descendants of those cattle-breeders, and they are to-day handling the same race upon the same lands. These farmers are the leading dairymen of Europe. As evidence of this, Chambers' Encyclopedia* gives the export of butter from the province of Friesland to England in 1874 as 266,041 cwt. The number of cows owned in that province in 1879 was 144,802. Assuming the same number in 1874, this export averages 205 $\frac{3}{4}$ lbs. per cow; assuming the same number of acres of grass lands, this export averages 117 $\frac{1}{8}$ lbs. per acre. No data of home consumption or of exports to other countries are given. These combined must have been large, and, were they added, would much increase these averages. Lest some reader may assume that a part of this enormous export must have been oleomargarine or artificial butter, it is well to add here that no such products were known in Friesland at that date.

According to U. S. Consular reports on Cattle and Dairy

* Edinburgh and London edition, article "Friesland."

Farming, the amount of butter imported from Holland into Great Britain in 1877 was 41,679,085 lbs. in 1884, of cheese, 65,994,544 lbs. The import of butter for 1877 rather than for 1884 is quoted, because the former date was "before oleomargarine had become an industry in that country."* There is no question that nearly all these imports were from the two provinces, North Holland and Friesland. The country we call Holland is composed of eleven provinces with a total area of 12,597 sq. miles. The total area of North Holland and Friesland is 2303 sq. miles. To get the significance of the above statistics, let them be compared with the total imports, to the same common market, from the United States and Canada. These in 1884 were, of butter 17,440,416 lbs., and of cheese, 109,333,280 lbs. So far as this breed of cattle is concerned, it is safe to let the reader draw his own conclusions.

As to the characteristics of this breed the most important is indicated by the above statistics. To the casual observer the color may appear the more striking. This is variegated in distinct markings. The American herd-books receive only black-and-white to entry. The European herd-books receive red-and-white, gray-and-white, and mouse-colored-and-white; but the great bulk of their entries are black-and-white. The structure of this breed is also an important characteristic. This is best shown by measurements. The average measurements of all the full-age cows (those five years old and upwards) received to the fourth volume of the Holstein-Friesian Advanced Register were as follows: Height at shoulders, 51.8 + inches; at hips, 53; length of body, 64.9 + ; of rump, 21.4 — ; width of hips, 21.9 — , at thurl, 19.6 + ; girth at smallest circumference of chest, 75.6 + . These are fairly representative of the breed, and describe what is technically called the milk-and-beef form. There are animals of the breed of other forms, but they must be regarded as exceptional in this respect. The average weight of these cows was 1262 + lbs. This is also fairly representative of the breed. Rapidity of growth and

* U. S. Consular Reports [1886]—Cattle and Dairy Farming, p. 15.

earliness of maturity are alike characteristics of the breed. This may also be shown by measurements. Taking the entries in one of the European herd-books, we find, from actual measurements reported, that heifers reach their full height at between two and a half and three years old, that each year for the following two years they increase one and three fourths inches in length of body, two inches in girth of chest, and three-fourths of an inch in width of hips. After five years old no increase is shown except what may be properly ascribed to additions of flesh. Another characteristic is constitutional vigor. No dairy breed probably excels it in this. It enables the breed to resist disease, to endure climatic changes, and its cows to endure forcing to enormous productions. In the reign of Peter the Great, importations of this breed were made into Northern Russia, into the district of Kolmogory, within three and a half degrees of the Arctic Circle. Other importations to the same district have since been made. All appear to have acclimated without difficulty. Crossed on the nondescript native cattle of that district they have produced a numerous progeny called the Kolmogory breed, "remarkable for its yield of milk."*

Every breed has limited adaptations. A breed valuable in one section may not be valuable in another that differs in soil, lay of territory, and wants of its inhabitants. The adaptations of this breed make it specially valuable on rich soils, level lands, and in densely populated districts, where every product—milk, butter, cheese, beef, and veal—can be utilized. In view of these facts, the merits of a breed may properly be measured by its distribution—by its aggressiveness. Judged by this standard, we find that this breed is the exclusive breed of North Holland and Friesland, "more esteemed than any other in Belgium;"† "furnishing the best and most prolific milch cows in Germany;"‡ crossed on native cattle, the "favorite in St. Petersburg,"||

* U. S. Consular Reports [1886]—Cattle and Dairy Farming, p. 519.

† The same, p. 367.

‡ The same, pp. 398, 404.

|| The same, p. 519.

and used in almost every country of Europe outside of Switzerland and Great Britain. At the present time it is finding place in South Africa, New Zealand, and in some of the states of South America. Its introduction and spread in our own country, within the present generation, is one of the marvels of our day.

BROWN-SWISS CATTLE.

By N. S. FISH, Groton, Conn., Secretary Brown-Swiss Cattle Breeders' Association.

Brown-Swiss cattle were first imported into this country by Mr. Henry M. Clarke of Belmont, Mass., in 1869. He imported seven cows and one bull; since then there have been several importations. Most of the animals have come from the famed Canton of Schwyz, and the adjacent Cantons of Zug, Uri, and Unterwalden. The Rigi mountains, covered to their tops with fine, rich herbage, lie here, and some of the finest breeds of cattle in the whole country are here produced, the cattle grazing in the valley in winter and on the mountains in summer.

The United States consul at Zurich in 1882 made a report to our government of the cattle and dairy interest of Switzerland. He writes: "For a hundred years Switzerland has been famous for the production of its dairies. At the cattle show of Paris, 1878, every Swiss cow exhibited bore away a prize in competition with exhibits from Holland, England, Denmark, and other famous cattle countries.

The Brown-Swiss cattle are fed on grass or hay only the year through. A fair average for cows in Canton Zurich is ten quarts of milk per day the milking-year through; in Schwyz and Zug the average is but little less."

The consul of St. Gall says: "When a farmer in Germany, Italy, or France wishes to improve his breed, he makes a selection from Swiss herds as the healthiest and hardiest known to the herd-book. . . . The Brown-Swiss is considered the dairy breed *par excellence* of Swit-

zerland; it not only gives more milk, but this is richer than any other European breed of cattle."

Marked Characteristics.—Size large; form firm; color shades from dark to light chestnut brown. The tuft of hair between the horns, on the inside of ear, and a narrow line along the back generally light. Horns rather short, waxey, with black tips. Nose black, with mealy-colored band surrounding nose. Switch, hoofs, and tongue black. Straight hind legs, wide thighs, and heavy quarters. The cows often weigh 1600 lbs., bulls 2000 lbs. Calves large, some weighing 110 lbs. when dropped. They mature fast, have healthy constitutions, yielding generous returns for whatever care, time, labor, or money is expended on them.

A cow shown at the Fat Stock Show in November, 1891, gave in three days 245 lbs. of milk, showing 9.32 lbs. of butter-fat by the Babcock test, yielding during one day of the test $3\frac{1}{4}$ lbs. of fat, the largest amount of butter-fat ever shown at an official test of any cow of any breed up to that time. The cow Muotta calved about November 1, 1893, and in February, 1894, gave 67 lbs. of milk in one day.

The milk of Brown-Swiss cows has a sweet flavor which is very noticeable, and makes it very desirable for family use. With good farm care the cows give under favorable circumstances from 20 to 25 quarts of milk per day. They make the finest of beef and veal; when intended to be used for working oxen, they are easily broken and are fast walkers.

The cows are persistent milkers, with good teats; where used to produce grade animals they give the best of satisfaction, with the Swiss characteristics predominating. There are now about 1800 recorded animals in this country, located in almost every State, and some in Mexico.

RED POLLED CATTLE.

By J. McLAIN SMITH, Dayton, Ohio, Sec'y Red Polled Cattle Club of America.

Hornless or polled cattle have existed in the counties of Norfolk and Suffolk, England, from time immemorial. Originally there were two distinct types—the Suffolks, usu-

ally of a pale red or dun color, and hence known as Suffolk duns—large and rather rough cattle, but celebrated for their milking qualities—and the Norfolks, commonly deep red in color, smaller, finer, more compact in build, not so large milkers, but great favorites with the butcher.

Youatt, speaking of the old Suffolk strain, as it existed in his day (some half-century ago), says: "In the height of the season some of these cows will give as much as eight gallons of milk (80 lbs.) in a day, and six gallons (60 lbs.) is not an unusual quantity."

The modern Red Polled cow is a result of the combination of these old types, and careful breeding and selection to unite their respective merits. Probably all of the herds in existence now have more or less blood of each. Individual animals, however, still differ considerably in size, form, and quality, according as the Norfolk or the Suffolk type predominates. But it is the aim of the most progressive breeders to combine the good qualities of both the old strains and produce a cow of medium size, blood-red in color, of fine bone, smooth and compact of form, hardy, docile, fattening easily, producing meat of high quality, and giving a good flow of fairly rich milk all the year round. How well they had succeeded in 1886 let the official reporter for the Royal Agricultural Society say. Speaking of the exhibition that year—the largest show of red polls ever made—he says: "The improvement made during the past few years in the style, substance, and quality of the animals, as well as the advance toward uniformity of type, is within measurable distance of the marvellous. No stronger proof of this can be desired or given than is to be found in the fact that the judges (all three of whom are keen men of business and thoroughly practical) commended in its entirety the class of cows with its thirty entries. Such an event as this is almost unknown, and but very seldom deserved." The judges themselves in their report say: "This class was, beyond question, an extraordinary one. Having selected twelve cows we placed them together in a line, and we venture to say few people have seen twelve better cows of any breed shown together."

Milking Qualities.—The modern Red Polled cow does not milk so largely as the old Suffolk, but her milk is of better quality. Sixty pounds a day, which Youatt says in his time was not unusual, is now, I think, somewhat rare. Four and a half to five gallons a day, or say 40 to 45 pounds, is a good yield from a mature cow in the flush of the season. But she will easily give, with proper care, six to eight thousand pounds in a year; and some will considerably exceed this. Mr. Garrett Taylor of Norwich some time ago commenced keeping the milk record of his large herd at Whitlingham, and the returns for a number of years are now published by the English society. The herd consists of over one hundred registered cows in milk, and the produce of each is weighed and recorded every day. The average yield of the mature cow is about 6000 lbs. a year, and individual animals have exceeded 12,000 lbs. The milk is sold in Norwich, but frequent tests show that it makes a little over $7\frac{1}{4}$ oz. of butter to the imperial gallon. This is equivalent to a pound of butter to 22 lbs. of milk, and would indicate an average yield of 272 lbs. of butter.

For the milk test at the London Dairy Show in October, 1889, sixty-one cows and heifers were entered in the different classes, and forty-eight were tested, consisting of thirteen dairy Shorthorns, twenty-three Jerseys, eight Guernseys, two Red Polls, one Ayrshire, and one Holstein. In the scale used one point is allowed for each pound of milk in twenty-four hours, twenty points for each pound of butter-fat, four points for each pound of other solids, and one point for each ten days since calving after the first twenty. According to this scale, of the forty-eight cows and heifers tested but *five* were able to score a hundred points or more. *Both* of the Red Polled cows were included in this *five*.

Mr. H. F. Euren gives in the London *Live Stock Journal* some tables embodying the results attained in the Chicago test, and in connection with them the record of fifteen Red Polled cows selected from the herd of Mr. Garrett Taylor. He finds there were but ten cows of the original Jersey herd of twenty-five that went through all the tests at Chi-

cago, and whose record, therefore, covers 135 days. Similarly there were but seven Guernseys and nine Shorthorns that went through all the tests.

The ten Jerseys averaged for 135 days 35.65 lbs. of milk a day, with an average of 4.57% of fat, or a total daily yield of 1.62 lbs.

The seven Guernseys gave an average of 31.94 lbs. of milk, with 4.5% of fat, or a total daily yield of 1.43 lbs.

The nine Shorthorns gave an average of 35.33 lbs. of milk, with 3.5% of fat, or a total daily yield of 1.23 lbs.

The average daily yield of the fifteen Red Polled cows for 135 days on grass alone was 32.1 lbs. of milk, with 3.75% of fat, or a total daily yield of 1.2 lbs.

The figures for the Red Polled cows are not, of course, official, but the yield of milk is undoubtedly correct, and Mr. Euren says the quality given—3.75% of fat—is the average of tests made with the Babcock test every two weeks.

In this country, as yet, few Red Polled cows have appeared in the public trials. In the test conducted by the Ohio State Board of Agriculture in 1892 five Red Polls were entered. They were tested at home by an official of the State Experiment Station, with the following result:

Name of Owner.	Cow.	Age.	Fresh.	Test.
Capt. U. T. Hills.....	Mayflower	8 yrs.	July 14, '92	Aug. 23, '92
	Tina	7 "	Feb. 23, '92	Mar. 24, '92
	Lady	8 "	Aug. 8, '91	Dec. 17, '91
J. M. L. Smith.. ..	Coronet	7 "	Nov. 1, '91	Dec. 17, '91
	Linda	6 "	Dec. 6, '91	Dec. 31, '91

Name of Cow.	Milk Yield during 24 Hours.	Quality.		Total Fat.
		Fat.	Tot. Solids.	
Mayflower.....	44.11 lbs.	3.85%	13.1 %	1.72 lbs.
Tina.. ..	39.12 lbs.	4.24	13.64	1.68 lbs.
Lady.....	33.06 lbs.	4.74	14.2	1.58 lbs.
Coronet.....	37.02 lbs.	3.82	12.5	1.41 lbs.
Linda.....	42.07 lbs.	3.51	12.33	1.49 lbs.

The cow Mayflower, above, was again officially tested 292 days after calving, and, according to the official report,

"made the remarkable return of 31 lbs. 4 oz. milk [in 24 hours], containing 4.73 per cent butter-fat, or 1.48 lbs."

J. W. Martin reports the following tests:

Hemethea, N. 6, dropped first calf May 24, 1889. From June 1, 1889, to February 11, 1890 (8 months 10 days), she gave 6101 pounds of milk. Milk tested at Wisconsin Experiment Station, September 11, 1889, 4.24 per cent fat.

April 1, 1890, she produced second calf, and from April 6 to February 1, 1891 (10 months less 5 days), she gave 7600 pounds of milk.

Dropped third calf April 3, 1891. May 4th she gave 41 pounds milk, which, tested with Babcock test, showed 3.60 per cent fat.

Hera, N. 6, dropped second calf June 28, 1890. From July 1, 1890, to March 12, 1891 (8 months 11 days), she gave 7235 pounds milk. Fresh again June 17, 1891. From June 22d to August 22d (2 months) she gave 3001 pounds milk.

Beef Qualities.—In this line, so far, we are entirely dependent for facts on the English records. No full-blood steers of the breed have as yet been shown in this country. In an article by Mr. H. F. Euren, prepared for the "Live Stock Journal Almanac" for 1883, and afterwards revised and published in vol. 2 of the "Herd Book," the author has collected a considerable amount of material, from which select the following:

A Red Polled steer (age three years and seven months), at Smithfield, in 1884, had a recorded live weight of 1919 pounds. It dressed 1280 pounds—66.74 per cent of the live weight. The same exhibitor's heifer (age three years, one month and three weeks) had a live weight of 1434 pounds, and dressed 65.31 per cent of this amount.

The live weight of a three-year-old steer shown at the Suffolk Club Show of 1876 was 2856 pounds. Steers of the Davy tribe, shown at Norwich in November, 1882, had the following recorded live weight: Age two years and eleven months, 1660 pounds; age four years and one month, 1796 pounds; and a heifer, age three years and seven months, 1759 pounds. At the Smithfield Club Show in 1889, two Red Polled steers, two years old, showed the largest daily

gain of anything on exhibition that old—2.18 pounds and 2.29 pounds, respectively. At the Smithfield Club Show of 1890 a Red Polled steer dressed the highest per cent of his live weight of anything slaughtered—73.72 per cent. This, according to the *London Live Stock Journal*, has only once been exceeded in England—by a cross-bred steer, which dressed 74 per cent of his live weight.

At the Norwich Fat Stock Show in 1893 the first prize steer, 22½ months old, weighed 1372 lbs.; the second, 22 months old, weighed 1202 lbs.; and the reserve, 17¾ months old, weighed 1238 lbs.—all Red Polls.

At the same show a Red Polled steer, between 2 and 3 years old, was shown which had received a prize the year before in the younger class, and had gained in the year 448 lbs.—an average of 1.23 lbs. a day.

As an illustration of the combination of milk and beef at the same show, Mr. Colman's 8-year-old Red Polled cow was "reserve" in the open classes, to a cross-bred—Shorthorn and Black Polled—shown by the Prince of Wales, and scaled 1522 lbs. As a milch cow in the Whitlingham herd she gave 7481 lbs. of milk in 10½ months, and in five years eleven weeks she gave 28,321½ lbs., and was dry only 12 weeks in that time.

DUTCH BELTED CATTLE.

By H. B. RICHARDS, Easton, Penna., Secretary Dutch Belted Cattle Association of America.

Dutch belted cattle are natives of Holland, and originated in that country during the seventeenth century, when the cattle interests of Holland were in the most thrifty condition; in fact, it was the chief industry of the country. At that time breeding had been developed to a science, and cattle of remarkable contrast of color were bred whose foundation color was black, with a broad white band around the centre of the body, a white head, a black ring around each eye, and a full white tail. Wonderful and remarkable as it may appear, a feat was accomplished during that period that would defy our modern breeders and can be safely classified as a lost art.

Dutch belted cattle became a classified breed and were bred to a remarkably high standard. For several centuries they were owned and controlled by the nobility keeping them pure and limiting their number to their ownership. They were first imported into this country about the middle of the present century, the importers procuring the finest herds in Holland; the herds in the United States to-day are purely of American breeding.

The American Association have adopted as their standard of color a pure black, with a continuous white belt around their body, beginning behind the shoulders and extending nearly to the hips; this sharp contrast of colors makes a beautiful and imposing contrast and a most beautiful sight; when seen in number grazing on the green, they are admired by all, even if not interested in cattle or farming. This belt is almost invariably reproduced, and is so perfectly fixed that it will crop out in their grades for many generations, even against cold strains of blood; the potency of this feature is very striking, as the belt is often reproduced after the foundation color is lost; and grades of any foundation color can be produced to an unlimited extent.

Their form is a strong characterized dairy type, medium size, and possessing all the qualifications of an ideal dairy animal. They are strictly a dairy breed, and are large and persistent milkers; strong constitutions, peaceable and quiet dispositions of a very compact form. Cows range from eight to twelve hundred, and bulls reach eighteen to twenty hundred. The late P. T. Barnum, the showman of national fame, said: "They struck my fancy in Holland about 1850; I imported a few, and then found their unique and novel appearance not their only quality, for they proved to be wonderful milkers, far superior to any other cattle to which my attention has been drawn."

Nearly all the herds now in the United States are owned in New York, Pennsylvania, and Massachusetts, with a few scattering South and West. A herd of eighteen were exhibited at the World's Columbian Exposition at Chicago, where they attracted great attention and were admired by

thousands who had never heard of such novel and beautiful cattle before. This herd was sold and exported to a wealthy resident of the City of Mexico, where they are now kept and are doing well in that congenial climate. There is an association of breeders of these cattle known as the Dutch Belted Cattle Association of America, who have adopted a high standard of excellence, requiring breeders to breed typical animals of correct markings, thereby gaining uniformity and correctness of type. The association issues a herd-book, of which vol. 4, of recent issue, is the last number.

ENGLISH STANDARDS FOR ANNUAL YIELD OF MILK OF THE VARIOUS BREEDS.

The standards proposed for the respective breeds by the British Dairy Farmers' Association for entry in the "Dairy Cattle Register" are as under:

Pedigree and Non-Pedigree.	Weight of Milk in the Milking Period (not exceeding 11 months).	Pure Butter Fat per Day (average of two tests as determined by analysis).
	lbs.	lbs.
Short-horn.....	8500	1.25
Jersey.....	6000	1.25
Guernsey.....	6000	1.25
Ayrshire.....	7500	1.00
Red Polled.....	7000	1.00
Kerry and Dexter Kerry..	4500	0.75
Dutch (Holstein).....	8500	1.00

The standard for crosses of either of the above will be the mean of the standards for the pure breeds. No animal is admitted whose milk contains less than 12 per cent of solids at any test. (McConnell.)

AVERAGE PERCENTAGE COMPOSITION OF MILK FROM DIFFERENT BREEDS. (König.)

Name of Breed.	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Total Solids.	Solids not Fat.
Steyer (Austrian)	12	86.90	4.17	3.24	4.96	.73	13.10	8.93
Simmenthal (Swiss)	6	87.26	3.79	2.64	5.81	.70	12.74	8.95
Tillerthal (Tyrolean)	22	87.43	3.70	3.07	5.10	.70	12.57	8.87
Vorarlberg (Austrian)	19	87.38	3.54	2.91	5.40	.77	12.62	9.08
Algau (Bavarian)	4	87.88	3.20	3.22	5.13	.57	12.12	8.92
Bohemian	2	86.00	5.06	3.67	4.63	.64	14.00	8.94
Holstein	24	88.04	3.25	3.99	4.16	.56	11.96	8.71
Oldenburg (German)	18	87.95	3.38	3.10	4.81	.76	12.05	8.67
Angler (Danish)	10	88.15	3.12	....	....	....	11.85	8.73
Short-horn	67	87.20	3.47	3.21	5.43	.69	12.80	9.33
Devon	20	86.57	4.44	....	....	.64	13.43	8.99
Ayrshire	43	86.93	3.58	3.42	5.43	.64	13.07	9.49
Jersey	31	85.90	4.32	3.34	5.70	.74	14.10	9.78
Guernsey	26	85.39	5.11	3.98	4.38	1.14 (?)	14.61	9.50
French	12	87.20	3.90	3.07	5.06	.77	12.80	8.90
Scandinavian	4	88.00	3.51	2.76	4.97	.76	12.00	8.49

RESULTS OF ENGLISH MILKING TRIALS.

(Averages of breed tests conducted at the annual dairy shows of the British Dairy Farmers' Assoc., 1879-93, inclusive.)

Total No. of Animals.	Breed.	Average Yield of Milk per Day.	Total Solids.		Fat.		Solids not Fat, Per Cent.	Live Weight.
			Yield per Day.	Per Cent.	Yield per Day.	Per Cent.		
		lbs.	lbs.		lbs.			lbs.
178	Short-horns	44.03	5.659	12.85	1.664	3.78	9.07	1403 (28)*
202	Jerseys	27.58	4.033	14.62	1.372	4.96	9.66	832 (44)
77	Guernseys	29.36	4.186	14.26	1.418	4.83	9.43	1038 (13)
10	Holsteins (Dutch)	45.19	5.534	12.25	1.540	3.41	8.84	1383 (3)
18	Ayrshires	37.82	5.086	13.45	1.595	4.22	9.23	1060 (7)
2	Devons	30.12	4.319	14.34	1.476	4.90	9.44	.....
8	Red Polls	35.11	4.551	12.96	1.377	3.92	9.04	1201 (5)
1	Welsh	46.00	5.860	12.74	1.914	4.16	8.58	.....
1	Aberdeen Angus	60.30	8.285	13.74	3.009	4.99	8.75	.....
12	Kerries and Dexter Kerries	26.59	3.555	13.37	1.110	4.18	9.19	749 (9)
33	Crosses	42.94	3.654	12.78	1.569	3.65	9.13	1339 (7)

* Average for 28 animals.

AVERAGE YIELDS AND COMPOSITION OF MILK OF DIFFERENT BREEDS. (Hucho.)

Breed.	Live Wt., Lbs.	Annual Yield.		Average Per Cent.			Per 1000 lbs. Live Wt.	
		Milk, lbs.	Fat, lbs.	Solids.	Fat.	Solids not Fat.	Milk, lbs.	Fat, lbs.
Short-horn.....	1300	6800	260	12.9	3.8	9.1	5200	200
Brown Swiss...	1300	7300	275	13.0	3.8	9.2	5600	210
Holstein.....	1100	7700	230	11.8	3.0	8.2	7000	210
Guernsey.....	1050	6600	330	14.7	5.0	9.7	6300	310
Ayshire.....	1000	6600	245	12.5	3.7	8.8	6600	245
Jersey...	900	6600	300	14.7	5.0	9.7	6700	330
Angler.....	900	6600	240	12.0	3.4	8.6	7300	270
Kerry.....	550	5000	190	12.5	3.8	8.7	9000	350

WORLD'S COLUMBIAN EXPOSITION, 1893.

Results of Breed Tests.

A. Breed Test No. 1 (Cheese Test), May 10 to 25.

	Milk Pro- duced, lbs.	Fat Pro- duced, lbs.	Cheese, lbs.	Price of Cheese per lb., cents.	Cost of Feed.	Net Gain.
15 Jerseys.....	13,296.4	601.91	1451.8	13.36	\$98.14	\$119.82
15 Guernseys.....	10,938.6	488.42	1130.6	11.95	76.25	88.30
15 Short-horns.....	12,186.9	436.60	1077.6	13.00	99.36	81.36

B. Breed Test No. 2 (Ninety-day Butter Test), June 1 to Aug. 29.

	Butter		Price of credited Butter.			
	Pro- duced, lbs.	Fat Pro- duced, lbs.	lbs.	per lb., cents.	Cost of Feed.	Net Gain.
25 Jerseys.....	73,488.8	3516.08	4274.01	\$1747.37	\$587.50	\$1323.81
25 Guernseys.....	61,781.7	2784.56	3360.43	1355.44	484.14	997.64
24 Short-horns.....	66,263.2	2409.97	2890.87	1171.77	501.79	910.12

AVERAGES PER DAY PER COW.

			Fat, per cent.	Cost of Food.
Jerseys	32.7	1.56	4.78	26.1 cts.
Guernseys.....	27.5	1.24	4.51	21.5 "
Short-horns.....	30.7	1.12	3.64	23.2 "

C. Breed Test No. 3 (Thirty-day Butter Test), Aug. 29 to Sept. 28.

	Butter		Price of credited Butter.			
	Pro- duced, lbs.	Fat Pro- duced, lbs.	lbs.	per lb., cents.	Cost of Feed.	Net Gain.
15 Jerseys.....	13,921.9	685.81	837.21	\$385.59	\$111.24	\$274.13
15 Guernseys.....	13,518.4	597.96	724.17	329.77	92.77	237.00
15 Short-horns.....	15,618.3	555.43	662.67	303.69	104.55	198.89

D. Breed Test No. 4 (Heifer Test), Sept 30 to Oct. 20.

7 Jerseys.....	3356.6	155.38	194.23	\$77.69	\$34.44	\$56.28
6 Short-horns.....	2581.0	97.89	122.36	48.95	23.53	47.42

RESULTS OF BREED TESTS CONDUCTED BY AMERICAN AGRICULTURAL EXPERIMENT STATIONS.

Breed.	No. of Cows In- cluded.	No. of Lacta- tion Periods	Average yields per Lactation Period.		Average per cent Fat.
			Milk.	Fat.	
NEW YORK (GENEVA):			lbs.	lbs.	
Jersey	4	10	5788.5	332.4	5.74
Guernsey.....	4	8	6450.8	347.7	5.39
Holstein.....	4	6	9946.3	312.8	3.15
Ayrshire.....	4	11	6816.8	242.2	3.55
Short-horn.....	2	2	5642.9	242.1	4.29
Devon.....	4	8	4118.6	180.9	4.39
American Holderness..	2	6	4894.0	176.7	3.61
MAINE:					
Jersey.....	2	4	5460	297	5.50
Holstein.....	2	3	8369	285	3.47
Ayrshire.....	2	4	6612	233	3.67
NEW JERSEY:					
Jersey	3	3	7695	376.3	4.89
Holstein.....	3	3	8455	300.2	3.55
Ayrshire.....	4	4	7461	275.3	3.69
Short-horn.....	3	3	10457	396.3	3.79
Guernsey	4	4	7446	379.0	5.09
<i>Averages for all Breeds and Lactation Periods.</i>					
Jersey	9	17	6048	331.8	5.49
Guernsey.....	8	12	6783	358.2	5.28
Holstein.....	9	12	9179	302.7	3.30
Ayrshire.....	10	19	6909	247.3	3.58
Short-horn... ..	5	5	8531	334.6	3.92
Devon.....	4	8	4119	180.9	4.39
American Holderness....	2	6	4894	176.7	3.61
Total	47	79			

The animals included in the foregoing breed tests rank on the average as follows:

1. *As to yield of fat:* Guernsey, Short-horn, Jersey, Holstein, Ayrshire, Devon, American Holderness.
2. *As to yield of milk:* Holstein, Short-horn, Ayrshire, Guernsey, Jersey, American Holderness, Devon.
3. *As to richness of milk:* Jersey, Guernsey, Devon, Short-horn, American Holderness, Ayrshire, Holstein.

AVERAGE YIELDS OF MILK AND FAT BY PREMIUM COWS AT STATE FAIRS, 1894.

State.	Name of Cow.	Breed.	Milk.	Fat.	Fat.	Test made at
New York.	Intze Von Holingen.....	Holstein	lbs. 58.55	lbs. 1.691	p.c. 2.89	Fair grounds.
Maine.	.....	Jersey	48.68	2.190	4.50	" "
	.....	"	39.50	1.896	4.80	" "
	.....	Holstein	43.68	.....	.....	" "
Ohio.	Very Much.....	Jersey	44.75	2.060	4.62	Home.
	Hilton Maid.	"	57.75	1.59	2.75	"
	Peterina 2d	"	57.33	1.66	2.90	"
Indiana.	Nahe 2d	"	47.00	1.553	3.30	Fair grounds.
	Toltecs Genet.	Jersey	26.75	1.453	5.43	" "
Illinois.	<i>Cows over 3 yrs. old.</i>					
	Beulah Shawlan ..	"	37.43	1.585	4.33	" "
	Alline Clyde	Ayrshire	39.95	1.535	3.84	" "
	Empr'ss Josephine	Holstein	54.90	1.565	2.85	" "
	<i>Cows under 3 yrs. old.</i>					
	Kitty King.....	Jersey	29.60	1.485	5.02	" "
	Luella 2d.....	Ayrshire	29.45	.845	2.88	" "
	Parana Abbe Kirk 6th.....	Holstein	17.00	.870	5.12	" "
Wisconsin.	Johanna 5th.....	"	83.95	2.500	2.98	Home.
	Daisy.....	Jersey	40.15	2.42	5.95	"
	Schoone.....	Holstein	63.60	2.095	3.28	"
	Linda Pedro	Jersey	32.85	2.015	6.13	"
Iowa.	Beulah Shawlan...	"	40.32	1.573	3.90	Fair grounds.
	Eurodna.....	"	40.12	1.597	4.07	" "
	Bontje P 2d Gerben	Holstein	44.62	1.490	3.35	" "
Nebraska.	Geertje Lefing....	"	50.31	1.510	3.00	" "
	Lutska Isabell....	"	43.44	1.425	3.28	" "
	Nettie Glenn.....	Aberdeen				
		-Angus	33.94	1.185	3.49	" "
	Queen.	Jersey	24.50	1.160	4.72	" "
California.	Lady Woods	"	38.58	2.626	6.74	" "
Toronto, Can.	Eunice Clay.....	Holstein	65.00	1.59	2.45	" "

HIGHEST RECORD FOR YIELD OF FAT

During Twenty-four Hours Made by any Cow in a Public Test.

BRIENZ, Brown-Swiss, 11 years old, weighing 1395 lbs.

Average daily yield of milk..... 81.7 lbs.;

" " " " fat 3.11 "

" per cent of fat in day's milk... 3.81 "

(American Dairy Show, Chicago, 1891; 3-day test.)

METHODS OF JUDGING THE VALUE OF DAIRY COWS.

The *British Dairy Farmers' Association*, which has conducted tests of dairy cows at their annual fair for the last fifteen years, has scored the dairy cows competing for premiums according to the following scale during late years :

- 1 point for each pound of milk;
- 20 points for each pound of fat;
- 4 points for each pound of solids not fat.
- 1 point for each ten days in milk after the first twenty days (limit 200 days).
- 10 points are deducted from the total score for each per cent. of fat below three per cent in the milk.

The cows entered in the test are separated into four classes, according to the breed, each class being divided into two divisions, cows and heifers. The classes are Shorthorns, Jerseys, Guernseys, and cross-breeds.

Other associations abroad or in this country have not generally followed any definite plan from year to year in awarding premiums to dairy cows at fairs, the awards having been given to cows producing most milk, or richest milk, or most butter-fat, or most solids, during the test, which may have lasted one to three days. In the milking trials conducted by the Royal Agricultural Society of England, the size of the cows has been considered, the cows being, as a rule, separated into two classes, viz., over and under 1100 lbs. live weight.

From the best information at hand at the present, the system of awards adopted by the British Dairy Farmers' Association, and given above, must be considered the most perfect and the most just to all concerned. Its main shortcomings lie, as it would seem, in its not considering the food eaten by each animal during the test and in the fact that the test is made at the fair, and not at home under every-day conditions and in surroundings familiar to the animals. The former objection would be removed by taking into account the dry matter in the food eaten, as shown by chemical analysis.

PERCENTAGE COMPOSITION OF VARIOUS KINDS OF MILK. (KÖNIG.)

	No. of Analy- ses.	Water.	Fat.	Casein and Al- bumen.	Milk Sugar.	Ash.	Specific Grav- ity.
Human.....	107	87.41	3.78	2.29	6.21	.31	1.0270
Mare.....	50	90.78	1.21	1.99	5.67	.35	1.0347
Buffalo.....	8	82.25	7.51	5.05	4.44	.75	1.0330
Ass.....	7	89.64	1.64	2.22	5.99	.51	1.0345
Cow	793	87.17	3.69	3.55	4.88	.71	1.0316
Ewe.....	32	80.82	6.86	6.52	4.91	.89	1.0341
Goat.....	38	85.71	4.78	4.29	4.46	.76	1.0328
Sow.....	8	84.04	4.55	7.23	3.13	1.05	1.038
Bitch ..	28	75.44	9.57	11.17	3.09	.73	1.035
Elephant.....	3	79.30	9.10	2.51	8.59	.50	1.0313
Hippopotamus..	1	90.43	4.51	....	4.40	.11	.....
Camel.....	3	86.57	3.07	4.00	5.59	.77	1.042
Llama.....	3	86.55	3.15	3.90	5.60	.80	1.034

COMPOSITION OF MORNING AND EVENING MILK, AND OF MORNING, NOON, AND EVENING MILK. (KÖNIG.)

	No. of An- alyses.	Water.	Fat.	Casein and Albumen.	Milk- sugar.	Ash.	Total Solids.
		Per ct.	Per ct.	Per ct.	Per ct.	P'rct.	Per ct:
Morning milk.	157	86.70	3.32	3.63	5.64	.71	13.30
Evening "	157	86.47	3.56	3.65	5.60	.72	13.53
Morning milk.	28	88.08	3.06	3.24	4.88	.74	11.92
Noon "	28	87.44	3.87	3.26	4.68	.75	12.56
Evening "	23	87.49	3.62	3.19	4.99	.71	12.51

COMPOSITION OF DIFFERENT PARTS OF THE SAME MILKINGS. (KÖNIG.)

	No. of An- alyses.	Water.	Fat.	Casein and Albumen.	Milk- sugar.	Ash.	Total Solids.
		Per ct.	Per ct.	Per ct.	Per ct.	P'rct.	Per ct.
First portion..	7	89.84	1.78	2.88	4.81	.69	10.16
Second " ..	7	88.12	3.34	2.94	4.92	.68	11.88
Third " ..	6	86.29	4.52	2.59	5.88	.72	13.71

AVERAGE ANALYSES OF AMERICAN SAMPLES OF MILK AND DAIRY PRODUCTS. (GOESSMANN.)

	Whole Milk.	Skim-milk.	Butter-milk.	Cream from Cooley Creamer.	Butter.
No. of samples.....	1738	328	31	176	25
Water.....	86.51	90.52	91.67	73.53	10.89
Fat.....	4.14	.39	.27	17.98	83.95
Casein and albumen..	3.20	3.53	2.79	... ..	.42
Milk-sugar.	5.45	4.76	4.47	7.87	.....
Ash.....	.70	.80	.80	.62	4.74
	100.00	100.00	100.00	100.00	100.00
Total solids.....	13.49	9.48	8.33	26.47	89.11
Solids not fat....	9.35	9.09	8.06	8.49	5.16

COMPOSITION OF COWS' MILK. (KÖNIG.)

	Average of 793 Analyses (largely European).	Minimum.	Maximum.
Water....	87.17 per cent.	80.32 per cent.	90.69 per cent.
Fat.....	3.69 " "	1.67 " "	6.47 " "
Casein.	3.02 { 3.55 per ct.	1.79 { 2.07 per ct.	6.29 { 6.40 per ct.
Albumen.....	.53	.25	1.44
Milk-sugar.....	4.88 per cent.	2.11 per cent.	6.12 per cent.
Ash.....	.71 " "	.35 " "	1.21 " "
	100.00		
Total solids.....	12.83 per cent.	9.31	19.68
Solids not fat.....	9.14 " "	.....	.....
Specific gravity....	1.0316 " "	1.0264	1.0370

CALCULATION OF COMPONENTS OF COWS' MILK.

According to Vieth the components of milk solids will stand in the ratio to one another of about

10 : 13 : 2

for casein and albumen : milk sugar : ash.

If the solids not fat in a sample of milk are 9 per cent,

the per cent. of casein in the same will be approximately $\frac{9}{25} \times 10 = 3.60$ per cent; sugar, $\frac{9}{25} \times 13 = 4.68$ per cent; and ash, $\frac{9}{25} \times 2 = .72$ per cent.

**TABLE SHOWING RELATION OF FAT TO CASEIN
AND OTHER SOLIDS. (COOKE.)**

Total Solids.	Fat.	Casein and Albumen.	Milk-sugar and Ash.
11.00.....	3.07	2.92	5.01
11.50..	3.29	3.00	5.21
12.00.....	3.50	3.07	5.43
12.50.....	3.75	3.19	5.56
13.00	3.99	3.30	5.71
13.50	4.34	3.44	5.72
14.00	4.68	3.57	5.75
14.50.....	4.93	3.79	5.68
15.00.....	5.38	4.00	5.62
15.50	5.69	4.15	5.66
16.00.....	6.00	4.30	5.70

This table, which is summarized from the analyses of about 2400 American samples of milk, shows that while the percentage of fat varies from 3.07 to 6 per cent, or nearly double, that of casein varies only from 2.92 to 4.30 per cent. It also shows that a higher percentage of fat is always accompanied by a higher percentage of casein. Milk-sugar and ash increase but little as the milk grows richer.

FERTILIZING INGREDIENTS IN DAIRY PRODUCTS.

Average of American Analyses. (COOKE and HILLS.)

	Nitrogen.	Phosphoric Acid.	Potash.	Value per Ton.
Whole milk.....	.53%	.19%	.175%	\$ 2.17
Skim-milk.....	.56	.20	.185	2.31
Cream... ..	.40	.15	.130	.66
Buttermilk.	.48	.17	.158	1.98
Whey.....	.15	.14	.181	.84
Butter.....	.12	.04	.036	.49
Cheese.....	3.93	.60	.120	14.19

COMPOSITION OF COLOSTRUM. (KÖNIG.)

	No. of Anal- yses.	Water.	Casein.	Albu- men.	Butter- fat.	Milk- sugar.	Ash.
Ewe.....	11	77.9	4.9	3.4	8.3	4.6	.9
Goat.....	1	64.1	5.2	3.2	24.5	.....	3.0
Sow.....	1	70.1	7.6	8.0	9.5	3.9	.9
Cow.....	42	74.6	4.0	13.6	3.6	2.7	1.6

COMPOSITION OF ASH OF COWS' MILK AND
COLOSTRUM.

	Cows' Milk.	Colostrum.
Total ash.....	.7 per cent	1.6 per cent
100 parts of ash will contain :		
Potash.....	24 "	7 "
Soda.....	6 "	6 "
Lime.....	23 "	35 "
Phosphoric acid.	28 "	41 "
Chlorin.....	13 "	13 "

A CHAPTER ON MILK TESTING.

The Babcock milk test is the only quick and simple method of determining the fat content of milk which has been generally adopted in this country. The test was invented by Dr. S. M. Babcock, of Wisconsin Agricultural Experiment Station, and was first published in July, 1890. The following is an outline of the method:

A known quantity of milk (17.6 cubic centimeters, or about $\frac{2}{3}$ of an ounce) is pipetted off into a graduated test-bottle; 17.5 cc. of commercial sulphuric acid, of a specific gravity of 1.82 to 1.83, is then measured out by means of a graduated cylinder or an automatic pipette, and added to the milk. The two fluids are mixed, and when the curd is dissolved the test-bottles are placed in a centrifugal machine and whirled for 5 minutes at a rate of 800-1200 revolutions per minute, the small hand-machines on the market requiring the higher number of revolutions. Boiling hot water is then filled into the bottles, by which means the liquid fat is brought into the narrow graduated neck of the

bottles ; after an additional whirling of the bottles for a minute, the length of the column of fat is read off in per cent.

The whole process of testing a sample of milk according to this method will take less than a quarter of an hour when a little skill in manipulation has been reached.

The various dealers in dairy implements have placed Babcock machines on the market in sizes from 4- to 60-bottle machines, and supply the necessary outfit, as test-bottles, pipettes, graduates, and sulphuric acid. There are at present three different types of machines—hand-machines (friction or cog-wheel machines, the latter ones to be preferred, but also somewhat more expensive), steam turbine and belt-power machines. Among the steam turbine tests Sharples' Russian Babcock Tester deserves special mention, since the bottles used in this machine can be filled while the machine is in motion. The test bottles used are arranged for half the usual quantity of milk.

Points to be watched in making tests by the Babcock method :

The strength of the acid used is very important; its specific gravity should not go below 1.82 or above 1.84 ; if the acid is somewhat too strong less may be taken, and a little more if it is rather weak. It is, however, not possible to make a satisfactory test with acid of a specific gravity below 1.82. Keep the acid bottle corked when not in use, as the acid will otherwise take up moisture from the air.

The centrifugal machine should run at a rate of about 800 to 1000 revolutions per minute; if its diameter is small, whirl 1000 or 1200.

Soft or rain-water is used in filling up the bottle after boiling, or hard water may be used if some drops of sulphuric acid have been added to it before the boiling.

In adding the acid the bottle should be held at an angle, so as to cause the acid to follow the inside of the wall. Mix the milk and acid at once, or within a short time, and proceed with the test without delay.

Read off results before the fat begins to crystallize. If many tests are made at a time, and the room is cold, place

the bottles in a pail with hot water and keep them warm until results are recorded.

Application of Babcock's Test.—The method may be used to advantage in determining the fat content of full milk, skim-milk, buttermilk, whey, cream, condensed milk, and cheese. It cannot be recommended for the estimation of fat in butter, since the error of analysis in this case is too large. In testing separator skim-milk, buttermilk, and whey by this method, no reading should be taken lower than one-tenth of one per cent. If only a small drop or two of liquid fat appears in the neck of the bottles after finished whirling, the result is therefore to be put down as .1 per cent, instead of estimates of .05, and still lower, which are sometimes made.

Lactometer.—The Quevenne lactometer, with the thermometer tube extending into the narrow stem of the instrument, is recommended for dairy work. In the N. Y. Board of Health lactometer, often used, the scale is divided into 120 divisions, the mark 100 corresponding to a specific gravity of 1.029, and that of 120 to a specific gravity of 1.0348. These lactometer degrees can be converted into Quevenne lactometer degrees by multiplying by .29. The following table gives the readings of the two scales between 60 and 120 on the Board of Health lactometer:

TABLE SHOWING THE QUEVENNE LACTOMETER DEGREES CORRESPONDING TO THE SCALE OF LACTOMETERS GRADUATED FROM 0 TO 120.

Ordinary Scale.	Quevenne Scale.	Ordinary Scale.	Quevenne Scale.	Ordinary Scale.	Quevenne Scale.
60	17.4	81	23.5	101	29.3
61	17.7	82	23.8	102	29.6
62	18	83	24.1	103	29.9
63	18.3	84	24.4	104	30.2
64	18.6	85	24.6	105	30.5
65	18.8	86	24.9	106	30.7
66	19.1	87	25.2	107	31
67	19.4	88	25.5	108	31.3
68	19.7	89	25.8	109	31.6
69	20	90	26.1	110	31.9
70	20.3	91	26.4	111	32.2
71	20.6	92	26.7	112	32.5
72	20.9	93	27	113	32.8
73	21.2	94	27.3	114	33.1
74	21.5	95	27.6	115	33.4
75	21.7	96	27.8	116	33.6
76	22	97	28.1	117	33.9
77	22.3	98	28.4	118	34.2
78	22.6	99	28.7	119	34.5
79	22.9	100	29	120	34.8
80	23.2				

In taking the specific gravity of milk by means of a lactometer, the temperature of the milk should not vary more than 10° either way from 60° F. The following tables show the proper corrections for temperature to be made, if the milk was either warmer or colder than 60° F., the temperature to which the specific gravities of all liquids are usually referred.

In practical work sufficiently accurate corrections for temperature may generally be made by adding .1 to the lactometer reading for each degree above 60° F., and by subtracting .1 for each degree below 60°; e.g., if the reading at 64° is 29.5, it will be about $29.5 + .4 = 29.9$ at 60°; if 34.0 at 52°, it will be about $34.0 - .8 = 33.2$ at 60°. By reference to the following table we find it is more correctly 33.0.

CORRECTION TABLE FOR SPECIFIC GRAVITY OF MILK. (VIETH.)

Reading.		Temperature of Milk (in Degrees Fahrenheit).															
		Lactometer															
		45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
20		19.0	19.0	19.1	19.1	19.2	19.2	19.3	19.4	19.4	19.5	19.6	19.7	19.8	19.9	19.9	20.0
21		19.9	20.0	20.0	20.1	20.2	20.2	20.3	20.3	20.4	20.5	20.6	20.7	20.8	20.9	20.9	21.0
22		20.9	21.0	21.0	21.1	21.2	21.2	21.3	21.3	21.4	21.5	21.6	21.7	21.8	21.9	21.9	22.0
23		21.9	22.0	22.0	22.1	22.2	22.2	22.3	22.3	22.4	22.5	22.6	22.7	22.8	22.8	22.9	23.0
24		22.9	23.0	23.0	23.1	23.2	23.2	23.3	23.3	23.4	23.5	23.6	23.6	23.7	23.8	23.9	24.0
25		23.8	23.9	24.0	24.0	24.1	24.1	24.2	24.3	24.4	24.5	24.6	24.6	24.7	24.8	24.9	25.0
26		24.8	24.9	24.9	25.0	25.1	25.1	25.2	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0
27		25.8	25.9	25.9	26.0	26.1	26.1	26.2	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0
28		26.7	26.8	26.8	26.9	27.0	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0
29		27.7	27.8	27.8	27.9	28.0	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0
30		28.6	28.7	28.7	28.8	28.9	29.0	29.1	29.1	29.2	29.3	29.4	29.6	29.7	29.8	29.9	30.0
31		29.5	29.6	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.8	30.9	31.0
32		30.4	30.5	30.5	30.6	30.7	30.9	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.9	32.0
33		31.3	31.4	31.4	31.5	31.6	31.8	31.9	32.0	31.1	32.3	32.4	32.5	32.6	32.7	32.9	33.0
34		32.2	32.3	32.3	32.4	32.5	32.7	32.9	33.3	33.1	33.2	33.3	33.5	33.6	33.7	33.9	34.0
35		33.0	33.1	33.2	33.4	33.5	33.6	33.8	33.9	34.0	34.2	34.3	34.5	34.6	34.7	34.9	35.0

CORRECTION TABLE FOR SPECIFIC GRAVITY OF MILK—(Continued).

Lactometer		Temperature of Milk (in Degrees Fahrenheit).														
		61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Reading.																
	20	20.1	20.2	20.2	20.3	20.4	20.5	20.6	20.7	20.9	21.0	21.1	21.2	21.3	21.5	21.6
	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	22.0	22.1	22.2	22.3	22.4	22.5	22.6
	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	23.0	23.1	23.2	23.3	23.4	23.5	23.7
	23	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	24.0	24.1	24.2	24.3	24.4	24.6	24.7
	24	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.9	25.0	25.1	25.2	25.3	25.5	25.6	25.7
	25	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.9	26.0	26.1	26.2	26.4	26.6	26.6	26.8
	26	26.1	26.2	26.3	26.5	26.6	26.7	26.8	27.0	27.1	27.2	27.3	27.4	27.6	27.7	27.8
	27	27.1	27.3	27.4	27.5	27.6	27.7	27.8	28.0	28.1	28.2	28.3	28.4	28.6	28.7	28.9
	28	28.1	28.3	28.4	28.5	28.6	28.7	28.8	29.0	29.1	29.2	29.4	29.5	29.7	29.8	29.9
	29	29.1	29.3	29.4	29.5	29.6	29.7	29.9	30.1	30.2	30.3	30.4	30.5	30.7	30.9	31.0
	30	30.1	30.3	30.4	30.5	30.7	30.8	30.9	31.1	31.2	31.3	31.5	31.6	31.8	31.9	32.1
	31	31.2	31.3	31.4	31.5	31.7	31.8	31.9	32.0	32.2	32.4	32.5	32.6	32.8	33.0	33.1
	32	32.2	32.3	32.5	32.6	32.7	32.9	33.0	33.2	33.3	33.4	33.6	33.7	33.9	34.0	34.2
	33	33.2	33.3	33.5	33.6	33.8	33.9	34.0	34.2	34.3	34.5	34.6	34.7	34.9	35.1	35.2
	34	34.2	34.3	34.5	34.6	34.8	34.9	35.0	35.2	35.3	35.5	35.6	35.8	36.0	36.1	36.3
	35	35.2	35.3	35.5	35.6	35.8	35.9	36.1	36.2	36.4	36.5	36.7	36.8	37.0	37.2	37.3

DIRECTIONS.—Bring the temperature of the milk to within 10° from 60° F. Take the reading of the lactometer and that of the temperature of the milk; find the former in the first vertical column of the table and the latter in the first horizontal row of figures; the figure where the horizontal and vertical columns meet is the corrected lactometer reading; e.g., observed, 31.0 at 67° F.; corrected reading, 31.9.

CALCULATION OF TOTAL SOLIDS OF MILK.

The relation existing between the various components of the milk is such as to make possible the calculation of the percentage of solids not fat, and total solids, in a sample of milk when the fat content and the specific gravity (lactometer reading) of the milk are known. Several formulas have been worked out by chemists in different parts of the world, by the application of which the total solids may be calculated from the percentage of fat and the specific gravity of the milk. We give here Babcock's formula, as it is simplest and gives results of all necessary accuracy for practical purposes. The formula is:

$$\text{Solids not fat} = \frac{L + .7f}{3.8},$$

and

$$\text{Total solids} = \frac{L + .7f}{3.8} + f,$$

where L = lactometer reading and f = per cent of fat in the milk.*

Rule.—Add the Quevenne lactometer reading at 60° F. to seven-tenths of the per cent of fat, divide the sum by 3.8 and correct as given below for milk poorer than 3 per cent and richer than 4 per cent. The result will be the per cent of solids not fat in the milk; this added to the per cent of fat gives the per cent of total solids present.

In the following tables calculations of per cent of solids not fat have been made according to a more general formula, also given by Babcock, for values of fat content from .0 to 6%, and for specific gravities ranging from 1.017 to 1.040. The results obtained by using these tables will in careful work vary only within .2% of the true content of solids not fat present.

* *Correction* to be made in calculating per cent of solids not fat, and solids, from per cent of fat and lactometer reading by the preceding formulas:

For milks containing less than 1% of fat subtract.....	.09
“ “ “ from 1 to 2% “ “ “	.06
“ “ “ “ 2 “ 3% “ “ “	.03
“ “ “ “ 3 to 4% of fat....	no correction.
“ “ “ “ 4 “ 5% “ “ add.....	.03
“ “ “ “ 5 “ 6% “ “ “	.06

TABLE SHOWING PER CENT OF SOLIDS NOT FAT
(Corresponding to Per Cent of Fat and Quevenne Lactometer Reading). (BABCOCK.)

Per Cent of Fat.																						
Lacto. Read. °	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	Lacto. Read. °
17..	4.42	4.44	4.46	4.48	4.50	4.52	4.54	4.56	4.58	4.60	4.62	4.64	4.66	4.68	4.70	4.73	4.75	4.77	4.79	4.81	4.83	17
18..	4.68	4.70	4.72	4.74	4.76	4.78	4.80	4.82	4.84	4.86	4.88	4.90	4.92	4.95	4.97	4.99	5.01	5.03	5.05	5.07	5.09	18
19..	4.94	4.96	4.98	5.00	5.02	5.04	5.06	5.08	5.10	5.12	5.14	5.17	5.19	5.21	5.23	5.25	5.27	5.29	5.31	5.33	5.35	19
20..	5.20	5.22	5.24	5.26	5.28	5.30	5.32	5.34	5.36	5.38	5.40	5.43	5.45	5.47	5.49	5.51	5.53	5.55	5.57	5.59	5.61	20
21..	5.46	5.48	5.50	5.52	5.54	5.56	5.58	5.60	5.62	5.64	5.66	5.69	5.71	5.73	5.75	5.77	5.79	5.81	5.83	5.85	5.87	21
22..	5.72	5.74	5.76	5.78	5.80	5.82	5.84	5.86	5.88	5.90	5.93	5.95	5.97	5.99	6.01	6.03	6.05	6.07	6.09	6.11	6.13	22
23..	5.98	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.17	6.19	6.21	6.23	6.25	6.27	6.29	6.31	6.33	6.35	6.37	6.39	23
24	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.38	6.40	6.43	6.45	6.47	6.49	6.51	6.53	6.55	6.57	6.59	6.61	6.63	6.65	24
25..	6.50	6.52	6.54	6.56	6.58	6.60	6.62	6.64	6.67	6.69	6.71	6.73	6.75	6.77	6.79	6.81	6.83	6.85	6.87	6.90	6.92	25
26	6.76	6.78	6.80	6.82	6.84	6.86	6.88	6.91	6.93	6.95	6.97	6.99	7.01	7.03	7.05	7.07	7.09	7.11	7.14	7.16	7.18	26
27..	7.02	7.04	7.06	7.08	7.10	7.12	7.14	7.17	7.19	7.21	7.23	7.25	7.27	7.29	7.31	7.33	7.35	7.38	7.40	7.42	7.44	27
28..	7.28	7.30	7.32	7.34	7.36	7.38	7.40	7.43	7.45	7.47	7.49	7.51	7.53	7.55	7.57	7.59	7.61	7.64	7.66	7.68	7.70	28
29..	7.54	7.56	7.58	7.60	7.62	7.64	7.66	7.69	7.71	7.73	7.75	7.77	7.79	7.81	7.83	7.85	7.88	7.90	7.92	7.94	7.96	29
30..	7.80	7.82	7.84	7.86	7.88	7.90	7.93	7.95	7.97	7.99	8.01	8.03	8.05	8.07	8.09	8.12	8.14	8.16	8.18	8.20	8.22	30
31..	8.06	8.08	8.10	8.12	8.14	8.16	8.19	8.21	8.23	8.25	8.27	8.29	8.31	8.33	8.36	8.38	8.40	8.42	8.44	8.46	8.48	31
32..	8.32	8.34	8.36	8.38	8.40	8.42	8.45	8.47	8.49	8.51	8.53	8.55	8.57	8.59	8.62	8.64	8.66	8.68	8.70	8.72	8.74	32
33	8.58	8.60	8.62	8.64	8.66	8.68	8.71	8.73	8.75	8.77	8.79	8.81	8.83	8.85	8.88	8.90	8.92	8.94	8.96	8.98	9.01	33
34..	8.84	8.86	8.88	8.90	8.92	8.95	8.97	8.99	9.01	9.03	9.05	9.07	9.09	9.12	9.14	9.16	9.18	9.20	9.22	9.24	9.27	34
35..	9.10	9.12	9.14	9.16	9.18	9.21	9.23	9.25	9.27	9.29	9.31	9.33	9.35	9.38	9.40	9.42	9.44	9.46	9.48	9.51	9.53	35
36..	9.36	9.38	9.40	9.42	9.44	9.47	9.49	9.51	9.53	9.55	9.57	9.59	9.62	9.64	9.66	9.68	9.70	9.72	9.75	9.77	9.79	36
37..	9.62	9.64	9.66	9.68	9.70	9.73	9.75	9.77	9.79	9.81	9.83	9.85	9.88	9.90	9.92	9.94	9.96	9.98	10.01	10.03	10.05	37
38..	9.88	9.90	9.92	9.94	9.97	9.99	10.01	10.03	10.05	10.07	10.09	10.12	10.14	10.16	10.18	10.20	10.22	10.25	10.27	10.29	10.31	38
39..	10.14	10.16	10.18	10.20	10.23	10.25	10.27	10.29	10.31	10.33	10.35	10.38	10.40	10.42	10.44	10.46	10.48	10.51	10.53	10.55	10.57	39
40..	10.40	10.42	10.44	10.46	10.49	10.51	10.53	10.55	10.57	10.59	10.61	10.64	10.66	10.68	10.70	10.72	10.75	10.77	10.79	10.81	10.83	40

TABLE FOR SOLIDS NOT FAT—Continued.

Per Cent of Fat.																						
Lacto. Read'g.	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	Lacto. Read'g.
17	4.83	4.85	4.87	4.89	4.91	4.93	4.95	4.97	4.99	5.01	5.03	5.05	5.07	5.09	5.11	5.14	5.16	5.18	5.20	5.22	5.24	.17
18	5.09	5.11	5.13	5.15	5.17	5.19	5.21	5.23	5.25	5.27	5.29	5.31	5.33	5.36	5.38	5.40	5.42	5.44	5.46	5.48	5.50	.18
19	5.35	5.37	5.39	5.41	5.43	5.45	5.47	5.49	5.51	5.54	5.56	5.58	5.60	5.62	5.64	5.66	5.68	5.70	5.72	5.74	5.76	.19
20	5.61	5.63	5.65	5.67	5.69	5.71	5.73	5.76	5.78	5.80	5.82	5.84	5.86	5.88	5.90	5.92	5.94	5.96	5.98	6.00	6.02	.20
21	5.87	5.89	5.91	5.93	5.95	5.98	6.00	6.02	6.04	6.06	6.08	6.10	6.12	6.14	6.16	6.18	6.20	6.22	6.24	6.27	6.29	.21
22	6.13	6.15	6.17	6.19	6.22	6.24	6.26	6.28	6.30	6.32	6.34	6.36	6.38	6.40	6.42	6.44	6.46	6.49	6.51	6.53	6.55	.22
23	6.39	6.41	6.44	6.46	6.48	6.50	6.52	6.54	6.56	6.58	6.60	6.62	6.64	6.66	6.69	6.71	6.73	6.75	6.77	6.79	6.81	.23
24	6.65	6.68	6.70	6.72	6.74	6.76	6.78	6.80	6.82	6.84	6.86	6.88	6.90	6.93	6.95	6.97	6.99	7.01	7.03	7.05	7.07	.24
25	6.92	6.94	6.96	6.98	7.00	7.02	7.04	7.06	7.08	7.10	7.13	7.15	7.17	7.19	7.21	7.23	7.25	7.27	7.29	7.31	7.34	.25
26	7.18	7.20	7.22	7.24	7.26	7.28	7.30	7.32	7.35	7.37	7.39	7.41	7.43	7.45	7.47	7.49	7.51	7.53	7.56	7.58	7.60	.26
27	7.44	7.46	7.48	7.50	7.52	7.54	7.56	7.59	7.61	7.63	7.65	7.67	7.69	7.71	7.73	7.75	7.78	7.80	7.82	7.84	7.86	.27
28	7.70	7.72	7.74	7.76	7.78	7.81	7.83	7.85	7.87	7.89	7.91	7.93	7.95	7.97	8.00	8.02	8.04	8.06	8.08	8.10	8.12	.28
29	7.96	7.98	8.00	8.02	8.05	8.07	8.09	8.11	8.13	8.15	8.17	8.19	8.21	8.24	8.26	8.28	8.30	8.32	8.34	8.36	8.38	.29
30	8.22	8.24	8.26	8.29	8.31	8.33	8.35	8.37	8.39	8.41	8.43	8.46	8.48	8.50	8.52	8.54	8.56	8.58	8.60	8.63	8.65	.30
31	8.48	8.50	8.53	8.55	8.57	8.59	8.61	8.63	8.65	8.67	8.70	8.72	8.74	8.76	8.78	8.80	8.82	8.84	8.87	8.89	8.91	.31
32	8.74	8.77	8.79	8.81	8.83	8.85	8.87	8.89	8.92	8.94	8.96	8.98	9.00	9.02	9.04	9.06	9.09	9.11	9.13	9.15	9.17	.32
33	9.01	9.03	9.05	9.07	9.09	9.11	9.13	9.16	9.18	9.20	9.22	9.24	9.26	9.28	9.30	9.33	9.35	9.37	9.39	9.41	9.43	.33
34	9.27	9.29	9.31	9.33	9.35	9.37	9.39	9.42	9.44	9.46	9.48	9.50	9.52	9.55	9.57	9.59	9.61	9.63	9.65	9.67	9.70	.34
35	9.53	9.55	9.57	9.59	9.61	9.63	9.66	9.68	9.70	9.72	9.74	9.76	9.79	9.81	9.83	9.85	9.87	9.89	9.91	9.94	9.96	.35
36	9.79	9.81	9.83	9.85	9.87	9.90	9.92	9.94	9.96	9.98	10.00	10.03	10.05	10.07	10.09	10.11	10.13	10.16	10.18	10.20	10.22	.36
37	10.05	10.07	10.09	10.11	10.14	10.16	10.18	10.20	10.22	10.24	10.27	10.29	10.31	10.33	10.35	10.37	10.40	10.42	10.44	10.46	10.48	.37
38	10.31	10.33	10.35	10.38	10.40	10.42	10.44	10.46	10.48	10.51	10.53	10.55	10.57	10.59	10.61	10.64	10.66	10.68	10.70	10.72	10.75	.38
39	10.57	10.59	10.62	10.64	10.66	10.68	10.70	10.72	10.75	10.77	10.79	10.81	10.83	10.85	10.88	10.90	10.92	10.94	10.96	10.99	11.01	.39
40	10.83	10.86	0.88	10.90	10.92	10.94	10.96	10.99	11.01	11.03	11.05	11.07	11.09	11.12	11.14	11.16	11.18	11.20	11.23	11.25	11.27	.40

TABLE FOR SOLIDS NOT FAT—Continued.

Lacto. Read. g.		Per Cent of Fat.																				Lacto. g.
		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9		6.0
17	5.24	5.26	5.28	5.30	5.32	5.34	5.36	5.38	5.40	5.42	5.44	5.46	5.48	5.51	5.53	5.55	5.57	5.59	5.61	5.63	5.65	..17
18	5.50	5.52	5.54	5.56	5.58	5.60	5.62	5.64	5.66	5.69	5.71	5.73	5.75	5.77	5.79	5.81	5.83	5.85	5.87	5.89	5.91	..18
19	5.76	5.78	5.80	5.82	5.84	5.86	5.89	5.91	5.93	5.95	5.97	5.99	6.01	6.03	6.05	6.07	6.09	6.11	6.13	6.16	6.18	..19
20	6.02	6.04	6.07	6.09	6.11	6.13	6.15	6.17	6.19	6.21	6.23	6.25	6.27	6.29	6.31	6.34	6.36	6.38	6.40	6.42	6.44	..20
21	6.29	6.31	6.33	6.35	6.37	6.39	6.41	6.43	6.45	6.47	6.49	6.52	6.54	6.56	6.58	6.60	6.62	6.64	6.66	6.68	6.70	..21
22	6.55	6.57	6.59	6.61	6.63	6.65	6.67	6.69	6.72	6.74	6.76	6.78	6.80	6.82	6.84	6.86	6.88	6.90	6.92	6.95	6.97	..22
23	6.81	6.83	6.85	6.87	6.89	6.92	6.94	6.96	6.98	7.00	7.02	7.04	7.06	7.08	7.10	7.13	7.15	7.17	7.19	7.21	7.23	..23
24	7.07	7.09	7.12	7.14	7.16	7.18	7.20	7.22	7.24	7.26	7.28	7.30	7.33	7.35	7.37	7.39	7.41	7.43	7.45	7.47	7.49	..24
25	7.34	7.36	7.38	7.40	7.42	7.44	7.46	7.48	7.50	7.53	7.55	7.57	7.59	7.61	7.63	7.65	7.67	7.69	7.72	7.74	7.76	..25
26	7.60	7.62	7.64	7.66	7.68	7.70	7.73	7.75	7.77	7.79	7.81	7.83	7.85	7.87	7.89	7.92	7.94	7.96	7.98	8.00	8.02	..26
27	7.86	7.88	7.90	7.92	7.94	7.97	7.99	8.01	8.03	8.05	8.07	8.09	8.11	8.14	8.16	8.18	8.20	8.22	8.24	8.26	8.28	..27
28	8.12	8.14	8.16	8.19	8.21	8.23	8.25	8.27	8.29	8.31	8.33	8.36	8.38	8.40	8.42	8.44	8.46	8.48	8.50	8.53	8.55	..28
29	8.38	8.41	8.43	8.45	8.47	8.49	8.51	8.53	8.55	8.58	8.60	8.62	8.64	8.66	8.68	8.70	8.73	8.75	8.77	8.79	8.81	..29
30	8.65	8.67	8.69	8.71	8.73	8.75	8.77	8.80	8.82	8.84	8.86	8.88	8.90	8.92	8.95	8.97	8.99	9.01	9.03	9.05	9.07	..30
31	8.91	8.93	8.95	8.97	8.99	9.02	9.04	9.06	9.08	9.10	9.12	9.15	9.17	9.19	9.21	9.23	9.25	9.27	9.30	9.32	9.34	..31
32	9.17	9.19	9.21	9.24	9.26	9.28	9.30	9.32	9.34	9.37	9.39	9.41	9.43	9.45	9.47	9.49	9.52	9.54	9.56	9.58	9.60	..32
33	9.43	9.46	9.48	9.50	9.52	9.54	9.56	9.58	9.61	9.63	9.65	9.67	9.69	9.71	9.74	9.76	9.78	9.80	9.82	9.84	9.87	..33
34	9.70	9.72	9.74	9.76	9.78	9.80	9.83	9.85	9.87	9.89	9.91	9.93	9.96	9.98	10.00	10.02	10.04	10.06	10.09	10.11	10.13	..34
35	9.96	9.98	10.00	10.02	10.04	10.07	10.09	10.11	10.13	10.15	10.17	10.20	10.22	10.24	10.26	10.28	10.31	10.33	10.35	10.37	10.39	..35
36	10.22	10.24	10.26	10.29	10.31	10.33	10.35	10.37	10.39	10.42	10.44	10.46	10.48	10.50	10.52	10.55	10.57	10.59	10.61	10.63	10.66	..36
37	10.48	10.50	10.53	10.55	10.57	10.59	10.61	10.64	10.66	10.68	10.70	10.72	10.74	10.77	10.79	10.81	10.83	10.85	10.88	10.90	10.92	..37
38	10.75	10.77	10.79	10.81	10.83	10.85	10.88	10.90	10.92	10.94	10.96	10.99	11.01	11.03	11.05	11.07	11.10	11.12	11.14	11.16	11.18	..38
39	11.01	11.03	11.05	11.07	11.09	11.12	11.14	11.16	11.18	11.20	11.23	11.25	11.27	11.29	11.31	11.34	11.36	11.38	11.40	11.42	11.45	..39
40	11.27	11.29	11.31	11.34	11.36	11.38	11.40	11.42	11.45	11.47	11.49	11.51	11.53	11.55	11.58	11.60	11.62	11.64	11.67	11.69	11.71	..40

MILK STANDARDS.

	Solids.	Fat.	Solids not Fat.
Vermont.....	12.5%	[3.25%]	9.25%
Massachusetts	13.0%	[3.7%]	9.3%
“ , in May and June.	12.0%		
New York.....	12.0%	3.0%	[9.0%]
New Jersey.....	12.0%		
Michigan.....	12.5%	3.0%	[9.5%]
Wisconsin.....		3.0%	
Minnesota.....	13.0%	3.5%	[9.5%]
Iowa		3.0%	
England.....	[11.5%]	2.5%	9.0%

ADULTERATION OF MILK.

The legal standards adopted in the different States of the Union determine the limits for fat or solids, below which the milk offered for sale must not fall. Where no control sample can be taken of a suspected sample of milk, calculations of the extent of the adulteration practised are made on basis of the legal standard in each State. Whenever possible, a control sample should be secured on the premises of the suspected party, and subjected to analysis. If the control sample contains appreciably less fat or solids not fat than did the suspected sample, the latter was skimmed or watered, or both skimmed and watered.

SKIMMING.—I. If a sample is skimmed, the following formula will give the number of pounds of fat abstracted from 100 lbs. of milk :

$$\text{Fat abstracted} = x = \text{legal standard for fat} - f, \quad (I)$$

f being the per cent of fat in the suspected sample.

In this and following formulas the percentages found in the control samples, if such are at hand, are always to be substituted for the legal standards.

II. The following formula will give the per cent of fat abstracted, calculated on the total quantity of fat originally found in the milk:

$$x = 100 - \frac{f \times 100}{\text{leg. stand. for fat}} \cdot \cdot \cdot \cdot (II)$$

WATERING.—I. If a sample is watered, the calculations are most conveniently based on the percentage of solids not fat in the milk:

Per cent extraneous water in milk

$$= x = 100 - \frac{s \times 100}{\text{leg. stand. for solids not fat}}, \quad \text{(III)}$$

s being the per cent of solids not fat in the suspected sample.

Example.—A sample contains 8.5 per cent of solids not fat; if the legal standard for solids not fat be 9 per cent,

$100 - \frac{8.5 \times 100}{9} = 5.6$, will give the per cent of extraneous water in the suspected sample of milk.

II. Watering of milk may also be expressed in per cent of water added to the original milk, by formula IV:

Per cent water added to original milk

$$= x = \frac{100 \times \text{leg. stand. for solids not fat}}{s} - 100. \quad \text{(IV)}$$

In the example given above, $\frac{100 \times 9}{8.5} - 100 = 5.9$ per cent of water was added to the original milk.

WATERING AND SKIMMING.—If a sample has been both watered and skimmed, the extent of watering is ascertained by means of formula III; and the fat abstracted found according to the following formula:

Per cent fat abstracted

$$= x = \text{leg. stand. for fat} - \frac{\text{leg. stand. for solids not fat}}{s} \times f. \quad \text{(V)}$$

Example.—A sample of milk contains 2.4 per cent of fat and 8.1 per cent solids not fat; then

extraneous water in milk $= 100 - \frac{8.1 \times 100}{9} = 10$ per cent;

fat abstracted $= 3 - \frac{9 \times 2.4}{8.1} = .33$ per cent.

100 lbs. of the milk contained 10 lbs. of extraneous water and .33 lbs. of fat had been skimmed from it.

TAINTED MILK.

The causes of tainted milk have been classified by the Swiss scientist Dr. Gerber as follows :

1. Poor fodder.
2. Poor, dirty water, used not only for watering the cows, but also for washing the cans.
3. Foul air in cow-stable.
4. Uncleanliness in milking.
5. Keeping the milk too long in too warm and poorly ventilated places.
6. Neglecting to cool the milk quickly after milking.
7. Lack of cleanliness in the care of the milk.
8. Poor transportation facilities.
9. Sick cows.
10. The cows being in heat.

II. CREAM.

PERCENTAGE COMPOSITION OF CREAM. (KÖNIG.)

	Mean of 43 Analyses.	Minimum.	Maximum.
Water	68.82	22.83	83.23
Fat	22.66	15.19	29.93
Casein, Albumen, etc.....	3.76	.63	7.88
Milk Sugar... ..	4.23	.59	5.52
Ash	.53	.11	2.50
	100.00		

PERCENTAGE COMPOSITION OF DAIRY PRODUCTS. (KÖNIG.)

	No. of Analyses.	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.	Specific Gravity.	
Skim-milk, gravity creaming ...	56	90.43	.87	3.26	4.74	.70	1.0357	
Centrifugal skim-milk.....	7	90.60	.31	3.06	5.29	.74	1.0350	
Buttermilk.....	57	90.12	1.09	4.03	4.04	.72	1.0348	
Whey.....	46	93.38	.32	.86	4.79	.65	1.0272	
Preserved milk...	4	87.97	3.21	3.34	4.74	.74	1.0313	
Condensed milk, (no sugar added)	36	58.99	12.42	11.92	14.49	2.18		
Condensed milk, (sugar added)...	64	25.61	10.35	11.79	50.06*	2.19		
Scherff's condensed milk.....	5	72.87	6.62	8.20	10.63	1.68	Lactic acid.	Alcohol.
Koumiss (from mares' milk)....	43	90.44	1.46	2.24	1.77	.42	.91	1.91
Koumiss (from cows' milk). ...	11	89.20	1.83	2.66	4.09	.43	.55	1.14
Kephir.....	22	91.21	1.44	3.49	2.41	.68	1.02	.75

* 13.84 per cent milk-sugar, 36.22 per cent cane-sugar.

YIELD OF CREAM FROM MILK. (VIETH.)

Per cent of Fat in Cream.

14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
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Number of Pounds of Cream from 1000 lbs. of Milk.

Per cent Fat in Milk.	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
3.0	197	172	152	137	125	114	105	98	91	85	80	76	72	68	65	62	59	57	54	52	50	48	47	45
3.1	204	178	158	142	129	118	109	101	94	88	83	78	74	71	67	64	61	59	56	54	52	50	48	47
3.2	211	185	164	147	134	123	113	105	98	92	86	81	77	73	70	66	63	61	58	56	54	52	50	49
3.3	219	191	169	152	138	127	117	108	101	95	89	84	79	76	72	69	66	63	60	58	56	54	52	50
3.4	226	198	175	158	143	131	121	112	104	98	92	87	82	78	74	71	68	65	62	60	58	56	54	52
3.5	234	204	181	163	147	135	125	116	108	101	95	90	85	81	77	73	70	67	64	62	60	58	56	54
3.6	241	210	187	168	152	139	128	119	111	104	98	93	88	83	79	75	72	69	66	64	61	59	57	55
3.7	248	217	192	173	157	143	132	123	114	107	101	95	90	86	81	78	74	71	68	66	63	61	59	57
3.8	256	223	198	178	161	148	136	126	118	110	104	98	93	88	84	80	77	73	70	68	65	63	61	59
3.9	263	229	203	183	166	152	140	130	121	113	107	101	96	90	86	82	79	75	72	70	67	65	62	60
4.0	270	236	209	188	170	156	144	134	125	117	110	104	98	93	89	85	81	78	74	72	69	66	64	62
4.1	276	242	215	193	175	160	148	137	128	120	113	106	101	96	91	87	83	80	76	73	71	68	66	64
4.2	284	248	221	198	180	165	152	141	131	123	116	109	103	98	94	89	85	82	78	75	73	70	68	65
4.3	292	255	226	203	184	169	155	144	135	126	119	112	106	101	96	92	88	84	80	77	74	72	69	67
4.4	299	261	232	208	189	173	159	148	138	129	122	115	108	103	98	94	90	86	82	79	76	74	71	69
4.5	306	267	237	213	194	178	163	151	141	133	125	118	111	106	101	96	92	88	85	81	78	75	73	70
4.6	314	274	243	219	198	181	167	155	145	136	128	121	114	108	103	98	94	90	87	83	80	78	74	72
4.7	321	280	249	224	203	186	171	159	148	139	131	123	117	111	105	101	96	92	89	85	82	79	76	74
4.8	329	287	254	229	207	190	175	163	151	142	134	126	119	113	108	103	98	93	91	87	84	81	78	75
4.9	336	293	260	234	212	194	179	166	155	145	136	129	122	116	110	105	101	97	93	89	86	83	80	77
5.0	343	299	266	239	217	198	183	170	158	148	139	132	124	119	113	108	103	99	95	90	90	84	81	79

LIST OF HAND AND POWER CREAM SEPARATORS ON THE MARKET, 1894.

Name.	Capacity per Hour.	Retail Price.	Manufacturer.
HAND SEPARATORS.			
	lbs.		
1. <i>The De Laval "Baby" Cream Separators.</i>			
Baby No. 1.....	150	\$75	The De Laval Separator Co., N. Y. City.
" No. 2.....	300	125	
" No. 3.....	600	200	
2. <i>The Davis Intern'l Hand or Power Separators (five styles).....</i>	150-600	75-200	Davis & Rankin Bldg. and Mfg. Co., Chicago, Ill.
<i>The Davis Hand and Belt Power Separators (five styles).....</i>	150-600	75-200	
3. <i>U. S. Cream Separators:</i>			
No. 3. B style.....	600	200	Vermont Farm Machine Co., Bel- lows Falls, Vt.
No. 4. A ".....	350-400	150	
No. 5. B ".....	270-300	125	
4. <i>The Butter Accumulator.</i>			
No. 3 A and 3 B as separator	300	125	Swedish Cream and Butter Separator Co., N. Y. City.
lator.....	150		
POWER SEPARATORS.			
1. <i>Alpha Separators.</i>			
Alpha No. 1. Belt Power...	2000	500	The De Laval Sep- arator Co., N. Y. City.
" No. 2. " ".....	3600	750	
" No. 1. Steam Turbine	2000	525	
" No. 2. " ".....	3600	800	
Alpha Acme Belt Power...	1300	375	
" " Steam Turbine	1300	400	
Standard Belt Power.....	1000-1300	350	
" Turbine.	1000-1300	375	
2. <i>The Russian Steam Sepa- rators:</i>			
The Dairy Russian.....	700-800	250	P. M. Sharples, West Chester, Pa.
The Standard ".....	1200-1500	350	
The Imperial ".....	2000-3000	500	
<i>The Standard Belt Sepa- rators:</i>			
The Dairy Belt.....	500-600	200	
The Standard Belt.....	1000-1500	350	Vermont Farm Ma- chine Co., Bel- lows Falls, Vt.
The Imperial ".....	2000-3000	500	
3. <i>U. S. Cream Separators:</i>			
No. 1. A and B style....	1800-2300	400	A. H. Reid, Phila- delphia, Pa.
No. 2. A style.....	1100-1300	350	
4. <i>The Reid Improved Danish Separator.....</i>	2000-3000	500	Columbia Cream Separator Co., Avon, N. Y.
5. <i>The Columbia Cream Sepa- rators (three styles)....</i>	300-600	100-150	

HAND AND POWER CREAM SEPARATORS—(Con.)

Name.	Capacity per Hour.	Retail Price.	Manufacturer.
POWER SEPARATORS—(Cont'd.)			
	lbs.		
6. <i>The Jumbo-Alexandria Separator</i>	2500-3000	\$500	Davis & Rankin Bldg. and Mfg. Co., Chicago, Ill.
7. <i>The Davis Hand and Belt Power Separators</i>	800 1000-1200 2000-2500	250 350 500	
8. <i>The Butter Accumulator</i> .			
No. 1A, as separator.	2000	400	Swedish Cream and Butter Separator Co., N. Y. City.
" accumulator....	1200		
No. 2A, B, & C, as separator	600	200	
" accumu-			
lator	400		
	Butter		
No. 4A, for cream only....	35-40	400	
No. 4B, " " " "	20-25	200	

FORMULA FOR FINDING THE FAT CONTENT OF CREAM.

Fleischmann's formula :

$$\text{Per cent fat in cream} = f_2 = \frac{100(f - f_1)}{R} + f_1,$$

where R = per cent of cream obtained, f = per cent fat in milk, f_1 = per cent fat in skim-milk ; or

$$f_2 = \frac{100F}{AR} \cdot B,$$

where F = per cent of fat in butter, B = yield of butter from 100 lbs. of milk, A = percentage churning. Under ordinary conditions of creaming, these formulas may be simplified to

$$f_2 = 6.67f - 1.42,$$

$$f_2 = 5.77B.$$

Formula for finding the per cent cream to be separated when a certain fat content in the cream is wanted (Fleischmann):

$$x = \frac{100(f - f_1)}{f_2 - f_1},$$

f , f_1 and f_2 = per cent of fat in full milk, skim-milk, and cream, respectively.

III. BUTTER.

BUTTER-MAKING.

By H. B. GURLER, De Kalb, Ill., ex-President Ill. State Dairymen's Assn.,
Author of "American Dairying."

Butter is made from milk. The cow manufactures the milk from the food she eats, hence the necessity of sound food. Unsound food makes off-flavored milk and poor butter. Some cows can manufacture food into milk at a profit, others cannot; hence the necessity of knowing the individuality of each cow, or her ability to work at a profit to her owner.

At this stage of the dairy work there is no excuse for a dairyman not knowing what each and every cow is doing for him, thus being able to "weed out" the unprofitable ones.

Be careful and cleanly in milking. Remove the milk to a pure atmosphere as soon as drawn from the cows. If the cream is raised by gravity process be careful of the surroundings, as milk will absorb bad odors from decayed vegetables, the hog-pen, the cow-yard, the kerosene-can, a filthy stable, from cooking in the kitchen, and various other sources.

When milk is put through the separator as soon as it is drawn from the cow this source of danger is removed. Cream from the separator should be cooled immediately to a temperature of 60°; 55° is better. A cooler that will ærate at the same time it is cooling is very desirable. This is a vital point which many butter-makers stumble over. When through separating and cooling, temper the cream to the temperature necessary to have it ripen at the time you wish to churn. If it is to be churned the following day this temperature should be 65°-70°. If the second day, 55°-60°; and if it is to stand four to seven days, cool to 40°, if possi-

ble, as soon as practicable, and hold at that temperature until the day before you wish to churn, when it should be warmed to a temperature that will give the right acidity by the time you wish to churn. This temperature will depend on the kind of cream, whether separator cream or cream from some gravity process. Cream from shallow setting may be sufficiently ripened when taken from the milk. I recommend the use of Prof. Farrington's acid tablets for testing the acidity of cream (see p. 213). They are a great help to a beginner.

Churn at as low a temperature as you can. This will depend on the per cent of fat in the cream. Rich cream can be churned at a much lower temperature than cream poor in fat. Cream from deep, cold setting may be churned at 58° to 62° ; and thick, rich cream from shallow setting at a much lower temperature. An ironclad rule cannot be made that will fit all cases. The separator will give cream containing various per cent of fat, from 15 to 40 per cent. Separator cream containing 15 per cent fat will need to be churned at about the same temperature as deep, cold setting cream. Separator cream containing 40 per cent can be churned at a temperature of 50° , can be gathered at 50° , so the buttermilk will draw at that temperature. A low temperature gives the most exhaustive churning. At this temperature the buttermilk should contain no more fat than the average separator skim-milk. Cream containing a large per cent of fat does not develop acid as fast as cream with more milk in it. Cool cream for churning about two hours before, so as to let the butter-fat have time to solidify or harden. This gives a more waxy texture to the butter.

Stop the churn when the butter granules are the size of wheat. If the granules are too small there is danger of a loss from its passing through the strainer. Wash no more than is necessary to remove the buttermilk. The colder it is churned the less washing is needed. When butter gathers at 54° one washing is sufficient; if at 62° to 64° , two or three washings will be needed. Washing removes some of the delicate flavor or aroma. Remove the water from the churn as soon as possible—as soon as it has done its

work. Never allow it to lie and soak unless there is no other way of hardening the butter to a temperature where you can handle it.

Salt to suit your trade. Work once or twice, as you prefer; twice working is preferable, as it makes the nicer-appearing butter. Work just enough to remove the mottled or streaked appearance. When worked twice this can be told at the time by the appearance of the butter. When worked but once it cannot be told until the butter has stood long enough for the salt to dissolve. If worked but once examine the butter the following day, until you make yourself a rule of thumb to work by. I have found this necessary. I am compelled to look after this point in my creamery work when the butter is worked but once. Use the kind of butter-package that suits your trade, but always let it be *neat*. Never send a mussy-looking package to market. You cannot afford to do it.

DIRECTIONS FOR THE USE OF MANNS' TEST FOR ASCERTAINING THE ACIDITY OF CREAM.

1. Stir the cream thoroughly; insert small end of pipette in cream and draw until nearly full; then put the finger over upper end of pipette and allow cream to escape slowly (by admitting air) until mark on neck of pipette is reached. Transfer to a tumbler, rinse the pipette three times with lukewarm water, adding the rinsing water to the cream in the tumbler. Now add to contents of the tumbler three drops of the solution marked "Indicator" (phenolphthalein).

2. Fill the burette up to the 0 mark with the solution marked "Neutralizer" (alkali solution).

3. While constantly stirring the cream with the glass rod, allow the liquid to flow from the burette into the tumbler until the entire contents of the tumbler shows a pink tinge. Stop adding the solution from the burette the moment the color is permanent.

4. Read the level of the liquid remaining in the burette. The reading shows the amount of acid present.

The experience of those using the test indicates that where the acidity of the cream is right, to secure the best results in yield and flavor of butter, from 38 to 42 cc. of the neutralizer will be required for the test. It is a simple matter for each butter maker to learn by experiment the exact degree of acidity and churning temperature suited to the best results, and with these as standards reduce the process of butter-making to a certainty. By testing his cream in the afternoon the butter-maker will be able to set it to ripen at such a temperature that it will show the proper acidity for churning next morning.

In testing the milk for cheese-making the same directions are to be followed, excepting that a much less acid condition is required; probably 15–20 cc. will give the best results. The whole numbers are cubic centimeters; the intermediate divisions are fractions of a cubic centimeter.

Precautions in Using the Test.—The solution marked “Neutralizer” is prepared of a certain strength. It is essential that this strength remain constant. Never let this solution stand without a stopper. Keep in glass or stoneware.

FARRINGTON'S ALKALINE TABLETS.

Prof. E. H. Farrington of the Wisconsin Agricultural Experiment Station has devised a simple method of ascertaining the acidity of cream in creamery work by means of alkaline tablets. Each tablet contains a definite amount of a powdered alkali (= approximately 4.5 cc. of a tenth normal alkali solution) and a small amount of the indicator phenolphthalein. A solution of the tablets in water has a reddish color, which is destroyed in the presence of an excess of acid. 25 cc. of cream is measured out, and a solution of five tablets in 50 cc. of water is added until the color of the cream remains slightly red. By placing the solution in a graduated 50 cc. glass cylinder the quantity added may be directly read off. Experience has shown that properly ripened cream will have an acidity requiring for neutralization about 40 cc. of the solution, made up as directed.

PERCENTAGE COMPOSITION OF BUTTER. (KÖNIG.)

	Average.	Minimum.	Maximum.	Sweet Cream Butter.	Sour Cream Butter.
No. of analyses included.....	302			10	11
Water.....	13.59	4.15	35.12	12.93	13.08
Fat	84.39	69.96	86.15	84.53	84.26
Casein.....	.74	.19	4.78	.61	.81
Milk sugar.....	.50			.68	.66
Lactic acid.....	.62	.45	1.16	....	....
Ash.....	.66	.02	15.08	1.25	1.19
	100.00				

AVERAGE CHEMICAL COMPOSITION OF SWEET CREAM AND SOUR CREAM BUTTER.

(FLEISCHMANN.)

	Made from Sweet Cream, not Salted.		Made from Sour Cream, Salted.	
	Not washed.	Washed.	Not washed.	Washed.
	Per ct.	Per ct.	Per ct.	Per ct.
Water	15.00	15.00	12.00	12.50
Fat	83.47	83.73	84.75	84.62
Casein and albumen.....	.60	.55	.50	.48
Other organic substances.....	.80	.60	.55	.40
Ash, or ash and salt.....	.13	.12	2.20	2.00

PERCENTAGE COMPOSITION OF EUROPEAN SAMPLES OF BUTTER.

	Schleswig-Holstein.	Danish.	Swedish.	French.		Italian.	German Preserved Butter.	English.
				Salted.	Un-salted.			
Number of samples analyzed.	28	12	40	5	78	15	24	50
Water.....	11.99	13.35	13.84	12.05	13.73	15.33	12.22	11.64
Fat	85.47	83.40	84.35	84.34	84.82	83.00	85.68	86.93
Casein, milk-sugar, { lactic acid, etc. }	1.19	1.39	1.23	1.60	1.36	1.47	1.26	.60
Salt.....	1.35	1.86	.58	2.01	.09	.20	.84	.83

YIELD OF BUTTER FROM MILK OF DIFFERENT RICHNESS. (KIRCHNER.)

100 lbs. of milk will yield the number of pounds of butter given in the table. (Percentage creaming, 16 per ct.; fat in butter, 83 per ct.)

Per cent. of Fat in Milk.	Per cent. of Fat in Skim-milk.			
	.20	.30	.40	.50
2.5	2.697	2.600	2.503	2.406
2.6	2.812	2.716	2.618	2.522
2.7	2.928	2.832	2.734	2.638
2.8	3.044	2.948	2.850	2.754
2.9	3.160	3.063	2.966	2.869
3.0	3.276	3.178	3.081	2.984
3.1	3.392	3.293	3.297	3.100
3.2	3.508	3.409	3.313	3.216
3.3	3.624	3.525	3.429	3.332
3.4	3.739	3.641	3.544	3.447
3.5	3.854	3.757	3.659	3.562
3.6	3.969	3.873	3.774	3.677
3.7	4.084	3.989	3.890	3.793
3.8	4.200	4.105	4.006	3.909
3.9	4.316	4.220	4.122	4.025
4.0	4.432	4.335	4.238	4.141
4.1	4.547	4.450	4.352	4.257
4.2	4.663	4.565	4.468	4.373
4.3	4.779	4.681	4.584	4.489
4.4	4.895	4.797	4.700	4.604
4.5	5.011	4.913	4.816	4.719
4.6	5.127	5.028	4.932	4.834
4.7	5.243	5.144	5.048	4.949
4.8	5.359	5.260	5.164	5.065
4.9	5.474	5.376	5.280	5.181
5.0	5.589	5.492	5.395	5.297

FORMULA FOR FINDING YIELD OF BUTTER.

In ordinary dairy or creamery practice, where modern methods of creaming and churning are applied, the yield of butter will exceed that of fat in the milk by 15 to 16 per cent, or 1 pound of fat in the milk will produce about 1.15 pounds butter, i.e., yield of butter from 100 lbs. of milk = 1.15*f*, *f* being the per cent of fat in the milk.

Fleischmann's formula:

$$\text{Yield of butter} = 1.16f - .25.$$

POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF BUTTER.

Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.
2.8.....	31.1	5.0.....	17.4
3.0.....	29.0	5.2.....	16.7
3.2.....	27.2	5.4.....	16.1
3.4.....	25.5	5.6.....	15.5
3.6.....	24.2	5.8.....	15.0
3.8.....	22.9	6.0.....	14.5
4.0.....	21.7	6.2.....	14.0
4.2.....	20.7	6.4.....	13.6
4.4.....	19.8	6.6.....	13.2
4.6.....	18.9	6.8.....	12.8
4.8.....	18.1	7.0.....	12.4

Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.	Lbs. of Milk per 1 lb. of Butter.	Per Cent Fat in Milk.
10.....	8.70	26.....	3.34
11.....	7.90	27.....	3.22
12.....	7.25	28.....	3.11
13.....	6.69	29.....	3.00
14.....	6.21	30.....	2.90
15.....	5.80	31.....	2.81
16.....	5.44	32.....	2.72
17.....	5.12	33.....	2.64
18.....	4.83	34.....	2.56
19.....	4.58	35.....	2.48
20.....	4.35	36.....	2.42
21.....	4.14	37.....	2.35
22.....	3.95	38.....	2.29
23.....	3.78	39.....	2.23
24.....	3.62	40.....	2.17
25.....	3.47		

The two preceding tables are based on ordinary creamery experience, 1 pound of fat in the milk producing 1.15 pounds of butter.

NUMBER OF POUNDS OF MILK REQUIRED FOR MAKING ONE POUND OF BUTTER. (KIRCHNER.)

Lbs. Butter per 100 lbs. of Milk.	Lbs. Milk per 1 lb. of Butter.	Lbs. Butter per 100 lbs. of Milk.	Lbs. Milk per 1 lb. of Butter.
2.4	41.67	3.8	26.32
2.5	40.00	3.9	25.64
2.6	38.46	4.0	25.00
2.7	37.04	4.1	24.39
2.8	35.71	4.2	23.81
2.9	34.48	4.3	23.26
3.0	33.33	4.4	22.73
3.1	32.26	4.5	22.22
3.2	31.25	4.6	21.74
3.3	30.30	4.7	21.28
3.4	29.41	4.8	20.83
3.5	28.57	4.9	20.41
3.6	27.68	5.0	20.00
3.7	27.03	5.5	18.18

DISTRIBUTION OF MILK INGREDIENTS IN BUTTER MAKING. (COOKE.)

	Total Solids.	Fat.	Casein.	Albumen.	Milk Sugar.	Ash.	Proportion of the Total Milk Fat found in the Product.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1000 lbs. of whole milk....	130.0	40.0	26.0	7.0	49.5	7.5	..
800 lbs. of skim-milk. ...	78.0	2.4	22.0	6.0	41.2	6.4	6
200 lbs. of cream.. . . .	52.0	37.6	4.0	1.0	8.3	1.1	94
187 lbs. of buttermilk.....	14.91	.8	3.77	.94	8.3	1.1	2
43.3 lbs. of butter.....	37.09	36.8	.23	.06	....	....	92

LOSS OF BUTTER CAUSED BY INEFFICIENT SKIMMING.

If three-tenths of one per cent of fat is left in the skim-milk, instead of two-tenths, in a separator creamery receiving 1000 lbs. of milk a day, there will be a loss of about 340 lbs. of butter for the whole year, on the supposition that 1000 lbs. of milk yield 800 lbs. of skim-milk, and 1 lb. of butter contains .86 lbs. of fat. If the separation is still

poorer, greater losses will be sustained, as will be seen in the table given below. (Friis.)

Lbs. of Milk per Day.	Excess of Fat Left in Skim-milk.			
	.05 per cent.	.10 per cent.	.20 per cent.	.30 per cent.
	Loss of Butter During Whole Year.			
1,000	170	340	680	1,020
2,000	340	680	1360	2,040
3,000	510	1020	2040	3,060
4,000	680	1360	2720	4,080
5,000	850	1700	3400	5,100
6,000	1020	2040	4080	6,120
7,000	1190	2380	4760	7,140
8,000	1360	2720	5440	8,160
9,000	1530	3060	6120	9,180
10,000	1700	3400	6800	10,200

SCORE FOR JUDGING BUTTER.

	World's Fair, 1893.
Flavor.....	45
Grain.....	25
Color.....	15
Salting.....	10
Packing.....	5
	<hr/> 100

This score was adopted in judging butter exhibits at various State fairs and dairymen's conventions during 1894; the Conn. Dairymen's Association scored 50 for flavor and 5 for salting, otherwise as above.

Minimum number of points entitling exhibitors to a premium:

Wisconsin Dairymen's Association, 93, 95 and 94 points, for dairy, separator creamery, and gathered-cream butter, respectively.

New York State Fair, 75 points.

**ENGLISH SCALE OF POINTS FOR JUDGING
BUTTER. (McCONNELL.)**

Perfection, 100.

- 25 Flavor : nutty, aromatic, sweet.
 - 20 Moisture : as free from beads of water as possible.
 - 10 Solidity : firm, not melting easily, nor softening.
 - 25 Texture : closeness of grain, distinct fracture ; not greasy.
 - 10 Color : natural, even.
 - 10 Make : remaining points, cleanliness, salting, nicely put up, etc.
-
- 100

IV. CHEESE.

HOW AMERICAN CHEESE IS MADE.

By JOHN W. DECKER, of Wisconsin Agricultural Experiment Station,
Author of "Cheddar Cheese Making."

As soon as the milk is received at the factory it is heated to 86° F. and a rennet test made.*

If the milk is not ripe enough it is held till the proper acidity is reached. If the milk is very sweet a starter of sour milk is added to hasten it. The milk should be set at such a ripeness that there will be one eighth of an inch of acid (fine strings) on the hot-iron in two hours and a half from the time rennet is added.

If the cheese is to be colored the color is added just before setting the milk. When it is thoroughly stirred in, we can add the rennet. The amount of rennet to be used depends on the kind of cheese desired. If a soft fast-curing cheese is wanted, enough rennet is used to coagulate the milk in fifteen to twenty minutes; if a slow-curing cheese, enough to coagulate in thirty to forty-five minutes. It is stirred in thoroughly in four or five minutes and then the dipper is run lightly over the top, to keep the cream down till the milk begins to thicken, when a cloth cover is spread over the vat and the coagulation allowed to continue till the curd will break clean over the fingers.

* The Monrad rennet test is recommended. It consists of a 160 cc. tin cylinder for measuring the milk, a 5 cc. pipette, a 50 cc. graduated flask, and a half-pint tin basin. The rennet is measured with the 5 cc. pipette and delivered into the 50 cc. flask, the rennet adhering to the pipette being rinsed into the flask with a little water. The flask is then filled with water to the 50 cc. mark, and the solution mixed by shaking. The milk, the temperature of which should be 86° F., is measured in the tin cylinder, emptied into the half-pint basin, and 5 cc. of the dilute extract is measured into the 160 cc. of milk, and the number of seconds required to curdle it noted. If a few specks of charcoal are scattered on the milk and the milk started into motion around the dish with a thermometer, the instant of curdling can be noted by the stopping of the specks. They will stop so suddenly as to seem to start back in the opposite direction.

The curd is then cut, using the horizontal knife first and cutting lengthwise of the vat. The cutting is finished from this point with the perpendicular knife, the curd being thus cut into cubes one half inch in diameter.

Without waiting for the curd to settle, we begin stirring very carefully with a wire basket, and rub the curd off from the sides of the vat with the hand. As soon as this is done we turn on the heat carefully and raise the temperature slowly to 98° F.; when the curd is firm enough a wooden rake is used to stir it. The temperature is raised at the rate of one degree in four or five minutes.

As soon as the temperature of 98° F. is reached we begin trying the curd on the hot-iron for acid. We must have the curd firm enough when the whey is drawn, so that a double handful pressed together will fall apart readily. This is the test for a proper cooking. When fine threads one eighth of an inch in length show on the hot iron the whey is ready to draw. This should be two and a half hours from the time the milk was set. The whey is drawn off by means of a whey gate and a whey strainer, and the curd dipped into a curd-sink or on racks placed in the vat. There should be racks in the curd-sink over which a linen strainer-cloth is thrown. The curd is dipped onto this cloth and the whey drains through. The curd should be stirred, to facilitate the escape of the whey, and is then left to mat together. In fifteen or twenty minutes it can be cut into blocks eight or ten inches square, and turned over. After turning several times these blocks can be piled two or three deep. The acid will continue to develop in the curd; when it will string about an inch it will have assumed a stringy or mealy texture, so that it will tear like the meat on a chicken's breast.

It is then run through the curd-mill and cut up into small pieces. These pieces are stirred up every little while to air. In the course of another hour and a half there will be two inches of acid on the curd; it will smell like toasted cheese when pressed against the hot-iron, and when a handful is squeezed, half fat and half whey will run out between the fingers. It is then ready to salt. It is cooled to 80° F. be-

fore salting. If a fast-curing cheese is wanted we use two pounds per hundred pounds of curd; two and a half pounds are used for a medium cheese, and three pounds for a slow-curing cheese. The curd should be spread out at an even thickness and the salt applied evenly. It should then be thoroughly stirred several times.

As soon as the harsh feeling has left the curd it is ready to go to press. The screw should be turned slowly, but fast enough so that a stream of brine is kept flowing. The full pressure should not be applied for ten minutes. In an hour the bandages can be turned down, and full pressure is then applied. The continuous-pressure gang-press made by D. H. Burrell and Co., is the most satisfactory, as the cheese will not loosen during the night. The next day the cheese are placed on the shelves and the rinds greased. They should be turned and rubbed every day. The temperature of the curing-room should be 60° to 65° F., and moisture should be supplied in dry weather. The cheese are boxed and shipped in about a month.

DISTRIBUTION OF INGREDIENTS IN CHEESE-MAKING. (COOKE.)

	Total Solids.	Fat.	Casein and Albumen.	Milk-sugar.	Ash.
	Per cent	Per cent	Per cent	Per cent	Per cent
Cheese.....	54.2	90.6	77.4	5.0	36
Cheese-press drips...	.9	.4	.6	1.5	1
Whey.....	44.9	9.0	22.0	93.5	63
	100.0	100.0	100.0	100.0	100

DISTRIBUTION OF FERTILIZING INGREDIENTS IN CHEESE-MAKING. (COOKE.)

	Nitrogen.	Phosphoric Acid.	Potash.
	lbs.	lbs.	lbs.
1000 lbs. of whole milk.....	5.30	1.90	1.75
900 lbs. of whey.....	1.35	1.23	1.63
100 lbs. of cheese.....	3.95	.65	.12

VARIETIES AND ANALYSES OF CHEESE.

(McCONNELL.)

	Water.	Casein.	Fat.	Sugar.	Ash.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
<i>British, pressed—</i>					
Cheddar, 3 months.....	36.17	24.93	31.83	3.21	3.86
" 6 ".....	31.17	26.31	33.68	4.91	3.93
" average.....	34.38	26.38	32.71	....	3.58
Cheshire, new.....	36.96	24.08	29.34	5.17	4.45
" old.....	32.59	32.51	26.06	4.53	4.31
Derby.. ..	31.68	24.50	35.20	4.38	4.24
Dunlop	38.46	25.87	31.86	.....	3.81
Gloucester (single).....	32.50	28.51	28.23	.....	4.66
" (double).....	35.96	21.74	26.83	.....	4.07
<i>British, soft—</i>					
Cream	30.65	4.94	62.99	.....	1.15
Stilton	30.35	28.85	35.39	.....	3.82
<i>French, soft—</i>					
Brie.....	50.35	17.18	25.12	.....	5.41
Camembert.....	50.16	21.85	21.13	.....	3.89
Gervais (cream).....	52.94	11.80	20.75	2.58	2.93
Neufchatel.....	44.47	14.60	33.70	.....	2.99
<i>French, pressed—</i>					
Gruyere.....	34.87	25.87	28.91	....	3.84
Roquefort.....	31.20	27.63	33.16	.....	6.01
<i>Dutch—</i>					
Edam (round).....	36.28	24.06	30.26	.....	4.90
Gouda (flat).....	21.90	46.95	24.81	.....	6.32
<i>German—</i>					
Backstein.....	73.10	19.80	2.80	2.20	2.10
<i>Swiss—</i>					
Backstein....	35.80	24.44	37.40	.....	2.36
Bellelay (soft).....	37.59	28.88	30.05	.....	3.48
Emmenthaler.....	35.14	30.86	31.00	.....	4.00
<i>Italian—</i>					
Gorgonzola.....	44.04	28.06	29.84	.....	3.87
Parmesan.....	31.34	41.99	19.22	.....	6.25
<i>Various—</i>					
American factory.....	25.93	38.12	31.55	..	4.38
Foreign skim, average....	46.08	33.37	10.54	6.12	3.81
German sour milk.....	63.63	25.27	4.85	.....	3.67
Whey cheese (cow).....	24.21	9.06	20.80	41.01	4.92
" " (goat).....	25.29	9.10	20.98	29.21	3.88

PERCENTAGE COMPOSITION OF CHEESE. (KÖNIG.)

	No. of Analyses.	Water.	Fat.	Casein and Al- bumen.	Nitrogen— free Ex- tract.	Ash.
Cream cheese.. ..	27	36.33	40.71	18.84	1.02	3.10
Full cream cheese	143	38.00	30.25	25.35	1.43	4.97
Half-skim cheese.....	21	39.79	23.92	29.67	1.79	4.73
Skim cheese.....	41	46.00	11.65	34.06	3.42	4.87
Sour-milk cheese.....	15	52.36	16.03	36.64	.90	4.07
Whey cheese....	7	23.66	16.91	8.90	45.75	4.78

FORMULA FOR FINDING YIELD OF CHEDDAR CHEESE.

The approximate yield of green cheddar cheese from 100 lbs. of milk may be found by multiplying the per cent of fat in the milk by 2.7; if f designate the per cent of fat in the milk, the formula will therefore be:

$$\text{Yield of cheese} = 2.7f. \quad (\text{Babcock.})$$

For cured cheese the factor will be about 2.6. If the percentages of casein and fat in the milk are both known, the yield of cheese may be calculated from the following formula, which will give practically correct results:

$$\text{Yield of cheese} = x = 1.1f + 2.5 \text{ casein.} \quad (\text{Babcock.})$$

YIELD OF DIFFERENT KINDS OF CHEESE FROM 100 LBS. OF MILK. (FLEISCHMANN.)

	Green Cheese.	Cured Cheese.
	lbs.	lbs.
Soft full-cream cheese intended for immediate consumption.....	25-33	.....
Very soft full-cream cheeses (Brie, Camembert, Neufchatel, etc.).....	18-22	12-15
Somewhat firmer, full-cream soft cheeses (Limburger, Remondon cheese, etc.).....	13-16	9-11
Soft half-skim cheese (Limburg), $1\frac{1}{2}$ lbs. butter and	12-13	9-11
Soft skim cheeses (<i>à la</i> Brie, Camembert, Livarot, Backstein, etc.), 3-3.4 lbs. butter and.....	7.5-12	6.5-9
Roquefort cheese (made from sheeps' milk).....	18	12-14.5
Full-milk, from American and English cheeses, and .75 lbs. whey-butter.	9-11	8-9
Full-milk from Dutch and Swiss cheeses..... and .75 lbs. whey-butter.	8-11	7-10
Half-skim firm cheeses, 1.6 lbs. butter and.....	7-10	5-8
Skim-milk cheese, 3-3.5 lbs. butter and.....	5-7	4-6
Sour-milk cheese, 3-3.5 lbs. butter and.....	7.5-9	5-6
Scandinavian "Gammelost"..... and 3-3.5 lbs. butter.	3.5-5.5	2-3
Whey cheese ("Mysost")..... and butter and skim-milk cheese.	6-7	.....

Whey in manufacture of full-cream cheese, 73-88 lbs., average 81 lbs.

" " " " half-skim " 72-80 " " 76 "

" " " " skim cheese 66-76 " " 71 "

Under similar conditions 5-7 lbs. less of whey are obtained in the manufacture of soft cheese than in that of firm cheese.

The loss sustained in the manufacture of cheese amounts on the average to 3 lbs. per 100 lbs. of milk, not considering the losses incurred in the curing of the cheese.

	Evening's Milk Cooled to	Rennetted at	Time Al- lowed for Coagulation	Tempera- ture in Cooking.	Breaking or Stirring.	Acid Developed.	Salt Added.	Pressure Applied.	Ripened at	Mold.	Shape of Cheese.	Weight of Cheese.	Remarks.
	° F.	° F.	Min.	° F.	Min.				° F.			lbs.	
Cheddar.....	68	84	45	100	100	Much	1:56	1 ton	60		Deep	60-80	{ 50% more rennet used; skewered; sour whey added, 1:120. Dried in oven at 70-80° F. " " " " " " " " " " Open, flaky curd desired; extra rennet. Extra cream added, or $\frac{1}{2}$ skim drawn off. Partly skim-milk; painted brown; differ only in thickness. Partly skim-milk. " sweet curd.
Cheshire— Early ripening...	70	80	50	90	30	Very much	1:25	15 cwt.	60	.....	"	80	
Medium " ...	68	87	60	92	40	Medi'm	1:30	Graduated	60	.....	"	80	
Late " ...	66	90	70	94	40	Little	1:35	"	60	.....	"	80	
Stilton.....	65	86	45	None	Little	"	1:40	56 lbs.	60	Green	"	20	
Stilton.....	65	85	60-150	"	Very little	"	1:60	None	65	Blue	"	15	No scalding; curd broken by hand. Drained in open moulds. Drained in open moulds; ripe in six weeks. Ripe in two months. Drained in open moulds. Drained in cloth; 1 cream to 2 milk; 1 drop rennet to quart of milk. Drained in cloths. Ripens in three years.
Gloucester (single and double).....	65	80	60	84	"	"	Outside	Graduated	65	"	Flat	15 & 30	
Wilts Loaf.....	65	80	60	90	Little	"	1:56	"	65	.....	Deep	30	
Derby.....	63	80	60	None	"	None	Outside	"	63	Blue	Flat	30	
Leicester.....	65	82	70	84	20	Little	1:160	"	65	.....	"	40	
Dunlop.....	65	80	60	None	60	None	1:56	"	60		Medi'm	56	No scalding; curd broken by hand. Drained in open moulds. Drained in open moulds; ripe in six weeks. Ripe in two months. Drained in open moulds. Drained in cloth; 1 cream to 2 milk; 1 drop rennet to quart of milk. Drained in cloths. Ripens in three years.
Brie.....	.....	83	240	"	None	"	Outside	None	50	Blue	Flat	4-5	
Camembert.....	.....	86	240	"	"	"	"	"	50	White	Deep	1	
Cantal.....	.....	75	60	"	15	"	Little	Much	46	.....	Flat	40-100	
Coulommiers.....	.....	78	720	"	None	"	None	None	....	Green	"	2 $\frac{1}{2}$	
Gervais (cream)....		65	720	"	"	"	"	"			Deep	$\frac{1}{4}$	No scalding; curd broken by hand. Drained in open moulds. Drained in open moulds; ripe in six weeks. Ripe in two months. Drained in open moulds. Drained in cloth; 1 cream to 2 milk; 1 drop rennet to quart of milk. Drained in cloths. Ripens in three years.
Gorgonzola.....	.....	90	20	"	"	"	Outside	"	46	Blue	"	40-60	
Parmesan.....	.....	92	45	130	40	Medi'm	"	Little	50	.....	Flat	150	

DETERMINATION OF HUMIDITY IN CHEESE-CURING ROOMS.

The proper degree of humidity in the cheese-curing room will vary with different kinds of cheese and at different stages of the curing process. Young cheese should be placed in a somewhat drier curing-room than older; the latter kinds, according to Fleischmann, require a relative humidity of 90° – 95° , against 85° – 90° for green cheese.

In the interior of our continent it is somewhat difficult to obtain as much moisture in the air of curing-rooms as is represented by these figures; the relative humidity of ordinary curing-rooms in this region, therefore, but rarely goes over 60° . A higher degree of humidity may be obtained by hanging wet sheets of canvas in the curing-room. (Decker.)

Kirchner states that the humidity of curing-rooms should not, in general, go below 80° or above 95° . Temperatures from 50° – 70° F. are preferable in the curing-room.

Self-recording thermometers are to be recommended for use in curing-rooms. For observation of relative humidity, a wet and dry bulb thermometer, a Mitthoff's hygrometer, or a Lambrecht's polymeter may be used to advantage. Any of these instruments may be obtained through dealers in chemical glassware or dairy supplies; the prices range from \$8 to \$30.

TABLE SHOWING THE RELATIVE HUMIDITY IN THE AIR OF CURING-ROOMS. (KING.)

DIRECTIONS.—Notice that the table is in three column sections. Find air temperature in first column, then find wet-bulb temperature in second column, same division. In third column opposite this is relative humidity.

Example.—Air temperature is 50°, in first column; wet-bulb is 44°, in second column, same division. Opposite 44° is 61, which is the per cent of saturation, or the relative humidity of the air.

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
40	32	37	45	35	31	49	41	48	53	46	58
	33	44		36	37		42	54		47	63
	34	52		37	44		43	60		48	69
	35	59		38	50		44	67		49	75
	36	68		39	57		45	73		50	81
	37	76		40	64		46	80		51	87
	38	84		41	71		47	86		52	94
	39	92		42	78		48	93			
				43	85						
				44	92						
41	32	31	46			50	39	32	54	42	32
	33	38					40	37		43	37
	34	46					41	43		44	42
	35	53		35	26		42	49		45	48
	36	60		36	32		43	55		46	53
	37	68		37	38		44	61		47	59
	38	76		38	45		45	67		48	64
	39	84		39	51		46	74		49	70
	40	92		40	58		47	80		50	76
42				41	65		48	87		51	82
				42	72		49	93		52	88
	33	33		43	79	51				53	94
	34	40		44	85		40	33		43	33
	35	47		45	93		41	39		44	38
	36	54					42	45		45	43
	37	61		36	28		43	50		46	49
	38	69		37	34		44	56		47	54
	39	77		38	40		45	62		48	59
	40	84		39	46		46	68		49	65
	41	92		40	52		47	74		50	70
43				41	59	52	48	81		51	76
	33	28		42	66		49	87		52	82
	34	34		43	72		50	93		53	88
	35	41		44	79					54	94
	36	48		45	86		41	35			
	37	55		46	93		42	40		44	34
	38	62					43	46		45	39
	39	70		37	29		44	51		46	44
	40	77		38	35		45	57		47	50
44	41	85		39	41	53	46	63		48	55
	42	92		40	47		47	69		49	60
				41	53		48	75		50	65
	34	29		42	60		49	81		51	71
	35	36		43	66		50	87		52	77
	36	43		44	73		51	94		53	82
	37	49		45	79					54	88
	38	56		46	86					55	94
	39	63		47	93		41	31			
45	40	70	48			54	42	36			
	41	78					43	41		45	36
	42	85		38	30		44	47		46	40
	43	92		39	36		45	52		47	45
				40	42						

HUMIDITY IN THE AIR OF CURING-ROOMS.—*Con.*

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
57	48	50	61	58	84	66	55	49	70	61	60
	49	55		59	89		56	53		62	64
	50	61		60	94		57	57		63	68
	51	66					58	61		64	72
	52	71		50	41		59	66		65	77
	53	77		51	45		60	71		66	81
	54	83		52	50		61	75		67	86
	55	88		53	54		62	80		68	90
58	56	94	62	54	59	67	63	85	71	69	95
				55	64		64	90			
	46	37		56	69		65	95		58	45
	47	42		57	74					59	48
	48	46		58	79		54	41		60	52
	49	51		59	84		55	45		61	56
	50	56		60	89		56	49		62	60
	51	61		61	95		57	53		63	64
59	52	67	63			68	58	58	72	64	68
	53	72		51	42		59	62		65	72
	54	78		52	46		60	66		66	77
	55	83		53	51		61	71		67	81
	56	89		54	55		62	76		68	86
	57	94		55	60		63	80		69	91
				56	64		64	85		70	95
	47	38		57	69		65	90			
60	48	43	64	58	74	69	66	95	73	59	45
	49	47		59	79					60	49
	50	52		60	84		55	42		61	53
	51	57		61	89		56	46		62	57
	52	62		62	95		57	50		63	61
	53	67					58	54		64	65
	54	72		52	43		59	58		65	69
	55	78		53	47		60	63		66	73
61	56	83	65	54	51	70	61	67	74	67	77
	57	89		55	56		62	71		68	82
	58	94		56	60		63	76		69	86
				57	65		64	81		70	91
	48	39		58	70		65	85		71	95
	49	44		59	74		66	90			
	50	48		60	79		67	95		60	46
	51	53		61	85					61	50
62	52	58	66	62	90	71	56	43	75	62	53
	53	63		63	95		57	47		63	57
	54	68					58	51		64	61
	55	73		53	44		59	55		65	65
	56	78		54	48		60	59		66	69
	57	84		55	52		61	63		67	73
	58	89		56	56		62	67		68	78
	59	94		57	61		63	72		69	82
63			67	58	65	72	64	76	76	70	86
	49	40		59	70		65	81		71	91
	50	44		60	75		66	86		72	95
	51	49		61	80		67	90			
	52	54		62	85		68	95		61	47
	53	58		63	90					62	50
	54	63		64	95		57	44		63	54
	55	68					58	48		64	58
64	56	73	68	53	40	73	59	52	78	65	62
	57	78		54	45		60	55		66	66

HUMIDITY IN THE AIR OF CURING-ROOMS.—*Con.*

Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.	Dry Bulb.	Wet Bulb.	Rel. Hum.
74	67	70	76	63	48	77	72	78	79	69	60
	68	74		64	52		73	83		70	64
	69	78		65	55		74	87		71	68
	70	82		66	59		75	91		72	71
	71	86		67	63		76	95		73	75
	72	91		68	66					74	79
	73	95		69	70		65	49		75	83
75			77	70	74	78	66	53	80	76	87
	62	47		71	78		67	56		77	91
	63	51		72	82		68	60			
	64	55		73	87		69	63		66	47
	65	58		74	91		70	67		67	51
	66	62		75	95		71	71		68	54
	67	66					72	75		69	57
	68	70		64	49		73	79		70	61
	69	74		65	52		74	83		71	64
	70	78		66	56		75	87		72	68
	71	82		67	59		76	91		73	72
	72	87		68	63					74	75
	73	91		69	67		66	50		75	79
	74	95		70	71		67	53		76	83
				71	74	79	68	57		77	87
										78	92

SCORE FOR JUDGING CHEESE.

	World's Fair 1893.	New York, 1894.		Wisconsin Dairymen's Assoc. 1894.
		For Export.	For Home Trade.	
Flavor.....	45	45	50	45
Texture (and body).....	20	30	25	30
Color	15	15	15	15
Salting	10	..	..	..
Make up (finish)	10	10	10	10
	100	100	100	100

ENGLISH SCALE OF POINTS FOR JUDGING CHEESE. (McCONNELL.)

Perfection, 100.

35 Flavor: nutty, buttery.

25 Quality: mellow, rich, melting on tongue.

15 Texture: solid, compact.

15 Color: natural-like, even.

10 Make: remainder, due to good making, as cleanliness,
— salting, perfect rind, etc.

100

WHEY TO BE ALLOWED AT CHEESE FACTORIES FOR QUANTITIES OF MILK FROM 30 TO 360 POUNDS. (ROBERTSON.)

The figures in the columns denote the inches of whey.

Weight of Milk in Pounds.	Diameters of Milk-cans in Inches.								
	20	19	18	17	16	15	14	13	12
30	2	2	3	3	3	3	4	5	6
35	2	3	3	3	3	4	5	6	7
40	3	3	3	4	4	5	6	7	7
45	3	4	4	4	4	5	6	7	8
50	3	4	4	5	5	6	7	8	9
55	4	4	5	5	6	7	8	9	10
60	4	5	5	6	6	7	8	9	11
65	4	5	5	6	7	8	9	10	12
70	5	5	6	7	7	8	10	11	13
75	5	6	6	7	8	9	10	12	14
80	5	6	7	8	8	10	11	12	15
85	6	6	7	8	9	10	12	13	16
90	6	7	7	9	9	11	12	14	17
95	6	7	8	9	10	11	13	15	18
100	7	7	8	9	10	12	14	16	19
105	7	8	9	9	11	13	15	16	19
110	7	8	9	10	11	13	15	17	20
115	8	9	10	10	12	14	16	18	21
120	8	9	10	11	12	14	17	19	22
125	8	9	10	11	13	15	17	19	23
130	9	10	11	12	13	16	18	20	24
135	9	10	11	12	14	16	19	21	
140	9	10	12	13	14	17	20	22	
145	10	11	12	13	15	17	20	23	
150	10	11	12	14	15	18	21	24	
155	10	11	13	15	16	19	22		
160	11	12	13	15	16	19	22		
165	11	12	14	16	17	20	23		
170	11	12	14	16	17	20	23		
175	12	13	15	16	18	21	24		
180	12	13	15	17	18	22	24		
185	12	14	15	17	19	22			
190	13	14	16	18	19	23			
195	13	14	16	18	20	23			
200	13	15	17	18	20	24			
205	14	15	17	19	21				
210	14	16	18	19	21				
215	14	16	18	20	22				
220	15	16	18	20	23				
225	15	17	19	21	24				
230	15	17	19	21	24				
235	16	18	19	22					
240	16	18	20	22					
245	16	18	20	23					
250	17	19	21	23					
260	17	19	22	24					
270	18	20	22						
280	19	21	23						
290	19	22	24						
300	20	23	24						
310	21	23							
320	21	24							
330	22								
340	23								
350	23								
360	24								

SCORE IN JUDGING PROFICIENCY OF BUTTER AND CHEESE MAKERS.

(Adopted by British Dairy Farmers' Association.)

Butter-making.

Preparation of cream.....	4	Salting.....	5
“ “ utensils.....	6	Making up.....	15
Ventilation of churn.....	4	Flavor and color..	7
Judgment and skill in churning..	15	Texture and freedom from moist-	
Washing butter in churn.....	10	ure.....	7
Use of strainer.....	4	Cleaning utensils.....	4
“ “ thermometer.....	7	Rapidity and cleanliness of work-	
“ “ butter-worker.....	7	ing.....	5

100

Cheese-making.

Testing acidity of milk	2	Care and skill in scaldings	20
Skill in obtaining milk at right		Ripening and proper acidity of	
temperature	10	curd	20
Temperature for renneting.....	3	Cleanliness and neatness in work	10
Renneting and well mixing.....	5		
Care and skill in breaking.....	20		

100

PAYMENT OF MILK AT CREAMERIES AND CHEESE FACTORIES.

Numerous systematic and extensive experiments by various scientists have proved that the value of milk for both butter and cheese production stands in direct proportion to its fat content. Patrons of separator cheese and butter factories should therefore receive payment for the milk delivered by them according to the percentage of fat in the milk, i.e., according to the quantity of fat delivered in their milk. The same applies to gathered-cream factories as well.

The tables given on pp. 234-35 will aid in the calculation of the value of milks of different richness, according to prices agreed upon. In paying for the milk delivered by patrons, four, or, essentially, three, different methods are followed at different factories, all of which are just to all parties concerned. The methods and the directions for using the tables in each case are given below. The tables and discussions entered upon are largely taken from Vermont Experiment Station Bulletin No. 16.

METHODS OF PAYMENT FOR MILK AT CHEESE AND BUTTER FACTORIES.

1. *A certain price is to be paid per one hundred lbs. of milk containing a definite per cent of fat (e.g., \$1.00 per 100 lbs. of four per cent milk).* By referring to the second half of the table on p. 234 we find \$1.00 opposite 4.00 per cent of fat; the figures in the same column as \$1.00 then give the value of 100 lbs. of milk containing percentages of fat ranging from 3.00 to 5.00; e.g., 100 lbs. of 3 per cent milk is worth 75 cents, of 4.5 per cent milk \$1.13, of 5.40 per cent milk \$1.35, etc.

2. *A certain price is to be paid per pound of fat delivered.* If 21 cents is the price agreed upon we multiply .21 by three, and the product, .63, gives the amount in dollars to be paid per 100 lbs. of three per cent milk. The column in which the figure .63 occurs opposite 3.0 per ct. is then to be used in the calculations as long as the price is paid, and 3.5 per cent milk will be paid with 73 cents per 100 lbs., 5.3 per ct. milk \$1.10 per 100 lbs., etc.

Example: Patron A delivers 840 lbs. of milk during one week, containing, according to the test made, 4.3 per cent fat. If the price agreed upon per pound of fat was as before stated, he is to receive 90 cents per 100 lbs. of milk, or \$7.56 in all.

Patron B, sending 625 lbs. of milk testing 3.45 per cent, will receive $6.25 \times .72 = \$4.50$, etc. In the table only tenths of per cents are given; 3.45 being half-way between 3.40 and 3.50, for which percentages 71 and 73 cents are to be paid respectively, we multiply by the mean of the two values, or .72. If a test differs less than five-hundredths from any percentages given in the table, the nearest figure is chosen.

3. *Patrons are to be paid what is received for the butter, less a certain amount for cost of making and marketing.* Multiply each man's milk by the per cent of fat it contains, and the sum of the several products will be the total amount of fat contained in the day's milk. Divide the pounds of butter made from the milk by the pounds of fat it contained, to

find how much butter each pound of fat makes. Multiplying the amount received per pound of butter, less the cost of making, etc., by this last result will give the amount to be paid for each pound of fat delivered.

Example: Suppose the patrons furnish milk containing in all 400 lbs. of fat, which made 460 lbs. of butter, selling for 27 cents per pound. The expense of making the butter is found to be, e.g., 4 cents per pound. $27 - 4 = 23$ cents; 460 divided by 400 equals 1.15; 23 multiplied by 1.15 equals 26.45, which is the amount, in cents, to be paid per pound of fat delivered; $26.45 \times 3 = 79.35$, or nearest 79 cents, is then the money to be paid for 100 lbs. of 3 per cent milk, and (see table) 90 cents for 100 lbs. of 3.40 per cent milk, \$1.24 for 100 lbs. of 4.7 per cent milk, etc.

4. *A certain price is to be paid per 100 lbs. of milk of average quality.* Find the total fat contained in the milk as before; divide this amount by the total weight of milk delivered, and the result will be the average per cent of fat in the milk. Starting from this per cent at the left of the table, go to the right until the price per 100 lbs. agreed upon is reached; the perpendicular column in which this figure is found is the one to be used. *Example:* Suppose milk of average quality is to be paid \$1.00 per hundred pounds, and the farmers furnish 8500 lbs. of milk, containing in all 440 lbs. of fat; 440 divided by 85.00 then equals 5.18, the number nearest to which in the table is 5.20 per cent. To the right of 5.20 per cent \$1.00 is found in the column headed .58, which column would be the one to use.

PRICE OF MILK PER 100 POUNDS.

P. ct. Fat.	Price per 100 lbs. of Milk, in dollars and cents.									
3.00	1.00	.97	.94	.91	.88	.86	.83	.81	.79	.77
3.10	1.03	1.00	.97	.94	.91	.89	.86	.84	.82	.79
3.20	1.07	1.03	1.00	.97	.94	.91	.89	.86	.85	.82
3.30	1.10	1.07	1.03	1.00	.97	.94	.92	.89	.87	.84
3.40	1.13	1.10	1.06	1.03	1.00	.97	.94	.92	.90	.87
3.50	1.17	1.13	1.09	1.06	1.03	1.00	.97	.95	.93	.89
3.60	1.20	1.16	1.12	1.09	1.06	1.03	1.00	.97	.95	.92
3.70	1.23	1.19	1.16	1.12	1.09	1.06	1.03	1.00	.98	.94
3.80	1.27	1.23	1.19	1.15	1.12	1.09	1.06	1.03	1.00	.97
3.90	1.30	1.26	1.22	1.18	1.15	1.11	1.08	1.06	1.03	1.00
4.00	1.33	1.29	1.25	1.21	1.18	1.14	1.11	1.08	1.06	1.02
4.10	1.37	1.32	1.28	1.24	1.21	1.17	1.14	1.11	1.08	1.05
4.20	1.40	1.35	1.31	1.27	1.24	1.20	1.17	1.14	1.11	1.07
4.30	1.43	1.39	1.34	1.30	1.26	1.23	1.19	1.17	1.14	1.10
4.40	1.47	1.42	1.38	1.33	1.29	1.26	1.22	1.19	1.16	1.12
4.50	1.50	1.45	1.41	1.36	1.32	1.29	1.25	1.22	1.19	1.15
4.60	1.53	1.48	1.44	1.39	1.35	1.31	1.28	1.25	1.21	1.17
4.70	1.57	1.52	1.47	1.42	1.38	1.34	1.31	1.28	1.24	1.20
4.80	1.60	1.55	1.50	1.45	1.41	1.37	1.33	1.30	1.27	1.23
4.90	1.63	1.58	1.53	1.48	1.44	1.40	1.36	1.33	1.29	1.25
5.00	1.67	1.61	1.56	1.52	1.47	1.43	1.39	1.36	1.32	1.28
5.10	1.70	1.65	1.59	1.55	1.50	1.46	1.42	1.39	1.35	1.30
5.20	1.73	1.68	1.63	1.58	1.53	1.49	1.44	1.41	1.37	1.33
5.30	1.77	1.71	1.66	1.61	1.56	1.51	1.47	1.44	1.40	1.35
5.40	1.80	1.74	1.69	1.64	1.59	1.54	1.50	1.47	1.42	1.38
5.50	1.83	1.77	1.72	1.67	1.62	1.57	1.53	1.50	1.45	1.41
5.60	1.87	1.81	1.75	1.70	1.65	1.60	1.56	1.52	1.48	1.44
5.70	1.90	1.84	1.78	1.73	1.68	1.63	1.58	1.55	1.50	1.46
5.80	1.93	1.87	1.81	1.76	1.71	1.66	1.61	1.57	1.53	1.49
5.90	1.97	1.90	1.84	1.79	1.74	1.69	1.64	1.60	1.56	1.51
6.00	2.00	1.94	1.88	1.82	1.76	1.71	1.67	1.62	1.58	1.54
3.00	.75	.73	.71	.70	.68	.67	.65	.64	.63	.61
3.10	.78	.75	.73	.72	.70	.69	.67	.66	.65	.63
3.20	.80	.78	.76	.75	.73	.71	.69	.68	.67	.65
3.30	.83	.80	.78	.77	.75	.74	.72	.70	.69	.67
3.40	.85	.83	.81	.79	.77	.76	.74	.73	.71	.69
3.50	.88	.85	.83	.82	.79	.78	.76	.75	.73	.71
3.60	.90	.88	.85	.84	.82	.80	.78	.77	.75	.73
3.70	.93	.90	.88	.86	.84	.83	.80	.79	.77	.75
3.80	.95	.93	.90	.89	.86	.85	.82	.81	.80	.77
3.90	.98	.95	.92	.91	.88	.87	.85	.83	.82	.79
4.00	1.00	.97	.95	.93	.91	.89	.87	.85	.84	.81
4.10	1.03	1.00	.97	.96	.93	.91	.89	.87	.86	.83
4.20	1.05	1.02	1.00	.98	.95	.94	.91	.90	.88	.85
4.30	1.08	1.05	1.02	1.00	.98	.96	.93	.92	.90	.88
4.40	1.10	1.07	1.05	1.02	1.00	.98	.95	.94	.92	.90

PRICE OF MILK PER 100 POUNDS.—*Continued.*

P. ct. Fat.	Price per 100 lbs. of Milk, in dollars and cents.									
4.50	1.13	1.10	1.07	1.05	1.02	1.00	.97	.96	.94	.92
4.60	1.15	1.12	1.10	1.07	1.05	1.02	1.00	.98	.96	.94
4.70	1.18	1.15	1.12	1.09	1.07	1.04	1.02	1.00	.98	.96
4.80	1.20	1.17	1.14	1.12	1.09	1.07	1.07	1.02	1.00	.98
4.90	1.23	1.20	1.17	1.14	1.11	1.09	1.07	1.04	1.02	1.00
5.00	1.25	1.22	1.19	1.16	1.14	1.11	1.09	1.06	1.04	1.02
5.10	1.28	1.24	1.21	1.19	1.16	1.13	1.11	1.09	1.06	1.04
5.20	1.30	1.27	1.24	1.21	1.18	1.16	1.13	1.11	1.08	1.06
5.30	1.33	1.29	1.26	1.23	1.20	1.18	1.15	1.13	1.10	1.08
5.40	1.35	1.32	1.29	1.26	1.23	1.20	1.17	1.15	1.12	1.10
5.50	1.38	1.34	1.31	1.28	1.25	1.22	1.20	1.17	1.14	1.12
5.60	1.40	1.37	1.34	1.30	1.27	1.24	1.22	1.19	1.17	1.14
5.70	1.43	1.39	1.36	1.33	1.30	1.27	1.24	1.21	1.19	1.16
5.80	1.45	1.41	1.39	1.35	1.32	1.29	1.26	1.23	1.21	1.18
5.90	1.48	1.44	1.41	1.38	1.34	1.31	1.28	1.26	1.23	1.20
6.00	1.50	1.46	1.43	1.40	1.36	1.33	1.30	1.28	1.25	1.22
3.00	.60	.59	.58	.57	.56	.55	.54	.53	.52	.51
3.10	.62	.61	.60	.59	.58	.57	.56	.55	.54	.53
3.20	.64	.63	.62	.61	.60	.59	.58	.57	.55	.54
3.30	.66	.65	.64	.63	.62	.60	.59	.58	.57	.56
3.40	.68	.67	.66	.65	.63	.62	.61	.60	.59	.58
3.50	.70	.69	.68	.66	.65	.64	.63	.62	.61	.59
3.60	.72	.71	.70	.68	.67	.66	.65	.64	.62	.61
3.70	.74	.73	.71	.70	.69	.68	.67	.65	.64	.63
3.80	.76	.75	.73	.72	.71	.70	.68	.67	.66	.65
3.90	.78	.77	.75	.74	.73	.71	.70	.69	.67	.66
4.00	.80	.79	.77	.76	.75	.73	.72	.71	.69	.68
4.10	.82	.81	.79	.78	.76	.75	.74	.72	.71	.70
4.20	.84	.83	.81	.80	.78	.77	.75	.74	.73	.71
4.30	.86	.84	.83	.82	.80	.79	.77	.76	.74	.73
4.40	.88	.86	.85	.83	.82	.80	.79	.78	.76	.75
4.50	.90	.88	.87	.85	.84	.82	.81	.79	.79	.76
4.60	.92	.90	.89	.87	.86	.84	.83	.81	.80	.78
4.70	.94	.92	.91	.89	.88	.86	.84	.83	.81	.80
4.80	.96	.94	.93	.91	.90	.88	.86	.85	.83	.81
4.90	.98	.96	.94	.93	.91	.90	.88	.86	.85	.83
5.00	1.00	.98	.96	.95	.93	.91	.90	.88	.86	.85
5.10	1.02	1.00	.98	.96	.95	.93	.92	.90	.88	.86
5.20	1.04	1.02	1.00	.98	.97	.95	.93	.92	.90	.88
5.30	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92	.90
5.40	1.08	1.06	1.04	1.02	1.00	.99	.97	.95	.93	.92
5.50	1.10	1.08	1.06	1.04	1.02	1.00	.99	.97	.95	.93
5.60	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97	.95
5.70	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.00	.98	.97
5.80	1.16	1.14	1.12	1.09	1.07	1.05	1.04	1.02	1.00	.98
5.90	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.04	1.02	1.00
6.00	1.20	1.18	1.15	1.13	1.11	1.09	1.07	1.05	1.03	1.02

DIRECTIONS FOR MAKING DIVIDENDS IN CREAMERIES AND CHEESE FACTORIES

According to the Per Cent of Fat in Milk Delivered.

(S. M. BABCOCK, in "Hoard's Dairyman.")

Find the amount of fat contained in the milk of each patron for any period desired, by multiplying the pounds of milk expressed in hundreds by the per cent of fat found by the test. Add together the amount of fat from all the patrons, thus obtaining the total pounds of fat delivered at the factory. Deduct the expenses of manufacture, etc., from the money received from sales, and divide the remainder by the total fat. This gives the price to be paid for each pound of fat. Multiply the pounds of fat delivered by each patron by the price; the product will be the amount which he is to receive.

If it is desired to know the number of pounds of butter made from each patron's milk, divide the total yield of butter by the total fat delivered; the quotient will be the amount of butter made from one pound of fat. The fat delivered by each patron multiplied by this figure will give the pounds of butter to be credited to each patron.

The accompanying table gives the butter yield from 100 lbs. of milk, when the pounds of butter from one pound of fat range from 1.10 to 1.20, and for milks containing from 3 to 6 per cent of fat. To use the table find in the upper horizontal line the number corresponding most nearly to the number of pounds of butter from one pound of fat. The vertical column in which this falls gives the pounds of butter from 100 pounds of milk containing the per cents of fat given in the outside columns.

Example: A creamery receives during one month 250,000 lbs. of milk, which contained 9531 lbs. of fat; the yield of butter for the same period was 10,983 lbs., which sold for 29 cents per pound, bringing \$3185.07. The expense for making, etc., was four cents per pound, amounting to \$439.32, leaving \$2745.75 to be divided among the patrons. Dividing this sum by 9531, the total number of pounds of fat gives 28.8 cents per pound for the fat. This multiplied by the number of pounds of fat in each patron's milk gives the amount which he should be paid.

The number of pounds of butter, 10,983, divided by 9531, the number of pounds of fat, gives 1.152 pounds of butter from each pound of fat. The column headed 1.15 in the table is nearest to this ratio, and will therefore give the butter obtained from 100 lbs. of milk containing different per cents of fat.

If a patron delivered 9420 lbs. of milk containing 3.2 per cent of fat during the period considered, his milk would have contained 301.44 lbs. of fat, which at 28.8 cents per pound would have amounted to \$86.81. It would have made $301.44 \times 1.152 = 347.26$ lbs. of butter. In the column headed 1.15 in the table, opposite 3.2 per cent of fat, we find 3.68, which is the number of pounds of fat from 100 lbs. of this patron's milk. The error from the use of the table in this way will never amount to more than $\frac{1}{2}$ ounce per 100 lbs. of milk.

Pounds of Butter from One Hundred Lbs. of Milk.

Per cent Fat.	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	Per cent Fat.
3.0	3.30	3.33	3.36	3.39	3.42	3.45	3.48	3.51	3.54	3.57	3.60	3.0
3.1	3.41	3.441	3.472	3.503	3.534	3.565	3.596	3.627	3.658	3.689	3.72	3.1
3.2	3.52	3.552	3.584	3.616	3.648	3.680	3.712	3.744	3.776	3.808	3.84	3.2
3.3	3.63	3.663	3.696	3.729	3.762	3.795	3.828	3.861	3.894	3.927	3.96	3.3
3.4	3.74	3.774	3.808	3.842	3.876	3.910	3.944	3.978	4.012	4.046	4.08	3.4
3.5	3.85	3.885	3.920	3.955	3.990	4.025	4.060	4.095	4.130	4.165	4.20	3.5
3.6	3.96	3.996	4.032	4.068	4.104	4.140	4.176	4.212	4.248	4.284	4.32	3.6
3.7	4.07	4.107	4.144	4.181	4.218	4.255	4.292	4.329	4.366	4.403	4.44	3.7
3.8	4.18	4.218	4.256	4.294	4.332	4.370	4.408	4.446	4.484	4.522	4.56	3.8
3.9	4.29	4.329	4.368	4.407	4.446	4.485	4.524	4.563	4.602	4.641	4.68	3.9
4.0	4.40	4.440	4.480	4.520	4.560	4.600	4.640	4.680	4.720	4.760	4.80	4.0
4.1	4.51	4.551	4.592	4.633	4.674	4.715	4.756	4.797	4.838	4.879	4.92	4.1
4.2	4.62	4.662	4.704	4.746	4.788	4.830	4.872	4.914	4.956	4.998	5.04	4.2
4.3	4.73	4.773	4.816	4.859	4.902	4.945	4.988	5.031	5.074	5.117	5.16	4.3
4.4	4.84	4.884	4.928	4.972	5.016	5.060	5.104	5.148	5.192	5.236	5.28	4.4
4.5	4.95	4.995	5.040	5.085	5.130	5.175	5.220	5.265	5.310	5.355	5.40	4.5
4.6	5.06	5.106	5.152	5.198	5.244	5.290	5.336	5.382	5.428	5.474	5.52	4.6
4.7	5.17	5.217	5.264	5.311	5.358	5.405	5.452	5.499	5.546	5.593	5.64	4.7
4.8	5.28	5.328	5.376	5.424	5.472	5.520	5.568	5.616	5.664	5.712	5.76	4.8
4.9	5.39	5.439	5.488	5.537	5.586	5.635	5.684	5.733	5.782	5.831	5.88	4.9
5.0	5.50	5.550	5.600	5.650	5.700	5.750	5.800	5.850	5.900	5.950	6.00	5.0
5.1	5.61	5.661	5.712	5.763	5.814	5.865	5.916	5.967	6.018	6.069	6.12	5.1
5.2	5.72	5.772	5.824	5.876	5.928	5.980	6.032	6.084	6.136	6.188	6.24	5.2
5.3	5.83	5.883	5.936	5.986	6.042	6.095	6.148	6.201	6.254	6.307	6.36	5.3
5.4	5.94	5.994	6.048	6.102	6.156	6.210	6.264	6.318	6.372	6.426	6.48	5.4
5.5	6.05	6.105	6.160	6.215	6.270	6.325	6.380	6.435	6.490	6.545	6.60	5.5
5.6	6.16	6.216	6.272	6.328	6.384	6.440	6.496	6.552	6.608	6.664	6.72	5.6
5.7	6.27	6.327	6.384	6.441	6.498	6.555	6.612	6.669	6.726	6.783	6.84	5.7
5.8	6.38	6.438	6.496	6.554	6.612	6.670	6.728	6.786	6.844	6.902	6.96	5.8
5.9	6.49	6.549	6.608	6.667	6.726	6.785	6.844	6.903	6.962	7.021	7.08	5.9
6.0	6.60	6.660	6.720	6.780	6.840	6.900	6.960	7.020	7.080	7.140	7.20	6.0

ON THE PRESERVATION OF MILK AND CREAM BY HEAT.

By Dr. H. L. RUSSELL, of Wisconsin Agricultural Experiment Station,
Author of "Dairy Bacteriology."

On account of the innumerable bacteria that gain access to milk during the process of milking, and subsequent to that time, and the rapid increase of the same in this nutritious fluid, this material universally undergoes fermentative changes, the rapidity of which is largely dependent upon the surrounding temperature. To increase the keeping quality of milk, it is necessary to annihilate these bacteria or keep them under influences unfavorable to their growth.

Heat has been found to be the most efficacious agent in preserving milk in its natural condition. It is applied in two ways, viz., 1. *Pasteurization*, where the milk or cream is heated for a short time (20-30 min.) at a temperature near the coagulating point of the proteid constituents of the milk (150°-160° F.). 2. *Sterilization*, where the temperature approximates the boiling-point and is applied for a longer time.

The object in both cases is to kill the bacteria present in the milk.

Sterilization accomplishes this most successfully, but it changes the proteid compounds so that the milk has an undesirable "cooked" flavor and odor.

This defect is not found in pasteurized milk, and if properly handled, milk treated by this process will remain sweet from 4 to 8 days.

For use in the near future the pasteurized product is, on the whole, the most satisfactory; the sterilized material being best adapted for export purposes.

The essential condition in pasteurization is that the pasteurizing temperature shall exceed the thermal death point (the temperature at which growing bacteria are destroyed) of disease-producing as well as fermentative bacteria. This temperature for most forms is about 140° F., but certain disease organisms like the tubercle germ of tuberculosis is not killed below 149° F. for 30 minutes, or 155° F. for 15 minutes.

As this germ is often found in milk from tuberculous cows, prudence dictates the use of this temperature as a standard for the pasteurization of milk and cream. The proteids in the milk are slightly affected at this temperature, but if the milk is thoroughly chilled, the "cooked" flavor disappears.

The application of this temperature kills only the growing bacteria, and does not affect the latent spores. If after being heated the milk is allowed to cool slowly, and is left at a comparatively warm temperature (exceeding 55° F.), these spores germinate and soon change the character of the milk, so that the value of the pasteurization is lost. To be efficient, it is necessary to *rapidly* cool the pasteurized product below the germinating point of the spores, for if they are once allowed to sprout, they will develop slowly at a very low temperature.

In pasteurizing milk or cream, the apparatus should be constructed so that a definite quantity of the fluid can be held at any desired temperature for any length of time, and during the process protected from infection from the air. The apparatus must also be made so as to be easily cleaned and thoroughly sterilized by steam throughout. The milk must be protected from air infection during its withdrawal from the pasteurizing vat into storage vessels (cans and bottles), and should be thoroughly chilled in a refrigerator for several hours (better over night) before being delivered to the consumer. This chilling process should succeed the heating operation as quickly as possible, as the sudden transition in temperature from 155° F. to 55° F. or less has a paralyzing effect on the development of those organisms (spores) that are not killed by the heat.

Pasteurization is applied with great success to milk and cream where these products are used in the liquid form. It is used to some extent in this country, but much more widely in continental Europe in the preparation of cream for the manufacture of butter by the use of a pure culture starter. It can also be used advantageously in the hot months for increasing the length of time that by-products of the factory like skim-milk and whey may be preserved.

PASTEURIZATION OF SKIM-MILK.**Results of Danish Experiments.**

The skim-milk was heated to 122–194° F. in the different trials, and then cooled. The figures given in the table show the number of hours in which the milk kept sweet in each case.

	No Heating Applied.	Skim-milk Heated to						Skim-milk Cooled to
		50° C. (122° F.).	60° C. (140° F.).	65° C. (149° F.).	70° C. (158° F.).	80° C. (176° F.).	90° C. (194° F.).	
1884	11.8	17.0	27.8	34.8	37.0	40.4	41.2	12½° C. (54° F.).
1890	5.0	6.9	20.8	28.0	36.9	38.0	41.6	25° C. (77° F.).

(Fjord, Lunde.)

ORDINARY DISEASES OF DAIRY COWS.

By W. G. CLARK, M.D.C., Johnstown, Wis., Instructor in Veterinary Science in the University of Wisconsin.

Garget.

CAUSES.—Irregularities of diet, overfeeding on stimulating food, exposure to cold, external injuries, as blows, etc.

SYMPTOMS.—Seldom attacks the whole udder. Swelling, heat, pain, and redness of the inflamed portion. The milk is curdled, whey-like, and mixed with blood. In severe cases there is much constitutional disturbance.

TREATMENT.—Endeavor to discover the cause and remove it. The food should be devoid of milk-producing constituents. Draw the milk frequently, using a milking-tube if necessary.

If the weather is warm bathe the udder for an hour or more with hot water.

Take fluid extract belladonna 1 oz., glycerin 2 ozs.; mix and apply three times daily with mild friction. Give two teaspoonfuls fluid extract belladonna three times daily. If constipated, give epsom salts 1 lb., ginger 1 oz., water 1 qt.

Milk Fever.

SYMPTOMS.—Dulness, uneasy movements of the hind limbs, head and horns hot; the animal soon becomes weak and unable to rise, head laid back on the flank or dashed to the ground, bowels constipated, sensation usually lost.

TREATMENT.—Give a purgative dose of salts. Apply mustard paste along the spine. Blanket and keep warm.

Give injections of soap and warm water. Internally give one half pint of whisky every three hours.

PREVENTION.—Spare diet a week before and after calving. If constipated after delivery give a dose of salts.

Abortion.

The cow may abort from any cause profoundly disturbing the nervous system, inflammation of the internal organs, diarrhœa, acute indigestion, blows on the abdomen, exposure to cold storms, drinking ice-water, feeding on ergotized grains and grasses, and infection from abortion discharges of other animals.

SYMPTOMS.—If it occurs within the first two months it is not apt to be noticed. During the latter part of gestation abortion resembles normal delivery, except that more effort and straining are present.

TREATMENT.—The most important object in an impending abortion is to recognize it as soon as possible and apply preventive measures. Place in a quiet dark stall and check straining by sedatives. Laudanum 1 oz.; repeat in two hours if necessary; or fl. ex. black haw. in same doses.

After an abortion burn the foetus and afterbirth and all litter that is soiled, or bury deeply and cover with quicklime.

Flood the womb with a 2% solution of carbolic acid and wash the external organs once daily with a 5% solution. Separate from the herd for 30 days.

In epizootic abortion material benefit has in many cases been derived from phosphate of lime. Small doses ($\frac{1}{2}$ dram) may be given daily in the food.

Hoven or Bloat.

CAUSES.—Overeating, choking, frosted roots, and fermentation of the food.

TREATMENT.—In urgent cases tap on the left side at a point equidistant from the point of the hip, the last rib and the processes of the lumbar vertebræ, pointing the trocar or knife downward, inward, and forward. If slight give spts. turpentine 1 oz., raw linseed oil $\frac{1}{2}$ pt., and place a gag in the mouth.

When relieved give a purgative and keep on a light diet for a few days.

Diarrhœa in Calves.

Always due to indigestion and caused usually by over-feeding or improper food.

PREVENTION.—Feed at least three times daily. The milk should be sweet and fed at a temperature of 90° to 100° F. The pails used in feeding should be kept sweet and clean.

TREATMENT.—Cut down the ration, scald the milk or add lime-water in the proportion of 1 to 5. If the discharges are bright yellow give castor oil 1 to 2 tablespoonfuls. If there is great weakness give small doses of stimulants (ginger, brandy, whisky).

Choking.

Common among cattle when fed on roots, etc. To prevent tie the head so that it cannot be thrown up, or withhold dangerous foods.

SYMPTOMS.—Head extended, bloating, labored breathing, continuous coughing. If in the throat there is great distress and the animal may die quickly. If lower the symptoms are not as acute.

TREATMENT.—If in the throat remove with the hand. If below reach and the object can be located from the outside, give small drenches of linseed oil and manipulate from the outside. Take time. Do not apply too much force. Usually best to work the object toward the throat.

If unable to remove the object it must be pushed down;

this may be done with a piece of 1-in. rubber-hose, 6 ft. in length, well oiled, and inserted in the gullet, and gently force the object down.

Tuberculosis.

Tuberculosis is an infectious disease characterized by the formation in the various organs of the body of tubercles or nodules, and is due to a specific micro-organism, the *bacillus tuberculosis*.

Tuberculosis in animals is identical with tuberculosis (consumption) in the human family, the ravages of which are far greater than those of any other disease.

The death rate from consumption, which is but one of its many forms, is about one in seven.

All domestic animals are more or less subject to the disease. Dairy cattle, however, in consequence of their mode of life and the heavy drain on their system from excessive breeding and milking, are more predisposed to the disease than any other of the domestic animals.

CAUSE.—The essential cause is the specific germ, the tubercle bacillus, without which the disease could not exist. Since the disease is found in the lungs in a large proportion of cases, it is evident that tuberculosis is usually contracted by inhaling the germs with the air. It may also be caused by the ingestion of infected meat and milk and by direct inoculation.

The development of the disease is favored by anything that tends to impair the general health of the animal, as overcrowding in poorly ventilated stables, hereditary predisposition, in-and-in breeding, lack of exercise, errors in diet, etc.

SYMPTOMS.—The symptoms are very obscure, and in some cases where the disease is well advanced there is seemingly little alteration in the health of the animal. The most prominent symptoms are a short, husky cough, enlargement of the lymph glands around the throat, dulness, capricious appetite, staring coat, and emaciation.

Persistent œstrum or heat, with barrenness, especially

when there is a harsh, staring coat and general unthrifty condition, is suspicious.

THE TUBERCULIN TEST.—Tuberculin is a glycerin extract of the soluble products produced by the growth of the tubercle bacillus, concentrated, filtered, and sterilized. It contains no living germs and cannot produce tuberculosis. It was introduced to the medical profession by Dr. Koch as a cure for tuberculosis. Although it has not found practical application as a curative agent, it furnishes us the best diagnostic agent for bovine tuberculosis yet known.

A summary of statistics indicates that about 88 per cent of tuberculous animals show the reaction fever on inoculation, while 90 per cent that were declared free from disease on account of the absence of fever did not show on autopsy any signs of the disease.

PREVENTION.—The stables should be light and well ventilated. Cattle should be kept from interchange of stalls or stanchions. Breed only from healthy animals. No consumptive person should be allowed to care for stock.

Isolate all suspected animals. Such animals should be examined by a competent veterinarian, and if found to be tuberculous the whole herd should be tested. Tuberculous animals should be killed and the carcasses burned or buried deeply and covered with quicklime. Disinfection should be thorough. Remove and burn all litter. Burn sulphur in the closed stable. Wash or spray all woodwork with a solution of corrosive sublimate, one part, to one thousand parts of water.

Corrosive sublimate is a deadly poison and should be used with care. Whitewash with freshly slaked lime.

SUGGESTIONS TO PATRONS OF CHEESE FACTORIES AND CREAMERIES.

(D. W. CURTIS, Sec'y Wisconsin Dairymen's Association.)

Care of Milk.

I. All milk for the cheese factory must be clean, pure, and wholesome, or the cheese will be bad. One hundred pounds of bad milk will injure 10,000 pounds of good milk.

2. The law is very strict against watering or skimming. A fine of \$10.00 to \$100.00 is imposed if convicted.

3. After a cow has dropped her calf, the milk should not be taken to the factory until the tenth milking.

4. Milk run through an aerator as soon as drawn from the cow, in open air, is better for cheese and butter making than when set in a tub of water and dipped. By any means at your command thoroughly air the milk until cooled.

5. Stagnant water, dead carcasses, or filth of any kind in the pasture or barn-yard produces tainted milk. For this reason set the can of night's milk in a clean place.

6. Milk with clean hands; never wet them with milk; it is positively filthy.

7. See that the cow's udder is brushed clean and free from fine dirt and dust before milking.

8. Never mix the night's and morning's milk. It will many times sour them both by pouring the warm milk into the cold.

9. Small cans (10 to 15 gallons) are much preferred to larger ones, as the milk is kept in a better condition.

10. Whey should be taken home in separate cans from that in which the milk is brought in.

11. If whey is taken home in the milk-cans, empty at once, wash with tepid water, then scald and turn them out to the sun.

12. Insist that the cheese-maker keep the whey-vat clean, by washing and scalding at least twice a week.

13. Insist that your factory shall take in milk by the Babcock test, paying each patron according to what he delivers.

14. Use a Babcock test yourself and know just what you produce; turn off the poor cows and fill their places with good ones. Every patron should know for himself whether he is boarding unprofitable cows. There is no better way of knowing this than by the use of the Babcock test at the barn. The cost of the test is but little, but its instruction is very valuable.

15. It should always be remembered that pure milk can only be had through healthy cows, pure feed, pure water,

pure air, and cleanly handling. Every patron is affected in the cash outcome by the way his brother patrons produce and handle their milk, hence the necessity of each adhering to sound rules based on sound dairy sense. There is not a first-class factory in the land where good prices are obtained for cheese but what the patrons practise thorough cleanliness in the care of milk. Remember, it is a matter of profit to each to do this.

Care of Cows.

Pay special attention to the comfort of your cows. Do not let them remain out in cold rain-storms; it will reduce the flow of milk. Feed liberally. The cow must at all times have all the good feed she can eat and digest. Be sure and provide some soiling-crop against the July and August drought; if the cow shrinks then you will lose money in the fall, when butter and cheese are high. Oats and peas, sweet corn or field corn, drilled $3\frac{1}{2}$ feet apart, are a good soiling-crop.

A silo is a great help in the economical production of cow feed. Thousands of successful dairymen have proved this. It is no longer an experiment.

Dairy farming at high profit calls for close study concerning the cow, concerning her feed, and how to produce it at the best and cheapest. Every dairy neighborhood will show men who make nearly double the profit from the business that others do. We believe that it will pay every man to be intelligent and as well posted as he can be on these important questions. We must bring up the grade of our reputation by making better butter and cheese. This will bring on a larger and better paying demand. To cheat the consumer with poor goods will, in the end, destroy the business. Better dairymen, better milk, better products, better reputation in the world's markets, will surely bring better profits, and is the only true road to DAIRY SUCCESS.

BY-LAWS AND RULES FOR CO-OPERATIVE CREAMERY ASSOCIATIONS.

These vary somewhat in different sections, but a good model are the following, which are generally used in New England and Northwestern co-operative creameries:

I. This association shall be known as the — — Co-operative Creamery Association.

II. The purpose of the association shall be to locate, establish and carry on the manufacture and sale of milk products, in such a manner as will conduce to the greatest convenience and profit of the producers over the greatest amount of territory in the town of — — and vicinity. Also to purchase, use, and hold real and personal estate necessary for the transaction of the business of the association.

III. The capital stock of the association shall be — — dollars, divided into — — shares of ten dollars each.

IV. This association shall be co-operative. Cream and milk may be purchased or accepted from any person not a stockholder on the same terms and conditions as may be prescribed for stockholders.

V. Any person directly engaged in agricultural pursuits may become a member of this association by taking one or more shares of the stock of the association.

VI. 1. The regular meetings of the association shall be held semi-annually, viz., on the first Mondays in — — and — — — in each year, at such time and place as the board of directors may determine; and notice of such meeting shall be given by the clerk to each member by mail seven days at least previous to the date of said meeting. 2. Special meetings may be called either by the president, with the advice and consent of a majority of the directors, or upon written request of one third of the stockholders of the association, upon seven days' notice as above. 3. Meetings of the board of directors may be called by the president or by any two directors.

VII. 1. The officers of the association shall consist of a president, clerk, treasurer, five directors, and two auditors. 2. The president shall be chosen annually by the board of

directors, by written ballot, at the regular meeting in October. 3. The clerk, treasurer, board of directors, and auditors shall be chosen by the stockholders annually, by written ballot, at the regular meeting in October, and all officers shall hold office till others are chosen and qualified in their stead. Vacancies in the above-named offices may be filled at any meeting of the stockholders ; in the meantime by the board of directors. In case of the absence of the clerk a temporary clerk may be chosen and qualified in his stead.

VIII. At any regularly called meeting of the association, nine of the members thereof, and at any meeting of the board of directors, three members thereof, shall constitute a quorum for the transaction of business. A less number may adjourn from time to time.

IX. It shall be the duty of the president, who shall be a director, to preside at all meetings of the association and of the board of directors, preserve order therein, put all questions, announce all decisions, and, in case of an equal division, to give the casting vote. He shall receive and safely preserve all bonds required of the officers of the association and sign all certificates or documents issued by the association or board of directors. In the absence of the president, it shall be the duty of one of the board of directors, in order of their seniority, to preside at any meeting.

X. It shall be the duty of the clerk to attend all meetings of the association and of the board of directors, and to keep a correct record of the same, which record shall be open for the inspection of any member. He shall give notice of all meetings and of all appointments on committees, to each member thereof, and to each officer chosen, of his election; and shall serve all such other notices as appertain to his office or as may be directed from time to time by the association or board of directors. He shall attest all certificates or documents issued signed by the president, shall file all bills and reports and such other documents as may be ordered to be filed, and shall carry on all such correspondence as may be directed ; shall act as secretary of all committees when called upon; shall keep a correct

financial account between the association and its members, and shall have charge of all property not otherwise disposed of. He shall give such bonds for the faithful performance of his duty, and receive such compensation for his services, as the board of directors may determine.

XI. It shall be the duty of the treasurer to receive all money belonging to the association, giving his receipt therefor. He shall draw all money for the payment of claims against the association under the direction of the board of directors. He shall make a report to the board of directors at such times as they may require. He shall perform all duties required of him by the laws of the commonwealth and shall give such bonds for the faithful performance of his duty as the board of directors may require.

XII. It shall be the duty of the board of directors to attend to the general affairs of the association, invest the funds of the same, appoint such other agents and officers as in their judgment the interests of the association require, and fix all compensations. They shall keep or cause to be kept a correct account of all cream or milk furnished by the stockholders or patrons, and a correct account of all sales. They shall prescribe the rules and regulations governing the collection and delivery of the cream and milk; may cause the quality of the same to be tested as often as may be deemed expedient; may authorize the premises of any stockholder or patron to be inspected, and may reject and refuse to collect or receive any cream or milk that is unsatisfactory or not furnished in compliance with the prescribed regulations. They shall establish prices and have full power over the business of the association, and shall in all cases pursue such measures as in their judgment will tend to the best interests of the association. They shall make a full report of their doings, and a full statement of the business at each regular meeting, or whenever called upon to do so by vote of the stockholders.

XIII. The duties of the auditors shall be to audit all accounts of the association, making a report to the board of directors at the time of the regular meetings, and at such other times as they may require.

XIV. The net profits of the business of the association, after such deductions have been made as the laws of the commonwealth require, shall be divided *pro rata* among the stockholders, according to the number of shares held by each. [Note.—It is understood that the profits shall not exceed 6 per cent on capital, all receipts in excess of this sum and necessary reserves being declared in payment to patrons for cream or milk furnished.]

XV. 1. Any person doing business for the association or incurring expense therefor shall receive a just remuneration for such services or expense. 2. All documents issued by the association shall bear the seal thereof, said seal to be in charge of the clerk. 3. The directors shall procure a corporate seal. 4. No member of the association can transfer his stock to any person not directly engaged in agricultural pursuits. 5. In case shares are transferred by one person to another, the certificate thereof must be surrendered to the treasurer, and the board of directors shall cause another certificate to be issued to the person to whom the transfer is made.

XVI. These by-laws shall not be altered or amended unless such alteration or amendment be proposed in writing one meeting previous to action being taken ; provided also that two thirds of the members vote in the affirmative.

BY-LAWS AND RULES FOR CO-OPERATIVE CHEESE FACTORIES.

ARTICLE I. This association shall be known as the — — — Factory Association.

ART. 2. There shall be two meetings held yearly at the factory—one in the spring and one in the fall or winter, to be called by the president.

ART. 3. At the first meeting in each year there shall be chosen by the patrons a president and a treasurer and salesman.

ART. 4. The salesman and treasurer shall sell all the cheese, and as soon as he shall have sold and collected for one month's make of cheese, he shall, after paying the proprietor for mak-

ing and deducting the other expenses, divide the proceeds *pro rata*, according to the number of pounds of milk delivered among the patrons.

ART. 5. It shall also be the duty of the treasurer and salesman to keep the books of the association, and make final dividend yearly to all the patrons whenever all the cheese is sold and paid for. He shall also keep a milk book, showing the number of cheese made each month, to be taken from the factory's books. Said treasurer's milk and cheese book shall be subject to the inspection of the patrons and the president.

ART. 6. The manager shall keep an accurate account with each patron of the number of pounds of milk delivered each day. Also an account of the number of cheese made, which accounts shall be subject to the inspection of the officers and patrons.

ART. 7. The president shall be authorized to preside over the entire transactions of patrons or officers, and constitute a committee to investigate all matters pertaining to said factory, and if any contingency should arise, he shall be authorized to bring suit in law against any delinquent.

ART. 8. The manager (cheese-maker) shall be authorized to criticise all milk offered, and he shall reject the same if in his judgment said milk is unfit to run into cheese; also to test with lactometer any milk, and if found to vary from a standard of milk known to be pure for the day shall report the same to the president, whose duty it shall be to send out a committee of three to the premises of said delinquent, witnessing the transit of the milk on the ensuing day from the cow to the factory, which shall again be tested as on the previous day, and if found to vary, the party in question shall be adjudged guilty of having diluted the same in ratio, as shall appear. The penalty for the first offence shall be twenty-five dollars; the second, one hundred dollars.

ART. 9. The president shall also have power to call special meetings of the patrons at any time he may deem it necessary, and he shall be required to call a meeting of the patrons whenever a request is presented to him signed by ten patrons. Whenever a meeting is to be called the president shall give patrons at least two days' notice.

ART. 10. The action of the treasurer and salesman in regard to selling or holding cheese shall be governed by a vote of a majority of the patrons. If no vote is taken, he is to exercise his best judgment in the matter.

ART. 11. In voting at any annual or special meeting of this association the patrons shall be allowed one vote for every cow the milk of which is brought to the factory. [This may be altered to one vote on each share of the capital stock or one vote to each shareholder.]

ART. 12. The treasurer and salesman shall attend all meetings of the association whenever possible, and shall take minutes of the proceedings, and place the same on file in his office, and in other respects act as secretary. In case he should be absent, a temporary secretary may be chosen. In case the president is absent at any meeting, a temporary president may be chosen for a presiding officer.

RULES FOR PATRONS AND INSTRUCTIONS TO CREAM OR MILK GATHERERS.

These rules may be made to apply to either whole-milk or gathered-cream creameries.

Feeding.—We insist upon only such food being fed to cows as will produce the largest and best quality of milk or cream. Turnips, onions, cabbage, or anything likely to injure the quality of milk, cream, or butter is prohibited.

Milking.—Cows must be carefully cleaned before milking, to avoid odors that taint the milk. The milk must be strained through two strainers—one of them cloth—before going into the cans. Thorough cleanliness must be observed in everything.

Creamers and Cans.—Creamers must be kept in a place free from odors, and cleanliness maintained in their vicinity. Tanks and cans must be kept sweet and clean, and the water free and clear. Cans must be *washed, then scalded every time* they are used. The water in the creamers should not go below 45 degrees in summer and 40 degrees in winter.

Setting Milk.—All cans must be filled full of fresh milk, so far as possible, and immediately placed in the tank. After cans are set in water they must not be disturbed. Patrons are not

allowed to draw off the milk except on Sundays, or with permission from the trustees.

Mixing Milk.—Cans must not be partly filled at one milking and after standing long enough for the cream to begin to separate be filled with milk from another milking, or with anything whatever. After a can has once been set it must not in any way be disturbed or meddled with, nor the milk drawn off by the patrons, except on Sunday, and all patrons and cream gatherers shall at all times use the tubes to draw the milk with.

Night's Milk.—When milk is delivered but once each day, the cans containing the night's milk must be set in cold water immediately after milking and the milk thoroughly stirred by using a dipper and pouring until the milk is thoroughly cooled. A better plan is to use a cooler to thoroughly cool and aerate the milk before it is put in the cans. The night's milk must be left setting in cold water until it is carried to the creamery.

Cream and Milk Gatherers.—Cream and milk gatherers are forbidden to take any cream or milk which is dirty, or for any reason, in their judgment, is not of satisfactory quality or condition, or which has been in any way so treated as to indicate that an attempt has been made to interfere with the proper and natural separation of the cream, or of its being correctly counted on the gauge, or in violation of these rules.

Any patron found neglecting or violating any of these rules must at once be reported to some one of the board of trustees or directors, and his cream or milk must not again be taken till he has satisfied the trustees that his neglect was, for good reasons, excusable; and if any patron shall more than once be so reported it shall be deemed a sufficient reason for refusal to again receive his cream at all.

Cream or milk gatherers are especially directed to take all possible pains to discover all violations or neglect of any of these rules, and strictly enforce them in every case.

These rules and instructions are found by experience and observation to be necessary for the protection of the association and the best good of all its members. Copies thereof will be securely posted conveniently near each tank where milk-cans are set, so that ignorance can be no excuse for neglect.

Patrons are requested to notify the board of trustees or direc-

tors if any cream or milk gatherer is in any way delinquent or careless in his observance of these instructions.

Patrons who are not disposed to be governed by these rules are requested to so advise the trustees or directors, and the treasurer will make prompt settlement with any who wish to withdraw.

By order of the trustees or directors.

....., President.

....., Treas.

MASSACHUSETTS LAW FOR THE ERADICATION OF TUBERCULOSIS IN CATTLE.

1. All the States and Territories of the United States, the District of Columbia, Canada, Great Britain, and all other localities without the limits of this commonwealth, are hereby declared infected districts.

2. It is hereby ordered that all neat cattle brought within the limits of this commonwealth from any of said localities on or after November 15, 1894, are hereby made subject to quarantine until they have been inspected and released by this board or one of its members thereto duly authorized.

3. Except as hereinafter provided no neat cattle shall be unloaded except in case of accident, for any purpose whatsoever, within this commonwealth at any place or places other than at such quarantine stations as are herein designated, or which may hereafter from time to time be designated by this board, unless upon written permit signed by the board of cattle commissioners or one of its members.

4. The stock-yards in Brighton and Watertown and the premises of the New England Dressed Beef & Wool Co., in Somerville, are hereby designated as quarantine stations.

5. All neat cattle entered at any quarantine station except as herein provided shall immediately be placed in quarantine and so remain, at the expense of the owner or consignee, for a period of not less than twenty-four hours, and shall be subject to the tuberculin test. This test shall be made by the board of cattle commissioners or one of its members, or a duly authorized agent thereof, and without expense to the owner.

6. Every such animal, which, in the opinion of the board or any of its members, is affected with tuberculosis, will be condemned and slaughtered as provided in sections 45 and 53 of chapter 491 of the acts of 1894.

7. All animals which upon such inspection shall be adjudged free from tuberculosis and other contagious diseases shall be branded with the seal of the commission. This brand will be placed upon the right horn and the outside of the right front hoof, on those animals having horns. Hornless cattle will be branded upon the right shoulder and upon the outside of the right front hoof.

8. All neat cattle passing through this commonwealth from points without its limit for exportation from this State will not be examined as herein provided; but such animals shall remain in quarantine until transported without the limits of the commonwealth.

9. All neat cattle brought within this commonwealth consigned directly to the Brighton abattoir for slaughter shall be confined by themselves for identification, and shall not be released except after an examination as above provided, or except for immediate slaughter.

Section 45 and 53 of chapter 491, State acts of 1894, define the manner of examination of suspected and slaughter of infected cattle. Animals killed for tuberculosis will be paid for at one half their actual value, provided they have been within the State six months prior to their being destroyed, (In effect Nov. 15, 1894.)

MASSACHUSETTS STATE BOARD OF HEALTH.

Regulations Concerning the Production and Sale of Milk.

Whereas, cows' milk is one of the most common and necessary articles of food, and is oftentimes seriously impaired in usefulness and rendered dangerous to health by the want of proper care in its production or subsequent treatment in handling, it is therefore ordered that the following regulations be and are hereby adopted:

Section 1. No person shall use any building for cows un-

less it contains at least one thousand cubic feet of space for each animal, is well lighted and ventilated, has tight roof and floors, good drainage, and a supply of pure water and all other necessary means for maintaining the health and good condition of the cows, and has been approved by the State Board of Health.

Sec. 2. Every person using any such building shall keep the same, and the premises connected therewith, and all land used for pasturage of the cows clean and free from filth.

Sec. 3. Every person keeping a milch cow shall permit it to be examined from time to time, as to its freedom from disease, by a veterinarian designated by the Board of Health.

Sec. 4. No person having an infectious disease, or having recently been in contact with any such person, shall milk cows or handle cows, measure or handle other vessels used for milk intended for sale, until all danger of communicating such disease to other persons shall have passed.

Sec. 5. No person shall sell or use for human food the milk of a diseased cow or permit such milk to be mixed with other milk; nor until it has been boiled shall sell or use such milk or any mixture of such milk for feed of swine or other animals.

RULES FOR DISINFECTION OF STABLES.

In Case of Appearance of Contagious Diseases.

(TRUMBOWER.)

1. Have all loose litter, hay, and rubbish removed and burned.
2. Have all manure removed to land where cattle have no access.
3. Have all feed-troughs, hay-racks and all woodwork thoroughly cleaned by washing with hot water in which two ounces of carbolic acid to each gallon of water are dissolved.
4. Thoroughly whitewash the whole of the interior of the building with a whitewash containing one pound of chloride of lime to each four gallons of water. Enough freshly burned quicklime should be added to make the wash show

where applied. Especially should this be applied to the sides and front of the stalls, feed-troughs and hay-racks (inside and outside).

5. All rotten woodwork to be removed and burned, and replaced with new.

6. All buckets, forks, shovels, brooms, and other objects used about the stable to be washed and covered with the same solution.

7. All drains to be thoroughly cleaned and disinfected with a solution of chloride of lime, one pound to four gallons of water.

8. In cases of glanders, all harness, poles, and shafts of wagons, neck-yokes and pole-straps should be thoroughly washed with hot water and soap, and afterwards oiled with carbolized oil (one part of carbolic acid to ten of oil). Before applying the oil, harness should be hung up in the open air for one week.

V. FEEDING STUFFS.

COMPOSITION OF FEEDING STUFFS.

In the ordinary chemical analysis of feeding stuffs the following constituents are determined, viz., water, ash, protein, crude fibre, nitrogen-free extract, ether extract (fat).

Water is present in all feeding stuffs, from above 90 per cent in green foods and some kinds of roots, to below 10 per cent in very dry hay and in concentrated food stuffs.

Ash, or mineral matter, is the non-combustible part of plants, and goes to make the bones of the animal, or to supply material for the maintenance of other parts of the animal body.

Protein is the name of a large group of substances, all characterized by the fact that they contain the element nitrogen; hence they are also called *nitrogenous* substances; and foods rich in protein are spoken of as *nitrogenous foods*. The protein substances supply the material necessary for the formation of lean meat, ligaments, tendons, hair, horns, hoofs, etc., and also of casein of the milk. Crude protein includes albuminoids and amides; among the former are found white of egg, lean meat, curd of milk and gluten; among the latter, asparagin and other crystallizable and water-soluble substances, generally speaking, of a somewhat inferior nutritive value.

Crude Fibre or woody fibre is the framework of plants, forming the walls of their cells; it is usually the least digestible portion of feeding stuffs, and the nutritive value of a plant is decreased as its crude fibre content increases.

Nitrogen-Free Extract includes starch, sugar, gums, organic acids, etc., and forms a most important and usually a very large part of cattle foods. Together with cellulose, nitrogen-free extract forms the group of bodies called *carbo-*

hydrates. A general name for carbohydrates is *heat-producing substances*, as against *flesh-forming substances*, i.e., nitrogenous compounds, the names indicating the main offices of the substances in animal nutrition.

Ether Extract, or *crude fat (oil)* includes a group of components dissolved out by ether in the analysis of foods; fat forms the main part of the extract; most feeding stuffs contain only a small quantity of ether extract, but this component is nevertheless of considerable importance in the feeding of animals.

Organic matter signifies the combustible portion of chemically dry feeding stuffs, i.e., all the components given in the preceding except water and ash.

Digestible Components.—The food stuffs used in the feeding of farm animals are only partly of direct value to the animals, the portion which their digestive fluids are unable to dissolve being voided in the excrements. The digestibility of fodders has been determined by direct experiments with different kinds of farm animals, in this country or abroad. The *digestion coefficients* (see pp. 263–65) mean the percentage of any one component which has been found to be digested by the animals experimented on.

Nutritive Ratio signifies the ratio between the digestible nitrogenous and non-nitrogenous components in a feeding stuff, or a combination of such. As fat has been found to yield about 2.2 times more heat, when burned, than do starch, sugar, and other carbohydrates, the per cent of digestible fat in a food is multiplied by 2.2 when the nutritive ratio is to be calculated; the product is added to the per cent of digestible carbohydrates (nitrogen-free extract + crude fibre), and this sum is divided by the per cent of digestible protein. (The factor $2\frac{1}{2}$ or $2\frac{1}{4}$ is sometimes used for obtaining “the starch equivalent” of fat.)

Example: Clover hay contains on the average 6.5 per cent digestible protein, 34.9 per cent digestible carbohydrates, and 1.6 per cent of digestible fat (see following table):

$$1.6 \times 2.2 = 3.52; \quad 34.9 + 3.52 = 38.42; \quad 38.42 \div 6.5 = 5.9.$$

Nutritive ratio, 1 : 5.9.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.*

Feeding Stuffs.	No. of Analyses.	Percentage Composition.*							Per cent Digestible Matter.		
		Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.	Organic Matter.	Crude Protein.	Carbohy- drates.	Ether Extract.
<i>Green Fodders and Silage.</i>											
Pasture grass.....	...	80.0	2.0	3.5	4.0	9.7	.8	18.0	2.6	10.6	.5
Green fodder corn (maize).....	126	79.3	1.2	1.8	5.0	12.2	.5	19.5	1.3	11.8	.4
Alfalfa (lucerne).....	23	71.8	2.7	4.8	7.4	12.3	1.0	25.5	3.6	11.4	.4
Green clover.....	43	70.8	2.1	4.4	8.1	13.5	1.1	27.1	2.9	14.1	.7
Alsike clover, in bloom	4	74.8	2.0	3.9	7.4	11.0	.9	23.2	2.7	13.1	.6
Rye fodder.....	7	76.6	1.8	2.6	11.6	6.8	.6	21.6	2.1	14.1	.4
Oat fodder.....	5	62.2	2.5	3.4	11.2	19.3	1.4	35.3	2.7	22.7	1.0
Sorghum fodder.....	11	79.4	1.1	1.3	6.1	11.6	.5	19.5	.8	12.7	.4
Red top, in bloom.....	5	64.8	2.3	3.3	9.4	19.1	1.2	32.9	2.3	20.5	.7
Meadow fescue, in bloom.....	4	69.9	1.8	2.4	10.8	14.3	.8	28.3	1.7	17.8	.5
Timothy.....	56	61.6	2.1	3.1	11.8	20.2	1.2	36.3	2.2	23.0	.7
Blue-grass.....	81	65.1	2.8	4.1	9.1	17.6	1.3	32.1	2.9	19.2	.8
Prickly comfrey.....	41	88.4	2.2	2.4	1.6	5.1	.3	9.4	1.4	4.6	.2
Corn silage.....	99	79.1	1.4	1.7	6.0	11.1	.8	19.5	.8	11.6	.7
Corn silage, Wis. anal.	17	73.6	2.1	2.7	7.8	12.9	.9	24.2	1.3	14.0	.7
Clover silage.....	5	72.0	2.6	4.2	8.4	11.6	1.2	25.4	2.0	13.5	1.0
Sorghum silage.....	6	76.1	1.1	.8	6.4	15.3	.3	22.8	.6	14.9	.2
<i>Hay and Dry Coarse Fodders.</i>											
Fodder corn (maize), field cured.....	35	42.2	2.7	4.5	4.3	34.7	1.6	55.1	2.6	33.3	1.1
Same, Wis. analyses....	5	29.0	4.2	6.5	22.1	36.5	1.7	66.8	3.7	40.4	1.2
Corn stalks (stover), field cured.....	60	40.1	3.4	3.8	19.7	31.9	1.1	56.5	2.0	33.4	.6
Hay from red clover....	38	15.3	6.2	12.3	24.8	38.1	3.3	78.5	6.5	34.9	1.6
Hay from mammoth clover.....	10	21.2	6.1	10.7	24.5	33.6	3.9	72.7	5.7	32.0	1.9
Hay f'm alfalfa (lucerne)	21	8.4	7.4	14.3	25.0	42.7	2.2	84.2	7.6	37.8	1.3
Hay from alsike clover.	9	9.7	8.3	12.8	25.6	40.7	2.9	82.0	6.8	36.8	1.4
Oat hay.....	6	8.9	6.2	7.6	29.3	45.1	2.9	84.9	4.3	46.4	1.5
Timothy hay.....	68	13.2	4.4	5.9	29.0	45.0	2.5	82.4	3.0	43.9	1.2
Hay from mixed mea- dow grasses.....	11	16.0	4.6	6.4	29.9	41.0	2.1	79.4	3.6	42.7	1.0
Hay from Hun. grass..	12	7.7	6.0	7.5	27.7	49.0	2.1	86.3	4.5	46.4	1.0
Marsh hay.....	2	7.9	5.2	7.8	30.1	46.3	2.7	86.9	3.5	44.7	1.7
Oat straw.....	12	9.2	5.1	4.0	37.0	42.4	2.3	85.7	1.6	41.4	.7
Barley straw†.....	97	14.2	5.7	3.5	36.0	39.0	1.5	80.1	.9	41.3	.6
Wheat straw.....	7	9.6	4.2	3.4	38.1	43.4	1.3	86.2	.8	37.9	.5
Rye straw.....	7	7.1	3.2	3.0	38.9	46.6	1.2	89.7	.8	42.7	.4
Buckwheat straw.....	3	9.9	5.5	5.2	43.0	35.1	1.3	84.6	2.3	37.7	.6
Pea vine†.....	14	13.6	6.6	9.0	35.5	33.7	1.6	79.8	4.3	32.3	.8

* Largely from Jenkins and Winton's Compilation of Analyses of American Feeding Stuffs.

† König.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.—Continued.

Feeding Stuffs.	No. of Analyses.	Percentage Composition.						Per cent Digestible Matter.			
		Water.	Ash.	Crude Protein.	Crude Fiber.	Nitrogen-Free Extract.	Ether Extract.	Organic Matter.	Crude Protein.	Carbohy- drates.	Ether Extract.
<i>Roots and Tubers.</i>											
Potatoes	12	78.9	1.0	2.1	.6	17.3	.1	20.1	1.4	16.1	.1
Sweet potatoes	6	71.1	1.0	1.5	1.3	24.7	.4	27.9	.9	22.2	.3
Red beets.....	9	88.5	1.0	1.5	.9	8.0	.1	10.5	.9	7.6	.1
Sugar beets.....	19	86.5	.9	1.8	.9	9.8	.1	12.6	1.1	9.3	.1
Mangel-wurzels.....	9	90.9	1.1	1.4	.9	5.5	.2	8.0	1.1	4.8	.2
Rutabagas.....	4	88.6	1.2	1.2	1.3	7.5	.2	10.2	.9	7.1	.2
Turnips.....	3	90.5	.8	1.1	1.2	6.2	.2	8.7	.6	5.5	.2
Carrots	8	88.6	1.0	1.1	1.3	7.6	.4	10.4	1.0	7.1	.3
<i>Grains and Flour Mill Products.</i>											
Corn (maize).....	208	10.9	1.5	10.5	2.1	69.6	5.4	87.6	7.1	62.7	4.2
Corn and cob meal....	7	15.1	1.5	8.5	6.6	64.8	3.5	83.4	6.5	56.3	2.9
Corn cob	18	10.7	1.4	2.4	30.1	54.9	.5	87.9	1.6	43.9	.3
Corn bran.....	2	10.9	1.7	9.4	4.8	67.3	5.9	87.4	6.2	50.9	3.4
Oats	30	11.0	3.0	11.8	9.5	59.7	5.0	86.0	9.1	44.7	4.1
Oat shorts*.....	6	10.0	5.2	16.2	7.5	54.5	6.6	84.8	12.6	45.7	5.4
Oat feed.....	4	7.7	3.7	16.0	6.1	59.4	7.1	88.6	12.5	46.9	2.8
Oat dust.....	2	6.5	6.9	13.5	18.2	50.2	4.8	86.6	8.9	38.4	5.1
Barley	10	10.9	2.4	12.4	2.7	69.8	1.8	86.7	9.5	66.1	1.2
Barley screenings.....	2	12.2	3.6	12.3	7.3	61.8	2.8	84.2	9.3	57.3	1.8
Wheat	310	10.5	1.8	11.9	1.8	71.9	2.1	87.7	9.2	64.9	1.4
Wheat bran—roller process.	7	12.0	5.6	16.1	8.4	53.7	4.2	82.4	12.6	44.1	2.9
Wheat bran—old process.....	9	12.0	4.9	13.0	8.1	58.2	3.8	83.1	10.1	47.5	2.6
Wheat shorts.....	12	11.8	4.6	14.9	7.4	56.8	4.5	83.6	11.6	45.4	3.2
Wheat middlings	33	12.1	3.4	15.7	4.7	60.2	4.0	84.5	12.2	47.2	2.9
Wheat screenings.....	10	11.6	2.9	12.5	4.9	65.1	3.0	85.5	9.8	51.0	2.2
Rye.....	6	11.6	1.9	10.6	1.7	72.5	1.7	86.5	8.3	65.5	1.2
Rye bran	7	11.6	3.6	14.7	3.5	63.8	2.8	84.8	9.7	48.0	1.6
Rye shorts.....	1	9.3	4.9	18.0	5.1	59.9	2.8	85.8	11.9	45.1	1.6
Buckwheat.....	8	12.6	2.0	10.0	8.7	64.5	2.2	85.4	7.7	49.2	1.8
Buckwheat bran.....	2	10.5	3.0	12.4	31.9	38.8	3.3	86.5	7.4	30.4	1.9
Buckwheat shorts.....	2	11.1	5.1	27.1	8.3	40.8	7.6	83.8	21.1	33.5	5.5
Buckwheat middlings..	6	12.7	5.1	28.2	4.2	42.3	7.5	82.2	22.0	33.4	5.4
Rice	10	12.4	.4	7.4	.2	79.2	.4	87.2	4.8	72.2	.3
Rice bran.....	5	9.7	10.0	12.1	9.5	49.9	8.8	80.3	5.3	45.1	7.3
Rice hulls.....	3	8.2	13.2	3.6	35.7	38.6	.7	78.6	1.6	44.5	.6
Rice polish	4	10.0	6.7	11.7	6.3	58.0	7.3	83.3	9.0	56.4	6.5
Pea meal	2	10.5	2.6	20.2	14.4	51.1	1.2	86.9	18.0	56.0	.9
Sorghum seed.....	10	12.8	2.1	9.1	2.6	69.8	3.6	85.1	7.0	52.1	3.1
Cow pea.....	5	14.8	3.2	20.8	4.1	55.7	1.4	82.0	18.3	54.2	1.1
Soja bean.....	8	10.8	4.7	34.0	4.8	28.8	16.9	84.5	29.6	17.9	15.9

* König.

AVERAGE COMPOSITION OF AMERICAN FEEDING STUFFS.—Continued.

Feeding Stuffs.	No. of Analyses.	Percentage Composition.						Per cent Digestible Matter.			
		Water.	Ash.	Crude Protein.	Crude Fibre.	Nitrogen-Free Extract.	Ether Extract.	Organic Matter.	Crude Protein.	Carbohy- drates.	Ether Extract.
<i>Miscellaneous Feeds.</i>											
Malt sprouts.....	5	9.6	5.9	24.8	11.0	47.0	1.7	84.5	19.8	36.2	1.7
Brewers' grains.....	15	75.7	1.0	5.4	3.8	12.5	1.6	23.3	3.9	9.5	1.3
Brewers' grains, dried.	5	7.7	3.6	22.2	12.3	47.9	6.3	88.7	16.2	35.5	5.3
Hominy chops.....	12	11.1	2.5	9.8	3.8	64.5	8.3	86.4	8.9	61.9	6.3
Corn germ.....	3	10.7	4.0	9.8	4.1	64.0	7.4	85.3	8.9	61.4	5.6
Germ meal.....	3	8.6	1.0	10.9	10.2	64.0	5.4	90.4	9.3	63.6	4.1
Gluten meal.....	32	9.6	.7	29.4	1.6	52.4	7.4	89.7	25.0	49.4	5.6
Grano-gluten.....	1	5.8	2.8	31.1	12.0	33.4	14.9	91.4	26.5	35.4	11.3
Starch feed, wet.....	12	65.4	.3	6.1	3.1	22.0	3.1	34.3	5.5	21.7	2.3
Cotton-seed meal.....	37	8.2	7.2	42.4	5.6	23.8	12.9	84.6	36.9	18.1	12.3
Cotton-seed hulls.....	10	9.9	2.9	4.2	47.4	33.2	2.2	87.2	1.0	26.2	1.8
Linseed meal, old pro- cess.....	21	9.2	5.7	32.9	8.9	35.4	7.9	85.1	28.3	32.8	7.1
Linseed meal, new pro- cess.....	14	10.1	5.8	33.2	9.5	38.5	3.0	84.1	27.2	32.9	2.7
Palm-nut meal*.....	600	10.4	4.3	16.8	24.0	35.0	9.5	85.3	16.0	52.6	9.0
Apples*.....	36	84.8	.5	.4	1.5	12.5	.3	14.7	.3	12.8	.2
Apple pomace.....	7	76.7	.5	1.4	3.9	16.2	1.3	22.8	1.0	11.9	1.1
Dried blood*.....	3	8.5	4.7	84.4	....	....	2.5	86.8	58.1	....	2.3
Skimmed milk*.....	96	90.4	.7	3.3	....	4.7	.8	8.9	3.1	4.7	.8
Buttermilk*.....	85	90.1	.7	4.0	....	4.0	1.1	9.2	3.9	4.0	1.1
Whey*.....	46	93.4	.7	.9	....	4.8	.3	5.9	.8	4.7	.3

* König.

AVERAGE DIGESTION COEFFICIENTS OF AMERICAN FEEDING STUFFS

As Determined by American Experiments. (JORDAN.)

	No. States.	No. Samples.	Single Trials.	Dry Matter.	Ash.	Protein (N. $\times$ 6.25).	Fibre.	Nitrogen-free Ex-tract.	Fat.
A.—EXPERIMENTS WITH RUMINANTS.									
GREEN FODDER (fed when green).									
Corn (maize) fodder—									
Whole plant, average of all trials. . .	2	15	30	68	35	61	61	74	74
Dent, immature, Pennsylvania	1	4	9	68	57	69	69	71	66
in milk, Pennsylvania	1	3	6	68	33	62	63	73	76
mature, Pennsylvania	1	7	13	67	22	53	54	75	78
Sorghum, North Carolina and Texas. .	2	2	4	67	42	47	59	74	74
Rye, Pennsylvania	1	1	2	73	56	79	79	70	74
Timothy (<i>Phleum pratense</i>), Utah. . .	1	1	3	63	32	48	56	66	53
Hungarian grass (<i>Setaria italica</i>), Me.	1	1	4	63	41	62	68	66	52
Pasture grass, Pennsylvania	1	1	1	69	50	65	74	72	55
Red clover (<i>Trifolium pratense</i>)	1	1	2	66	55	67	53	78	64
SILAGE.									
Corn (maize) silage, whole plant—									
Average of all kinds	6	17	37	66	31	53	67	70	81
Dent, immature, Maine, New York and Pennsylvania	3	5	12	64	33	49	71	66	75
Dent, in milk, Pennsylvania	1	3	8	65	32	50	65	69	87
Flint mature, Maine and New York. .	2	4	10	73	30	63	75	77	83
Soja-bean silage	1	1	2	59	57	76	55	52	72
DRIED FODDERS (fed air-dry or partially so).									
Corn (maize) fodder, whole plant—									
Average of all kinds	4	24	50	66	34	55	66	69	72
Dent, immature, Maine and Penn. . .	2	6	12	62	38	51	67	64	68
in milk, New York and Penn. . .	2	5	12	63	31	45	64	66	76
mature, Pennsylvania	1	4	6	70	20	55	52	77	79
Flint, mature, Maine	1	4	9	71	42	65	76	73	70
Sweet, mature, Maine	1	3	6	67	36	64	74	68	74
Corn (maize) butts, Maryland	1	1	2	66	11	21	73	69	79
husks, Maryland	1	1	2	72	16	29	79	75	32
fodder, tops above ear, Maryland	1	1	2	55	7	22	70	53	63
pulled, Maryland, North Carolina and Texas	3	3	6	60	....	51	69	63	64
stover, Pennsylvania	1	1	4	62	45	52	66	64	52
Sorghum fodder, leaves, N. Carolina .	1	1	2	63	29	61	70	64	47
Oat straw, Maine	1	1	2	50	....	....	58	53	38

AVERAGE DIGESTION COEFFICIENTS.—Continued.

	No.	States.	No.	Samples.	Single	Trials.	Dry	Matter.	Ash.	Protein (N. $\times$ 6.25).	Fibre.	Nitrogen free	Ex-	Fat.
												tract.		
A.—EXPRTS. WITH RUMINANTS—Cont.														
DRIED FODDERS—Continued.														
Hay from grasses named:														
Barley, Maine.....	1	1	4	61	45	65	62	63	40					
Blue joint (<i>Calamagrostis canadensis</i>), Maine.....	1	2	3	54	29	63	54	56	45					
Cat-tail millet (<i>Pennisetum spicatum</i>), North Carolina.....	1	1	2	62	68	63	66	59	46					
Hungarian grass (<i>Setaria italica</i>), Maine.....	1	1	2	65	47	60	68	67	64					
Johnson grass (<i>Sorghum halepense</i>), North Carolina.....	1	1	1	54	56	45	58	54	39					
Orchard grass (<i>Dactylis glomerata</i>), Maine and New York.....	2	2	3	56	...	59	60	55	54					
Redtop (<i>Agrostis vulgaris</i>), Maine..	1	2	3	60	29	61	61	62	50					
Timothy (<i>Phleum pratense</i>), average of all kinds, Maine and Utah.....	2	10	22	58	37	49	53	63	57					
ditto, in full bloom, Maine....	1	3	5	61	44	57	59	64	56					
ditto, late cut, Maine....	1	3	5	54	32	45	48	61	51					
Wild-oat grass (<i>Danthonia spicata</i>), Maine.....	1	2	2	64	35	58	68	65	50					
Witch-grass (<i>Triticum repens</i>), Me..	1	2	3	61	41	58	63	65	57					
Pasture grass, Pennsylvania.....	1	2	3	72	52	73	76	74	67					
Mixed grasses, New York and Penn.	3	4	9	56	....	51	55	59	52					
Hay from legumes named:														
Alfalfa, Colorado, and New York..	2	2	3	58	....	73	46	68	51					
Alsike clover (<i>Trifolium hybridum</i>), Maine.....	1	2	3	62	52	66	53	71	50					
Crimson clover (<i>Trifolium incarnatum</i>), North Carolina.....	1	1	2	61	53	69	46	70	46					
Red clover (<i>Trifolium pratense</i>), Maine and Wisconsin.....	2	2	7	53	....	52	47	61	48					
White clover (<i>Trifolium repens</i>), Me.	1	1	1	66	58	73	61	69	51					
Cowpea vines, North Carolina.....	1	1	2	59	49	65	42	71	52					
Soja-bean vines, North Carolina.....	1	1	2	62	....	71	61	69	29					
MISCELLANEOUS FODDERS.														
Buttercup hay (<i>Ranunculus acris</i>), Me.	1	1	1	56	48	56	41	67	70					
Peanut-vine hay, North Carolina.....	1	1	2	60	20	63	52	69	66					
Sorghum bagasse, North Carolina.....	1	1	1	61	13	14	46	65	64					
White weed, white daisy (<i>Chrysanthemum leucanthemum</i>), Maine.....	1	1	1	58	52	58	45	67	62					
ROOTS.														
Sugar-beets, Maine.....	1	1	2	94	32	91	100	100	50					
Mangel-wurzels, Maine....	1	1	2	78	16	75	43	91	...					

AVERAGE DIGESTION COEFFICIENTS.—Continued.

	No. States.	No. Samples.	Single Trials.	Dry Matter.	Ash.	Protein (N. $\times$ 6.25).	Fibre.	Nitrogen-free Extract.	Fat.
A.—EXPTS. WITH RUMINANTS—Cont.									
ROOTS—Continued.									
Rutabagas, Maine	1	1	2	87	31	80	74	95	84
Turnips (strap-leaf), Maine	1	1	2	93	59	90	100	96	97
Potatoes, Maine	1	1	3	77	...	44	...	91	13
GRAINS (fed whole or ground).									
Corn and cob meal, North Carolina	1	1	3	79	...	52	45	88	84
Corn meal, North Carolina and N. Y.	2	2	5	87	...	60	...	92	92
Cotton seed, raw, North Carolina	1	1	2	66	43	68	75	50	87
roasted, North Carolina	1	1	2	56	...	47	66	51	72
Pea meal, Maine	1	1	2	87	44	83	26	94	54
BY-PRODUCTS.									
Brewers' grains, dried, Massachusetts	1	1	2	62	...	79	53	59	91
Corn cobs, Massachusetts	1	1	2	59	...	17	65	60	50
Cotton-seed hulls, N. Car. and Texas	2	3	11	41	24	10	38	40	77
meal, N. Car. and Wis.	2	2	7	76	...	88	...	64	97
Gluten feed (Buffalo), Massachusetts	1	1	2	78	...	85	43	81	81
meal, Maine	1	1	2	87	...	87	...	91	88
Linseed meal, new process, Mass	1	1	2	81	...	87	61	86	91
old process, Mass.	1	1	2	79	...	89	57	78	89
Malt sprouts, Wisconsin	1	1	1	67	...	80	33	68	100
Wheat bran, Maine and Massachusetts;	2	4	7	61	...	78	25	68	72
middlings, Maine and Mass.	2	2	4	79	...	82	...	88	85
B.—EXPERIMENTS WITH SWINE.									
GRAINS AND BY-PRODUCTS.									
Barley, Minnesota	1	1	1	80	5	81	48	87	67
Corn (maize) (whole kernel), Maine and									
Minnesota	2	2	2	86	...	79	44	91	62
meal, Maine	1	1	1	89	...	86	29	94	82
Corn and cob meal, Maine	1	1	1	76	...	76	28	84	82
Peas, Minnesota	1	1	1	90	40	89	78	95	50
Wheat shorts, Minnesota	1	1	2	76	5	73	36	87	...
Wheat bran, Minnesota	1	1	2	61	...	75	33	66	72

FEEDING STANDARDS. (WOLFF.)

(Per day and per 1000 lbs. live weight.)

	Total Organic Substance.	Nutritive (Digestible) Substances.			Total Nutritive Substances.	Nutritive Ratio.	
		Crude Protein.	Carbo-hydrates.	Ether Extract.			
	lbs.	lbs.	lbs.	lbs.	lbs.		
1. Steers at rest in stall.....	17.5	0.7	8.0	0.15	8.85	1:12	
2. Steers moderately worked.. ..	24.0	1.6	11.3	0.30	13.20	1:7.5	
Steers heavily worked.....	26.0	2.4	13.2	0.50	16.10	1:6.0	
3. Milch cows.	24.0	2.5	12.5	0.40	15.40	1:5.4	
4. Horses moderately worked.....	21.0	1.6	10.0	0.50	12.10	1:7.0	
Horses heavily worked.....	23.0	2.5	12.1	0.70	15.30	1:5.5	
5. Wool sheep, coarser breeds	20.0	1.2	10.3	0.20	11.70	1:9.0	
“ “ finer breeds.....	22.5	1.5	11.4	0.25	13.15	1:8.0	
6. Fattening steers, 1st period....	27.0	2.5	15.0	0.50	18.00	1:6.5	
“ “ 2d “	26.0	3.0	14.8	0.70	18.50	1:5.5	
“ “ 3d “	25.0	2.7	14.8	0.60	18.10	1:6.0	
7. Fattening sheep, 1st period	26.0	3.0	15.2	0.50	18.70	1:5.5	
“ “ 2d “	25.0	3.5	14.4	0.60	18.50	1:4.5	
8. Fattening swine, 1st period	36.0	5.0	27.5		32.50	1:5.5	
“ “ 2d “	31.0	4.0	24.0		28.00	1:6.0	
“ “ 3d “	23.5	2.7	17.5		20.20	1:6.5	
9. Growing cattle:							
<i>Aver. live weight.</i>							
<i>Age, Months.</i>	<i>per head.</i>						
2-3	165 lbs ...	22.0	4.0	13.8	2.0	19.8	1:4.7
3-6	330 “	23.4	3.2	13.5	1.0	17.7	1:5.0
6-12	550 “	24.0	2.5	13.5	0.6	16.6	1:6.0
12-18	770 “	24.0	2.0	13.0	0.4	15.4	1:7.0
18-24	940 “	24.0	1.6	12.0	0.3	13.9	1:8.0
10. Growing sheep:							
5-6	62 lbs....	28.0	3.2	15.6	0.8	19.6	1:5.5
6-8	73 “	25.0	2.7	13.3	0.6	16.6	1:5.5
8-11	84 “ ..	23.0	2.1	11.4	0.5	14.0	1:6.0
11-15	90 “	22.5	1.7	10.9	0.4	13.0	1:7.0
15-20	95 “	22.0	1.4	10.4	0.3	12.1	1:8.0
11. Growing fat pigs:							
2-3	55 lbs....	42.0	7.5	30.0		37.5	1:4.0
3-5	110 “	34.0	5.0	25.0		30.0	1:5.0
5-6	137 “	31.5	4.3	23.7		28.0	1:5.0
6-8	187 “	27.0	3.4	20.4		23.8	1:6.0
8-12	275 “	21.0	2.5	16.2		18.7	1:6.5

RATIONS FOR DAIRY COWS.

	Org'nic Matter.	Digestible.				Nut. Ratio.
		Protein	Carbo- hydrates	Fat.	Total.	
	lbs.	lbs.	lbs.	lbs.	lbs.	
Woods & Phelps.....	25.0	2.5	12.5	.65	15.65	1:5.6
Woll.....	24.5	2.2	13.3	.7	16.2	1:6.9
Wolff's German Ration	24.0	2.5	12.5	.4	15.4	1:5.4

CALCULATION OF COMPONENTS OF FEED RATIONS.

Let us suppose that we have at our disposal the following common feeding stuffs: Fodder corn, clover hay, and wheat bran, and that we want to know how much is required to keep a milch cow of 1000 lbs. live weight in good condition and to secure a maximum yield of milk. We will feed 14 lbs. of fodder corn, 6 lbs. of clover hay, and 10 lbs. of wheat bran. According to the table these quantities contain the following number of pounds of digestible matter:

	Organic Matter.	Digestible.		
		Protein.	Carbo- hydrates.	Ether Extract.
	lbs.	lbs.	lbs.	lbs.
14 lbs. of field-cured fodder corn	9.35	.52	5.66	.17
6 lbs. clover hay.....	4.71	.39	2.09	.10
10 lbs. wheat bran.....	8.24	1.26	4.41	.29
Total.	22.30	2.17	12.16	.56

This ration falls somewhat short of the feeding standard in total organic matter and digestible substances. To bring it nearer to the standard, we add a couple of pounds of some concentrated feed. In selecting the foods and deciding the quantities to be given in each case, the market prices of the feeds must be considered. We will suppose that a lot of corn-meal is available in this case, and will add two pounds of this feed to the above ration.

	Organic Matter.	Digestible.			Nutri- tive Ratio.
		Crude Protein	Carbo- hydrates.	Ether Extract	
	lbs.	lbs.	lbs.	lbs.	
Ration as above.....	22.30	2.17	12.16	.56	1:
2 lbs. of corn meal.....	1.75	.14	1.25	.08	
Total....	24.05	2.31	13.41	.64	6.4
Proposed American feeding standard for milch cows..	24.5	2.2	13.3	.7	6.9
Wolff's feeding standard for milch cows....	24.0	2.5	12.5	.4	5.4

The ration now corresponds very well with the proposed American feeding standard ; there is a small deficit of organic matter and of digestible fat ; but there is no necessity of trying to follow any standard ration blindly, as they are only intended to be approximate gauges which the farmer may use in estimating the quantities of nutrients required by farm animals in order to do their best, cost and product both being considered.

In constructing rations according to the above feeding standards, several points must be considered besides the chemical composition and the digestibility of the feeding stuffs ; the standards cannot be followed directly without regard to bulk and other properties of the fodder ; the ration must not be too bulky, and still must contain a sufficient quantity of roughage to keep up the rumination of the animals, in case of cows and sheep, and to secure a healthy condition of the animals generally. The local market prices of cattle foods are of the greatest importance in determining which foods to buy ; the conditions in the different sections of our great continent differ so greatly in this respect that no generalizations can be made. In general, nitrogenous concentrated feeds are the cheapest feeds in the South, and the flour-mill, the brewery, and the starch factory refuse feeds the cheapest in the Northwest.

RATIONS FOR DAIRY COWS

Fed by 16 American Dairymen Producing 325 lbs. of Butter or more per Cow per Year.*

1. *Colorado*.—30 lbs. silage, 10 lbs. alfalfa hay, 10 lbs. clover hay, 5 lbs. wheat bran, 2 lbs. corn meal.

2. *Connecticut*.—35 lbs. corn silage, 10 lbs. hay, 3 lbs. wheat bran, 3 lbs. corn and cob meal, 2 lbs. cotton-seed meal, 2 lbs. Chicago gluten meal.

3. *Illinois*.—7½ lbs. clover hay, 7½ lbs. timothy hay, 12 lbs. corn and cob meal, 8 lbs. bran, 1¼ lbs. linseed meal, 1¼ lbs. cotton-seed meal.

4. *New Jersey*.—24 lbs. corn silage, 8 lbs. corn meal, 2 lbs. wheat bran, 4 lbs. oats, 2 lbs. oil meal.

5. *New York*.—20 lbs. hay, 2 lbs. wheat bran, 2 lbs. cotton-seed meal, 2 lbs. hominy meal.

6. *New York*.—12 lbs. timothy hay, 1 lb. wheat bran, 1 lb. middlings, 2 lbs. corn meal, 2 lbs. cotton-seed meal, 40 lbs. skim-milk.

7. *New York*.—42 lbs. corn silage, 2½ lbs. clover hay, 2½ lbs. timothy hay, 8 lbs. corn and cob meal, 14 lbs. dried brewers' grains.

8. *North Carolina*.—30 lbs. corn silage, 8 lbs. fodder corn, 3 lbs. corn meal, 3 lbs. wheat bran, 1 lb. cotton-seed meal.

9. *Pennsylvania*.—24 lbs. corn fodder, 5.1 lb. wheat bran, 5.1 lbs. corn meal, 3 lbs. cotton-seed meal, 2 lbs. oil meal.

10. *Pennsylvania*.—10 lbs. corn fodder, 6 lbs. hay, 3½ lbs. wheat bran, 1½ lbs. cotton-seed meal, 1½ lbs. oil meal, 2½ lbs. corn meal.

11. *Texas*.—30 lbs. corn silage, 13½ lbs. sorghum hay, 1.3 lbs. corn meal, 2.6 lbs. cotton-seed meal, 2.2 lbs. cotton-seed, 1.3 lbs. wheat bran.

12. *Vermont*.—30 lbs. corn silage, 10 lbs. hay, 4.2 lbs. corn meal, 4.2 lbs. wheat bran, .8 lb. linseed meal.

13. *West Virginia*.—48 lbs. corn silage, 2½ lbs. corn and cob meal, 2½ lbs. ground wheat, 2½ lbs. oats, 2½ lbs. barley meal.

* See Woll, "One Hundred American Rations for Dairy Cows," Bulletin No. 38, Wisconsin Agricultural Experiment Station.

14. *Wisconsin*.—26 lbs. corn silage, 10 lbs. clover hay, 5 lbs. timothy hay, 8 lbs. wheat middlings, $1\frac{1}{2}$ lbs. oil meal.

15. *Wisconsin*.—50 lbs. corn silage, 5 lbs. sheaf oats, 5 lbs. corn fodder, 1 lb. clover hay, 1 lb. millet, 2.7 lbs. cotton-seed meal, 1.3 lbs. oil meal, 6 lbs. wheat bran.

16. *Canada*.—40 lbs. corn silage, $7\frac{1}{2}$ lbs. clover hay, 3 lbs. straw, $1\frac{1}{8}$ lbs. oats, $1\frac{1}{8}$ lbs. barley, $1\frac{1}{8}$ lbs. pea meal, 3 lbs. wheat bran, 1 lb. cotton-seed meal.

The preceding rations contain the following approximate amounts of nutrients, calculated for 1000 lbs. live weight :

No.	Organic Matter.	Digestible.				Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	Total.	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	31.09	2.70	15.78	.80	19.28	1 : 6.5
2	25.70	2.69	13.96	.97	17.62	1 : 6.0
3	22.09	2.37	12.06	.75	15.18	1 : 5.8
4	19.41	2.06	11.71	.87	14.64	1 : 6.5
5	26.19	2.36	13.78	.79	16.93	1 : 6.6
6	25.73	3.50	14.05	1.12	18.67	1 : 4.7
7	31.30	3.37	16.31	1.31	20.99	1 : 5.7
8	20.38	1.79	11.98	.80	14.57	1 : 7.7
9	26.52	2.53	15.74	.90	19.17	1 : 7.0
10	20.05	2.31	11.00	.72	14.03	1 : 5.4
11	26.58	2.21	12.31	1.30	15.82	1 : 6.9
12	24.23	1.86	14.03	.75	16.64	1 : 8.4
13	22.37	1.54	14.15	.72	16.41	1 : 10.2
14	31.00	3.01	16.02	.87	19.90	1 : 6.0
15	23.79	2.73	12.46	.99	16.18	1 : 5.4
16	22.96	2.08	12.17	.71	14.96	1 : 6.6

VALUATION OF FEEDING STUFFS.

The commercial value of protein, fat, and carbohydrates in concentrated feeding stuffs has been calculated from the average composition and market price of common feeding stuffs as follows :

— Cost of one pound of —			
	Protein.	Fat.	Carbohydrates.
In Germany.....	3:	2	1 (König, Wolff.)
“ Connecticut (1888)	1.6 cts.	4.2 cts.	.96 cts. (Jenkins.)
“ “ (1890)	1.4	2.9	1.4 “
“ Wisconsin..(1891)	1.5	3.6	.5 (Woll.)
“ Indiana.....(1891)	1.0	2.75	.63 (Huston.)
“ Minnesota..(1893)	3.1	3.1	.24 (Hays.)

MANURIAL VALUE OF FARM PRODUCTS.

(ARMSBY.)

	Pounds per Ton.			Value per Ton.				Manurial Value of \$10 Worth.
	Nitro-gen.	Phos-phoric Acid.	Pot-ash.	Nitro-gen.	Phos-phoric Acid.	Pot-ash.	Total	
Meadow hay....	20.42	8.2	26.4	\$3.47	\$0.57	\$1.06	\$5.10	\$5.10
Clover “.....	40.16	11.2	36.6	6.83	0.78	1.46	9.07	9.07
Potatoes..	7.01	3.2	11.4	1.19	0.22	0.46	1.87	0.12
Wheat bran.....	49.15	28.6	54.6	8.35	2.00	2.10	12.45	7.78
Linseed meal....	105.12	32.2	24.8	17.87	2.25	0.99	21.11	7.54
Cotton-seed meal.	135.65	29.2	56.2	23.06	2.04	2.25	28.35	10.12
Wheat.....	37.53	10.6	15.8	6.38	0.74	0.63	7.75	2.58
Oats.....	36.42	12.4	8.8	6.21	0.87	0.35	7.43	3.86
Corn.....	33.06	11.8	7.4	5.62	0.83	0.30	6.75	3.78
Barley.....	39.65	9.0	15.4	6.74	0.63	0.62	7.99	2.96
Milk.....	10.20	3.4	3.0	1.73	0.24	0.12	2.09	0.88
Cheese.....	90.60	23.0	5.0	15.40	1.61	0.20	17.21	0.69
Live cattle.....	53.20	37.2	3.4	9.04	2.60	0.14	11.78	1.18

AMOUNT, COMPOSITION, AND VALUE OF MANURE PRODUCED BY DIFFERENT KINDS OF FARM ANIMALS.

(Results of experiments conducted at Cornell University Experiment Station.)

	Food.	Analyses and Value per Ton of Manure.					Amount and Value per 1000 lbs. Live Weight per Day.		
		Water.	Nitrogen.	Phos- phoric Acid.	Potash.	Value per ton.*	Pounds per Day.	Value per Day.*	Value per Year.*
		Per ct.	Per ct.	Per ct.	Per ct.				
Sheep.....	Hay, corn and oats; or hay, wheat bran, cotton- seed meal, and linseed meal.....	59.52	.77	9.39	.59	\$3.30	34.1	\$0.072	\$26.09
Calves.....	Skim-milk, corn meal, wheat bran, and hay; or corn meal, linseed meal, wheat bran, and hay.....	77.73	.50	.17	.53	2.18	67.8	.067	24.45
Pigs.....	Skim-milk, corn meal, and meat scraps; or corn meal, wheat bran, and linseed meal.....	74.13	.84	.39	.32	3.29	83.6	.167	60.88
Cows.....	Hay, silage, beets, wheat bran, corn meal, and cot- ton-seed meal.....	75.25	.43	.29	.44	2.02	74.1	.080	29.27
Horses.....	Hay and a mixture of oats, corn meal, and wheat bran.....	48.69	.49	.26	.48	2.21	48.8	.076	27.74

* Valuing nitrogen at 15 cents, phosphoric acid at 6 cents, and potash at 4½ cents per pound.

Name.	Moisture.	Nitrogen.	Potash.	Phosphoric Acid.			Lime.	Magnesia.	Sulphuric Acid.	Chlorin.
				Soluble	Reverted	Total.				
Algæ (<i>Lyngbia majuscula</i>).....	16.26	4.25	.79	.....	.....	.19	2.06	1.18	.....	.....
Ammonite.....	5.88	11.33	.....	.....	.....	3.43	.....	.....	.....	.....
Apatite.....	.....	.....	.....	.....	.....	36.08	.....	.....	.....	.....
Ashes, anthracite coal.	.....	.....	.10	.....	.....	.10	.....	.....	.....	.....
“ bituminous “	.....	.....	.40	.....	.....	.40	.....	.....	.....	.....
“ lime-kiln.	15.45	.....	1.20	.....	.....	1.14	48.50	2.60	.....	.....
“ wood, leached.....	30.22	.....	1.27	.....	.....	1.51	28.68	2.66	.14	.....
“ “ unleached.....	12.50	.....	5.25	.....	.....	1.70	34.00	3.40	.....	.....
Bat guano.....	40.09	8.20	1.31	2.37	1.24	3.80	.....	.....	.....	.....
Bone-ash.....	7.00	.....	.....	.....	.....	35.89	44.89	.....	.....	.....
Bone-black.....	4.60	.....	.....	.....	.....	28.28	.....	.....	.....	.....
“ dissolved.....	.....	.....	.....	15.40	1.30	17.00	.....	.....	.....	.....
Bone meal.	7.50	4.05	.....	.40	7.60	23.25	.....	.....	.....	.....
“ “ dissolved.....	.....	2.60	.....	.....	13.53	17.60	.....	.....	.....	.....
“ “ free from fat.....	.....	6.20	.....	.....	.....	20.10	.....	.....	.....	.....
“ “ from glue factory	.....	1.70	.....	.....	.....	29.90	.....	.....	.....	.....
Carnallite.....	.....	.....	13.60	.....	.....	.....	.....	13.19	.56	41.56
Caribbean guano.....	7.31	.....	.....	.....	.....	26.77	39.95	3.29	2.68	.....
Castor pomace.....	9.50	5.50	1.10	.....	.....	1.75	.....	.....	.....	.....
Cotton-hull ashes.....	7.80	.....	22.75	1.25	6.50	8.85	9.60	10.75	.....	.....
Cotton-seed meal, decort.....	7.75	7.10	1.80	.....	.....	3.10	.....	.....	.....	.....
“ “ undercort.....	.....	4.30	1.50	.....	.....	3.10	.....	.....	.....	.....
Cuba guano.....	24.27	1.67	.....	.....	.....	13.35	.....	.....	.....	.....
Dried blood.....	12.50	10.52	.....	.....	.....	1.91	.....	.....	.....	.....
Dried fish.....	12.75	7.25	.....	.....	.....	8.25	.....	.....	.....	.....
Eel-grass (<i>zostera marina</i>).....	81.19	.35	.32	.55	2.60	.07	.51	.32	.....	.....
Gas lime.....	22.28	.....	.....	.....	.....	.....	43.66	8.30	20.73	.....
Horn and hoof waste.....	10.17	13.25	.....	.....	.....	1.83	.....	.....	.....	.....
Kainit.....	3.20	.....	13.54	.....	.....	.....	1.15	9.80	20.25	33.25
Kelp (<i>laminaria</i>).....	87.75	.20	.24	.....	.....	.06	.40	.20	.....	.....

Name.	Moist- ure.	Nitro- gen.	Potash.	Phosphoric Acid.			Lime.	Mag- nesia.	Sul- phuric Acid.	Chlo- rine.
				Soluble	Reverted	Total.				
Sulphate of potash and magnesia.....	4.75	.....	25.50	.....	.....	.....	2.57	.....	44.25	2.60
Sulphate of potash, high grade.....	2.54	.....	33.40	.....	.....	.....	.....	.....	45.72	.....
Sylvanite.....	7.25	.....	10.65	.....	.....	.....	.....	.....	.....	.....
Tankage.....	10.00	6.70	.....	.30	5.10	11.80	.....	.....	.....	.....
Thomas slag.....	1.45	.....	.....	.00	3.06	23.49	48.66	3.42	.....	.....
Tobacco stalks.....	6.18	3.71	5.02	.....	.....	.65	2.22	.59	.....	.....
" stems.....	10.00	2.35	8.20	.....	.....	.70	4.20	.80	.65	.....
Wool washings.....	.....	.....	3.92	.....	.....	.....	.....	.....	.....	.....
Wool waste.....	15.80	6.50	1.20†	.....	.....	.35	.11	.06	.....	.....
<i>Composition of Farm Manures.</i>										
Barnyard manure, average.....	68.87	.49	.43	.....	.....	.....	.....	.....	.....	.....
Cattle excrement, solid, fresh.....	.....	.20	.10	.....	.....	.17	.....	.....	.....	.....
Cattle urine, fresh.....	.....	.58	.49	.....	.....	.....	.....	.....	.....	.....
Hen manure, fresh.....	60.00	1.10	.56	.....	.....	.85	.....	.....	.....	.....
Horse excrement, solid.....	.....	.44	.35	.....	.....	.17	.....	.....	.....	.....
Horse urine, fresh.....	.....	1.55	1.50	.....	.....	.....	.....	.....	.....	.....
Human excrement, solid.....	77.20	1.00	.25	.....	.....	1.09	.....	.....	.....	.....
Human urine.....	95.90	.60	.20	.....	.....	.17	.....	.....	.....	.....
Pigeon manure, dry.....	10.00	3.20	1.00	.....	.....	1.90	2.10	.80	.60	.50
Poudrette, night soil.....	50.00	.80	.30	.....	.....	1.40	.80	.60	.40	.08
Sheep excrement, solid, fresh.....	.....	.55	.15	.....	.....	.31	.....	.....	.....	.....
Sheep urine, fresh.....	.....	1.95	2.26	.....	.....	.01	.....	.....	.....	.....
Stable manure, mixed.....	73.27	.50	.30	.....	.....	.30	.50	.60	.....	.....
Swine excrement, solid, fresh.....	.....	.60	.13	.....	.....	.41	.....	.....	.....	.....
Swine urine, fresh.....	.....	.43	.83	.....	.....	.07	.....	.....	.....	.....

* 18.5 per cent carbonate.

† Nova Scotia plaster contains 94 per cent pure gypsum and 4 per cent carbonate of lime; Onandaga and Cayuga, 65-75 per cent gypsum and 18-23 per cent carbonate of lime.

‡ Sometimes as high as 5 per cent.

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS, 1894.

	Cents per lb.
Nitrogen—	
in ammonia salts.....	19
in nitrates.....	14½
Organic nitrogen—	
in dry and fine-ground fish, meat, blood, and in high- grade mixed fertilizers.....	18½
in cotton-seed meal, linseed meal, and castor pomace...	15
in fine-ground bone and tankage.....	16½
in fine-ground medium bone and tankage.....	15
in medium bone and tankage.....	12
in coarse bone and tankage.....	7
in hair, horn-shavings, and coarse fish scraps.....	7
Phosphoric acid—	
soluble in water.....	6
soluble in ammonium citrate.....	5½
in fine bone and tankage.....	5½
in fine medium bone and tankage.....	4½
in medium bone and tankage.....	3
in coarse bone and tankage.....	2
in fine-ground fish, cotton-seed meal, linseed meal, castor pomace, and wood ashes.....	5
insoluble (in am. cit.) in mixed fertilizers.....	2
Potash as high-grade sulphate, and in mixtures free from muriate.....	5½
Potash as muriate.....	4½

The manurial constituents contained in feed stuffs are valued as follows:

Organic nitrogen.....	15
Phosphoric acid.....	5
Potash.....	5

CYLINDRICAL SILOS.

Approximate Capacity of Cylindrical Silos for Well
Matured Corn Silage, in Tons. (KING.)

Depth. Feet.	Inside Diameter in Feet.										
	15	16	17	18	19	20	21	22	23	24	25
20.....	58.84	66.95	75.58	84.74	94.41	104.6	115.3	126.6	138.3	150.6	163.4
21.....	62.90	71.56	80.79	90.57	100.9	111.8	123.3	135.3	147.9	161.0	174.7
22.....	67.35	76.52	86.38	96.84	107.9	119.6	131.8	144.7	158.1	172.2	185.8
23.....	71.73	81.61	92.14	103.3	115.1	127.5	140.6	154.3	168.7	183.6	199.3
24.....	76.12	86.61	97.78	109.6	122.1	135.3	149.2	163.7	179.0	194.9	211.5
25.....	80.62	89.64	103.6	116.1	129.3	143.3	158.0	173.4	189.5	206.4	223.9
26.....	85.45	97.23	109.8	123.0	137.1	151.9	167.5	183.8	200.9	218.8	237.4
27.....	90.17	102.6	115.8	129.8	144.7	160.3	176.7	194.0	212.0	230.8	250.5
28.....	94.99	108.1	122.0	136.8	152.4	168.9	186.2	204.3	223.3	243.2	263.9
29.....	99.92	113.7	128.3	143.9	160.3	177.6	195.8	214.9	234.9	255.8	277.6
30.....	105.0	119.4	134.8	151.1	168.4	186.6	205.7	225.8	246.8	268.7	291.6
31.....	109.8	124.9	141.1	158.2	176.2	195.2	215.3	236.3	258.2	281.8	305.1
32. ..	115.1	135.9	147.8	165.7	184.6	204.6	225.5	247.5	270.5	294.6	319.6

Area of Feeding Surface and Inside Diameter of Cylindrical Silo Required to Supply Herds of Different
Sizes. (KING.)

	Feeding Surface.	Inside Diameter.
30 cows.....	150 square feet	14 feet.
40 "	200 " "	16 "
50 "	250 " "	18 "
60 "	300 " "	19.75 "
70 "	350 " "	21.25 "
80 "	400 " "	22.75 "
90 "	450 " "	24 "
100 "	500 " "	25.25 "

PERCENTAGES OF NUTRIENTS (NUTRITIVE INGREDIENTS), WATER, AND REFUSE IN SPECIMENS OF FOOD MATERIALS. (AT WATER.)

Food Materials.	Refuse (Bones, Skin, Shell, etc.).	Edible Portion.					
		Water.	Nutrients.				
			Total.	Protein.	Fat.	Carbo- hydrates.	Mineral Matters.
<i>Animal Foods, as Purchased.</i>							
Beef: Neck.....	20.0	49.6	30.4	15.6	14.0	.....	0.8
Shoulder.....	12.6	55.8	31.6	17.0	13.7	.....	0.9
Chuck rib.....	14.6	49.5	35.9	15.0	20.1	.....	0.8
Rib.....	21.0	38.2	40.8	12.2	27.9	.....	0.7
Sirloin.....	19.5	48.3	32.2	15.0	16.4	.....	0.8
Round steak.....	7.8	60.9	31.3	18.0	12.3	.....	1.0
Side without kidney fat.....	19.2	44.3	36.5	13.9	21.8	.....	0.8
Rump, corned.....	5.0	70.8	24.2	16.7	5.1	.....	2.4
Flank, corned.....	12.1	43.7	44.2	12.4	29.2	.....	2.6
Veal: Shoulder.....	17.9	56.7	25.4	16.6	7.9	.....	0.9
Mutton: Shoulder.....	16.3	49.0	34.7	15.1	18.8	.....	0.8
Leg.....	18.1	50.6	31.3	15.0	15.6	.....	0.7
Loin.....	15.8	41.5	42.7	12.6	29.5	.....	0.6
Side, without kidney fat..	17.3	44.2	38.5	15.0	23.7	.....	0.8
Pork: Shoulder roast, fresh.....	14.6	43.0	42.4	13.6	28.0	.....	0.8
Ham, salted, smoked.....	11.4	36.8	51.8	14.8	34.6	.....	2.4
Chicken.....	38.2	44.6	17.2	15.1	1.2	.....	0.9
Turkey.....	32.4	44.7	22.9	16.1	5.9	.....	0.9
Eggs, in shell.....	13.7	63.1	23.2	12.1	10.2	.....	0.9
Fish, etc.: Flounder, whole.....	66.8	27.2	6.0	5.2	0.3	.....	0.5
Bluefish, dressed.....	48.6	43.0	11.1	9.8	0.6	.....	0.7
Codfish, dressed.....	29.9	58.5	11.6	10.6	0.2	.....	0.8
Shad, whole.....	50.1	35.2	14.7	9.2	4.8	.....	0.7
Mackerel, whole.....	44.8	40.4	15.0	10.0	4.3	.....	0.7
Halibut, dressed.....	17.7	61.9	20.4	15.1	4.4	.....	0.9
Salmon, whole.....	35.3	40.6	24.1	14.3	8.8	.....	1.0
Salt codfish.....	42.1	40.5	17.6	16.0	0.4	.....	1.2
Smoked herring.....	50.9	19.2	29.9	20.2	8.8	.....	0.9
Salt mackerel.....	40.4	28.1	31.5	14.7	15.1	.....	1.7
Canned salmon.....	4.9	59.3	35.8	19.3	15.3	.....	1.2
Lobsters.....	62.1	31.0	6.9	5.5	0.7	0.1	0.6
Oysters.....	82.3	15.4	2.3	1.1	0.2	0.6	0.4
<i>Animal Foods, Edible Portion.</i>							
Beef: Neck.....	.....	62.0	38.0	19.5	17.5	.....	1.0
Shoulder.....	.....	63.9	36.1	19.5	15.6	.....	1.0
Chuck rib.....	.....	58.0	42.0	17.6	23.5	.....	0.9
Rib.....	.....	48.1	51.9	15.4	35.6	.....	0.9
Sirloin.....	.....	60.0	40.0	18.5	20.5	.....	1.0
Round.....	.....	68.2	31.8	20.5	10.1	.....	1.2
Side, without kidney fat.....	.....	54.8	45.2	17.2	27.1	.....	0.9
Rump, corned.....	.....	58.1	41.9	13.3	26.6	.....	2.0
Flank, ".....	.....	40.8	50.2	14.2	33.0	.....	3.0
Veal: Shoulder.....	.....	68.8	31.2	20.2	9.8	.....	1.2
Mutton: Shoulder.....	.....	58.6	41.4	18.1	22.4	.....	0.9
Leg.....	.....	61.8	38.2	18.3	19.0	.....	0.9
Loin.....	.....	49.3	50.7	15.0	35.0	.....	0.7

PERCENTAGES OF NUTRIENTS, ETC., IN FOOD MATERIALS.—*Continued.*

Food Materials.	Edible Portion.					
	Water.	Nutrients.				
		Total.	Protein.	Fat.	Carbo-hydr.	Mineral Matters
<i>Animal Foods, Edible Portion.</i>	%	%	%	%	%	%
Mutton: Side, without kidney fat..	53.5	46.5	16.9	28.7	.....	0.9
Pork: Shoulder roast, fresh.....	50.3	49.7	16.0	32.8	.....	0.9
Ham, salted, smoked.....	41.5	58.5	16.7	39.1	.....	2.7
Fat, salted	12.1	87.9	0.9	82.8	.....	4.2
Sausage: Pork.....	41.2	58.8	13.8	42.8	.....	2.2
Bologna	62.4	37.6	18.8	15.8	.....	3.0
Chicken	72.2	27.8	24.4	2.0	.....	1.4
Turkey...	66.2	33.8	23.9	8.7	.....	1.2
Eggs.....	73.8	26.2	14.9	10.5	.....	0.8
Milk.....	87.0	13.0	3.6	4.0	4.7	0.7
Butter.....	10.5	89.0	1.0	85.0	0.5	3.0
Oleomargarine.....	11.0	89.5	0.6	85.0	0.4	3.0
Cheese: Full-cream.....	30.2	69.8	28.3	35.5	1.8	4.2
Skim-milk.....	41.3	58.7	38.4	6.8	8.9	4.6
Fish: Flounder.....	84.2	15.8	13.8	0.7	.....	1.3
Haddock.....	81.7	18.3	16.8	0.3	.....	1.2
Codfish.....	82.6	17.4	15.8	0.4	.....	1.2
Shad.....	70.6	29.4	18.6	9.5	.....	1.3
Mackerel.....	73.4	26.6	18.2	7.1	.....	1.3
Halibut.....	75.4	24.6	18.3	5.2	.....	1.1
Salmon.....	63.6	36.4	21.6	13.4	.....	1.4
Salt cod.....	53.6	.....	21.4	0.3	.....	1.6
Herring, salt.....	34.6	.....	36.4	15.8	.....	1.5
Mackerel, salt.....	43.4	.....	17.3	26.4	.....	2.6
Oysters	87.1	12.9	6.0	1.2	3.7	2.0
<i>Vegetable Foods.</i>						
Wheat flour.....	12.5	87.5	11.0	1.1	74.9	0.5
Graham flour (wheat).....	13.1	86.9	11.7	1.7	71.7	1.8
Rye flour.....	13.1	86.9	6.7	0.8	78.7	0.7
Buckwheat flour.....	14.6	85.4	6.9	1.4	76.1	1.0
Oatmeal.....	7.6	92.4	15.1	7.1	68.2	2.0
Cornmeal.....	15.0	85.0	9.2	3.8	70.6	1.4
Rice	12.4	87.6	7.4	0.4	79.4	0.4
Peas.....	12.3	87.7	26.7	1.7	56.4	2.9
Beans.....	12.6	87.4	23.1	2.0	59.2	3.1
Potatoes.....	78.9	21.1	2.1	0.1	17.9	1.0
Sweet potatoes.....	71.1	28.9	1.5	0.4	26.0	1.0
Turnips.....	89.4	10.6	1.2	0.2	8.2	1.0
Carrots.....	88.6	11.4	1.1	0.4	8.9	1.0
Onions.....	87.6	12.4	1.4	0.3	10.1	0.6
String beans.....	87.2	12.8	2.2	0.4	9.4	0.8
Green peas.....	78.1	21.9	4.4	0.6	16.0	0.9
Green corn	81.3	18.7	2.8	1.1	13.2	0.6
Tomatoes.....	96.0	4.0	0.8	0.4	2.5	0.3
Cabbage.....	91.9	8.1	2.1	0.3	5.5	1.1
Apples.....	83.2	16.8	0.2	0.4	15.9	0.3
Sugar, granulated.....	2.0	98.0	.....	.....	97.8	0.2
Molasses.....	24.6	75.4	.....	.....	73.1	2.3
White bread (wheat).....	32.3	67.7	8.8	1.7	56.3	0.9
Boston crackers.....	8.3	91.7	10.7	9.9	68.7	2.4

**AMOUNTS OF NUTRIENTS FURNISHED FOR
TWENTY-FIVE CENTS IN FOOD MATERIALS
AT ORDINARY PRICES. (ATWATER.)**

Food Materials as Furnished.	Prices per Pound.	Twenty-five Cents will pay for					
		Total Food Materials.	Nutrients.				Calories of Potential Energy.
			Total.	Protein	Fats.	Carbo- hydr.	
	cts.	lbs.	lbs.	lbs.	lbs.	lbs.	cal.
<i>Meats, etc.</i>							
Beef: Neck.	8	3.13	.95	.49	.44	.....	2765
	6	4.17	1.27	.65	.58	.....	3655
Chuck-ribs.	16	1.56	.56	.23	.31	.....	1735
	12	2.08	.75	.31	.42	.....	2390
Ribs.....	22	1.14	.47	.14	.32	.....	1610
	18	1.39	.57	.17	.39	.....	1960
Shoulder.....	14	1.79	.57	.30	.25	.....	1615
	10	2.50	.79	.43	.34	.....	2235
Sirloin.....	22	1.14	.37	.17	.19	.....	1120
	18	1.39	.45	.21	.23	.....	1360
Rump.....	18	1.39	.63	.19	.43	.....	2170
	15	1.67	.76	.23	.52	.....	2620
Round, first cut.....	18	1.39	.44	.25	.17	.....	1180
	15	1.67	.52	.30	.21	.....	1445
Round, second cut.....	10	2.50	.52	.35	.15	.....	1285
	8	3.13	.65	.44	.18	.....	1580
Flank, corned.....	15	1.67	.77	.21	.49	.....	2460
	10	2.50	1.11	.31	.73	.....	3655
Corned and canned.....	18	1.39	.66	.37	.24	.....	1700
	14	1.79	.85	.48	.31	.....	2200
Liver	8	3.13	.96	.63	.17	.11	2095
Mutton: Shoulder.....	20	1.25	.41	.18	.22	.....	1265
	15	1.67	.58	.25	.31	.....	1775
Leg.....	25	1.00	.31	.15	.16	.....	955
	20	1.25	.39	.19	.20	.....	1195
Loin	25	1.00	.43	.13	.29	.....	1465
	20	1.25	.53	.15	.37	.....	1840
Pork: Rib roast	12	2.08	.88	.28	.58	.....	2970
	16	2.50	1.06	.34	.70	.....	5885
Smoked ham, whole.....	16	1.56	.86	.25	.58	.....	2915
	12	2.08	1.08	.31	.72	.....	3615
Salt fat pork.	15	1.67	1.17	.02	1.38	.....	5860
	12	2.08	1.03	.02	1.72	.....	7295
Pork sausage.....	15	1.67	.98	.13	.72	.....	3465
	12	2.08	1.22	.29	.89	.....	4295
Poultry, etc.: Chicken.....	22	1.14	.32	.28	.02	.....	605
	16	1.56	.45	.38	.03	.....	835
Turkey.....	23	1.09	.37	.26	.09	.....	865
	18	1.38	.47	.32	.12	.....	1100
<i>Fish, etc.</i>							
Mackerel, whole	18	1.39	.22	.14	.06	.....	515
	15	1.67	.25	.17	.07	.....	610
	10	2.50	.37	.25	.11	.....	930
Bluefish, dressed.....	15	1.67	.19	.16	.01	.....	340
	10	2.50	.28	.25	.02	.....	550
	10	2.50	.28	.25	.01	.....	505
Cod, dressed.....	8	3.13	.36	.33	.01	.....	655
	6	4.17	.48	.44	.01	.....	860

STEAM BOILER AND ENGINE MANAGEMENT.

By Prof. A. W. RICHTER, of the University of Wisconsin.

Boiler.

Feed Apparatus.—Every boiler should be provided with a check-valve, placed between the feed apparatus and boiler, and in such a manner as to have the weight of the valve assist in closing it. Between this check-valve and boiler there should be an additional globe or gate-valve which may be closed, thus permitting repairing or cleaning of the check-valve while the boiler is in operation.

Water Supply.—Feed-water should enter a boiler in such a manner that the plates do not receive the direct impact of cold water. The usual practice is to have the feed enter through the blow-off pipe, thus preventing this pipe from clogging. The feed supply should be regulated so as to keep the water level as stationary as possible. The greatest care must be taken that the water level does not fall below the top of the flues. Neglect in this direction will cause the metal to become overheated and consequently weakened, causing leakage of joints and increased wear and tear, but more often resulting in an explosion of a more or less serious nature.

Water-glass and Water-gauges.—Every boiler should have three water-gauges in addition to a water-glass; these are usually attached to a hollow cast-iron cylinder or tube connected with the water and steam spaces.

The water-glass should be blown out daily, and, if clogged, can be safely cleaned with a bent wire.

In no case should the water glass alone be depended upon to indicate the water level.

Steam-gauge.—Each boiler should be provided with a steam-gauge, which gauge should be directly connected with it.

Safety-valve.—Every boiler should be provided with a safety-valve having direct communication with the steam space, and moreover should there be an intervening valve. Some of the most disastrous explosions can be traced to faulty arrangement in this respect. The valve thoughtlessly left closed after cleaning or repairs prevents the safety-valve from relieving the pressure when it rises above the safe working pressure of the boiler.

Safety-valves are of two kinds: spring and lever safety-valves. Of the two valves the lever-valve has the most disadvantages, one of the most important being the ease with which it may be made useless by adding an additional weight to that already provided, in order to keep the valve on its seat, and therefore greatly increasing the pressure at which it will blow off.

A safety-valve should be raised each day by hand so as to allow steam to escape; this prevents clogging and rusting.

The dealer will usually set the spring-valve so that it will blow off at the desired pressure. It can be adjusted, however, by loosening or tightening a screw provided for that purpose.

The lever-valve may be set with the aid of the following formula:

$$l = \frac{bPA - Vb - wc}{W};$$

l = distance from weight to fulcrum;

b = " " valve centre to fulcrum;

c = distance from the centre of gravity of the lever of the fulcrum;

P = boiler pressure;

A = area of valve;

V = weight of valve;

w = " " lever,

W = weight hung upon the lever.

Firing.—Firing should be gradual, and the grate kept completely covered with coal or ashes. The fire should not be more than four or five inches deep unless the pieces of coal are large, in which case the depth may be increased.

The fire-doors and flue-doors should not be opened in order to keep down the steam pressure. This practice not only wastes fuel but is injurious to the boiler, and will not be necessary if the boiler is properly attended to.

Priming or Foaming.—Foaming is a rapid disturbance of the water, in consequence of which it rises in the boiler in the form of spray or foam; it is usually caused by dirty water, presence of oil, etc., the boiler not having been cleaned for some time or not thoroughly cleaned. Foaming may, however, be due to other causes, such as too small a steam space, sudden demand

of a great quantity of steam, etc. In case a boiler foams all steam connections should be shut off and the fire dampened by means of a fresh supply of live coal or ashes. These precautions will usually suffice to allow the water to settle, and to enable one to ascertain the true water level. If the glass shows a small amount of water, start the pump or injector, and fill the boiler to a point between the second and third gauge. The boiler may then be blown off to the first gauge by means of the surface blow-off, if one be present, and if not present the regular blow-off valve may be used. This operation being repeated, the impurities are gradually diminished, but care must be taken that the water level does not fall below the top of the flues. The boiler can now be used as before, but in all cases it should be thoroughly cleaned as soon as possible.

Removal of Scale.—Potatoes, about eight or ten in number, are sometimes placed in the boiler after cleaning. Soda or kerosene may also be injected with the feed-water in quantity to be determined by observation. Boiler compounds should be used with caution, and when used should be obtained from a reliable dealer. Too great a quantity of any of the above will be harmful.

Cleaning.—The interval during which a boiler requires no cleaning depends upon the quantity and the quality of water evaporated. Under usual conditions, in order to obtain the best results, a boiler should be cleaned every six or eight weeks.

If a boiler is to be cleaned it should be allowed to stand until it is partially cooled off. When blown out cold the metal in the interior will usually be found covered with a thick coating of soft deposit, which can easily be scraped off or washed off with a hose and stream of water.

If a boiler be blown off while the metal is at a high temperature, the deposited matter is usually baked and forms a solid and hard coating, increasing rapidly if not carefully removed by the process of chipping.

Boiler Power.—The manner in which the horse-power of a boiler is usually calculated is far from satisfactory, depending rather upon its size than its power of evaporation.

! In 1884 the American Society of Mechanical Engineers adopted the following definite standard;

"A horse-power shall be equivalent to an evaporation of thirty pounds of water into dry steam per hour from feed-water at 100° Fahrenheit, and under a pressure of 70 lbs. per square inch above the atmosphere."

Steam-engine.—The engine should be provided with a governor to regulate its speed, a lubricator to oil valve and piston, and a sufficient number of oil cups, so that all bearings may be properly oiled.

Starting the Engine.—Before starting, all bearings should be supplied with oil, and all waste pipes connected with cylinder and steam-chest opened. The engine should then be started slowly, so as to allow the water to escape. A quantity of steam will always condense as it comes in contact with the cold cylinder-walls, in addition to the water already present in the steam-pipe. This water does not pass off as readily as steam, neither can it be compressed to any great extent. Therefore, if more water be present in the cylinder than will fill the clearance space, and this water not be allowed to escape, the piston moving towards the end of its stroke will strike the water, and consequently be compelled to stop. The greater the speed of the piston as it advances, the greater the force with which it strikes the water, resulting in many cases in a broken cylinder-head.

It is well to have a waste-pipe connected to the steam-pipe at a point just above the engine-valve, in order that the water which has collected in the steam pipe may be blown out before opening the steam-valve.

After the engine has been in operation for a minute or two the waste-valves should be closed.

Horse-power.—The horse-power of an engine may be calculated by means of the following formula:

$$\text{H. P.} = \frac{P L a n}{33000};$$

H. P. = horse power;

P = mean effective pressure in the cylinder;

L = twice the length of the stroke, in feet;

a = area of piston in square inches;

n = number of revolutions per minute.

VI. GENERAL TABLES.

WEIGHTS AND MEASURES.

I. Weights.

A. AVOIRDUPOIS WEIGHT.

1 ton = 20 hundred weight (cwt.)	= 2240 pounds (lbs.);
1 cwt.	= 112 pounds.
1 lb. = 16 ounces (oz.)	= 256 drams = 768 scruples = 7680 grains;
1 oz.	= 16 drams = 48 scruples = 480 grains;
	1 dram = 3 scruples = 30 grains;
	1 scruple = 10 grains.

B. APOTHECARIES' WEIGHT, FOR DRUGS.

1 lb. = 12 oz.	= 96 drams = 288 scruples = 5760 grains;
1 oz.	= 8 drams = 24 scruples = 480 grains;
	1 dram = 3 scruples = 60 grains;
	1 scruple = 20 grains.

C. TROY WEIGHT, FOR JEWELS AND PRECIOUS METALS.

1 lb. = 12 oz.	= 24 carats = 240 pennyweight (dwt.) = 5760 grains;
1 oz.	= 2 carats = 20 dwts. = 480 grains;
	1 carat = 10 dwts. = 240 grains;
	1 dwt. = 24 grains.

II. Measures.

A. LINEAR.

1 mile = 8 furlongs (frlgs.)	= 80 chains = 320 rods = 5280 feet;
1 frlg.	= 10 chains = 40 rods = 660 feet;
	1 chain = 4 rods = 66 feet;
	1 rod = 16½ feet;
	1 chain = 100 links;
	1 link = 7.92 inches;
1 yard = 3 feet	= 36 inches;
1 foot	= 12 inches.

B. SURFACE.

1 square mile	= 640 acres;
	1 acre = 10 square chains = 160 sq. rods = 4840 sq. yds.
	= 43,560 square feet.

C. CAPACITY.

1. DRY MEASURE.

1 bushel = the volume of 77.627 lbs. of distilled water at 4°C.;	
1 bushel = 4 pecks = 8 gallons = 32 quarts = 2150.4 cubic inches;	
1 peck = 2 gallons = 8 quarts = 537.6	" "
1 gallon = 4 quarts = 268.8	" "
1 quart = 67.2	" "

2. LIQUID MEASURE.

1 gallon = the volume of 8.3388822 lbs. = 58,373 troy grains of distilled water at 4° C.;	
1 gallon = 4 quarts = 8 pints = 32 gills = 231 cubic inches;	
1 quart = 2 pints = 8 gills = 57.75	" "
1 pint = 4 gills = 28.88	" "

Metric System.

1 meter (m) = 10 decimeters (dm) = 100 centimeters (cm) = 1000 millimeters (mm) = 0.1 dekameters (Dm) = 0.01 Hektometer (Hm) = 0.001 Kilometer (Km) = 0.0001 Myriameter (Mm).

1 Mm = 10 Km = 100 Hm = 1000 Dm = 10,000 m;

1 Km = 10 Hm = 100 Dm = 1,000 m;

1 Hm = 10 Dm = 100 m;

1 Dm = 10 m;

1 m = 10 dm = 100 cm = 1000 mm;

1 dm = 10 cm = 100 mm;

1 cm = 10 mm.

2. SURFACE MEASURES.

1 Ar (a) = 100 square meters (sq. m) = 0.01 hektar (ha);

1 Ar = 1 sq. Dm = 100 square m;

1 sq. Km = 100 Ha = 10,000 A = 1,000,000 sq. m;

1 Ha = 100 A = 10,000 sq. m;

1 A = 100 sq. m.

3. MEASURES OF CAPACITY.

1 liter (l) = 1 cubic decimeter (cbdm) = 1,000 cubic centimeters (cbcm) = 0.001 cubic meter (cbm) = 10 deciliters (dl) = 100 centiliters (cl) = 0.01 hektoliter (hl).

1 Hl = 10 Dl = 100 l = 1,000 dl = 10,000 cl;

1 Dl = 10 l = 100 dl = 1,000 cl;

1 l = 10 dl = 100 cl.

4. WEIGHTS.

1 kilogram (kg) = 100 dekagrams (Dg) = 1000 grams (g);

1 gram = 10 decigrams (dg) = 100 centigrams (cg) = 1,000 milligrams (mg);

1 ton = 1000 Kg = 100,000 Dg = 1,000,000 g;

100 Kg = 10,000 Dg = 1,000,000 g;

1 Kg = 100 Dg = 1,000 g.

Conversion of U. S. Weights and Measures to Metric, and vice versa.

LINEAR.

Inches to Millimeters.	Feet to Meters.	Yards to Meters.	Miles to Kilometers.
I = 25.4001	.3048	.9144	1.6094
Meter to Inches.	Meter to Feet.	Meter to Yards.	Kilometer to Miles.
I = 39.3700	3.2808	1.0936	0.6214

SQUARE.

Sq. Inches to Sq. Centmr.	Sq. Feet to Sq. Decimeters.	Square Yards to Square Meters.	Acres to Hektares.
I = 6.452	9.290	0.836	0.4047
Sq. Centime. to sq. in.	Sq. Meters to Sq. Feet.	Square Meters to Square Yards.	Hektares to Acres.
I = 0.1550	10.764	1.196	2.471

CUBIC.

Cubic In. to Cu. Centmr.	Cubic Feet to Cubic Meters.	Cubic Yards to Cubic Meters.	Bushels to Hektoliters.
I = 16.387	0.0283	0.765	0.3524
Cu. Centmrs to Cubic In.	Cu. Decimeters to Cubic Inches.	Cubic Meters to Cubic Feet.	Cubic Meters to Cubic Yards.
I = 0.0610	61.023	35.314	1.308

CAPACITY.

Fluid Drams to Cu. Centi- meters.	Fluid Ounces to Millimeters.	Quarts to Liters.	Gallons to Liters.
I = 3.70	29.57	0.9464	3.7854
Cu. Centi- meters to Fluid Drams.	Centiliters to Fluid Ounces.	Liters to Quarts.	Decaliters to Gallons.
I = 0.27	0.338	1.0567	2.6417
			Hectoliters to Bushels.
			2.8377

WEIGHT.

Grains to Milligrams.	Avoirdupois Ounces to Grams.	Avoirdupois Pounds to Kilo- Grams.	Troy Ounces to Grams.
I = 64.7989	28.3495	0.4536	31.1035
Milligrams to Grains.	Kilograms to Grains.	Hectograms to Ounces Av.	Kilograms to Pounds Av.
I = 0.01543	15432.36	3.5274	2.2046
Quintals to Pounds Av.	Milliers or Tonnes to Pounds Av.		Kilograms to Ounces Troy.
I = 220.46	2204.6		32.1507

TABLE FOR CONVERTING QUARTS OF MILK
INTO POUNDS.

Qts.	Lbs.	Qts.	Lbs.	Qts.	Lbs.	Qts.	Lbs.
1	2.15	29	62.3	57	122.4	85	182.5
2	4.3	30	64.4	58	124.5	86	184.6
3	6.4	31	66.5	59	126.6	87	186.8
4	8.6	32	68.7	60	128.8	88	188.9
5	10.7	33	70.8	61	130.9	89	191.0
6	12.9	34	73.0	62	133.1	90	193.2
7	15.0	35	75.1	63	135.2	91	195.3
8	17.2	36	77.3	64	137.4	92	197.5
9	19.3	37	79.4	65	139.5	93	199.6
10	21.5	38	81.6	66	141.7	94	201.8
11	23.6	39	83.7	67	143.8	95	203.9
12	25.8	40	85.9	68	146.0	96	206.1
13	27.9	41	88.0	69	148.1	97	208.2
14	30.1	42	90.2	70	150.3	98	210.4
15	32.2	43	92.3	71	152.4	99	212.5
16	34.3	44	94.5	72	154.6	100	214.7
17	36.5	45	96.6	73	156.7	200	429.3
18	38.6	46	98.7	74	158.8	300	644.0
19	40.8	47	100.9	75	161.0	400	858.6
20	42.9	48	103.0	76	163.1	500	1073.3
21	45.1	49	105.2	77	165.3	600	1288.0
22	47.2	50	107.3	78	167.4	700	1502.6
23	49.4	51	109.5	79	169.6	800	1717.3
24	51.5	52	111.6	80	171.7	900	1931.9
25	53.7	53	113.8	81	173.9	1000	2146.6
26	55.8	54	115.9	82	176.0		
27	58.0	55	118.1	83	178.2		
28	60.1	56	120.2	84	180.3		

TABLE FOR CONVERTING POUNDS OF MILK
INTO QUARTS.

Lbs.	Qts.	Lbs.	Qts.	Lbs.	Qts.	Lbs.	Qts.
1	.47	29	13.5	57	26.6	85	39.6
2	.93	30	14.0	58	27.0	86	40.1
3	1.40	31	14.4	59	27.5	87	40.5
4	1.86	32	14.9	60	28.0	88	41.0
5	2.33	33	15.4	61	28.4	89	41.5
6	2.80	34	15.8	62	28.9	90	41.9
7	3.26	35	16.3	63	29.4	91	42.4
8	3.73	36	16.8	64	29.8	92	42.9
9	4.19	37	17.2	65	30.3	93	43.3
10	4.66	38	17.7	66	30.8	94	43.8
11	5.13	39	18.2	67	31.2	95	44.3
12	5.59	40	18.6	68	31.7	96	44.7
13	6.06	41	19.1	69	32.2	97	45.2
14	6.52	42	19.6	70	32.6	98	45.7
15	6.99	43	20.0	71	33.1	99	46.1
16	7.46	44	20.5	72	33.6	100	46.6
17	7.92	45	21.0	73	34.0	200	93.2
18	8.39	46	21.4	74	34.5	300	139.8
19	8.85	47	21.9	75	35.0	400	186.4
20	9.32	48	22.4	76	35.4	500	233.0
21	9.79	49	22.8	77	35.9	600	279.6
22	10.3	50	23.3	78	36.3	700	326.2
23	10.7	51	23.8	79	36.8	800	372.8
24	11.2	52	24.2	80	37.3	900	419.4
25	11.7	53	24.7	81	37.7	1000	466.0
26	12.1	54	25.2	82	38.2		
27	12.6	55	25.6	83	38.7		
28	13.1	56	26.1	84	39.1		

KILOGRAMS CONVERTED INTO POUNDS AVOIRDUPOIS.

Kilos.	0	1	2	3	4	5	6	7	8	9
0.0	0.000	0.022	0.044	0.066	0.088	0.110	0.132	0.154	0.176	0.194
.1	0.220	0.243	0.265	0.287	0.309	0.331	0.353	0.375	0.397	0.419
.2	0.441	0.463	0.485	0.507	0.529	0.551	0.573	0.595	0.617	0.639
.3	0.661	0.683	0.705	0.728	0.750	0.772	0.794	0.816	0.838	0.860
.4	0.882	0.904	0.926	0.948	0.970	0.992	1.014	1.036	1.058	1.080
.5	1.102	1.124	1.146	1.168	1.190	1.213	1.235	1.257	1.279	1.301
.6	1.323	1.345	1.367	1.389	1.411	1.433	1.455	1.477	1.499	1.521
.7	1.543	1.565	1.587	1.609	1.631	1.653	1.676	1.698	1.720	1.742
.8	1.764	1.786	1.808	1.830	1.852	1.874	1.896	1.918	1.940	1.962
.9	1.984	2.006	2.028	2.050	2.072	2.094	2.116	2.138	2.161	2.183

POUNDS CONVERTED INTO KILOGRAMS.

Pounds.	0	1	2	3	4	5	6	7	8	9
0.0	.000	.005	.009	.014	.018	.023	.027	.032	.036	.041
.1	.045	.050	.054	.059	.064	.068	.073	.077	.082	.086
.2	.091	.095	.100	.104	.109	.113	.118	.122	.127	.132
.3	.136	.141	.145	.150	.154	.159	.163	.168	.172	.177
.4	.181	.186	.191	.195	.200	.204	.209	.213	.218	.222
.5	.227	.231	.236	.240	.245	.249	.254	.259	.263	.268
.6	.272	.277	.281	.286	.290	.295	.299	.304	.308	.313
.7	.318	.322	.327	.331	.336	.340	.345	.349	.354	.358
.8	.363	.367	.371	.376	.381	.386	.390	.395	.399	.404
.9	.408	.413	.417	.422	.426	.431	.435	.440	.445	.449

INCHES REDUCED TO DECIMALS OF A FOOT. (TRAUTWINE.)

Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.	Ins.	Foot.
$\frac{1}{32}$	.0026	1	.0833	2	.1667	6	.5000	10	.8333
$\frac{1}{16}$	.0052	$1\frac{1}{8}$	.0938	$2\frac{1}{2}$	.2083	$6\frac{1}{2}$	.5417	$10\frac{1}{2}$	.8750
$\frac{1}{8}$	.0104	$1\frac{1}{4}$	.1042	3	.2500	7	.5833	11	.9167
$\frac{1}{4}$	.0208	$1\frac{3}{8}$	.1146	$3\frac{1}{2}$	.2917	$7\frac{1}{2}$	.6250	$11\frac{1}{2}$	.9583
$\frac{3}{8}$	.0313	$1\frac{1}{2}$	.1250	4	.3333	8	.6667	12	1.000
$\frac{1}{2}$	.0417	$1\frac{5}{8}$	.1354	$4\frac{1}{2}$	.3750	$8\frac{1}{2}$	.7083		
$\frac{5}{8}$	.0521	$1\frac{3}{4}$	.1458	5	.4167	9	.7500		
$\frac{3}{4}$	.0625	$1\frac{7}{8}$	.1563	$5\frac{1}{2}$	.4583	$9\frac{1}{2}$	.7917		
$\frac{7}{8}$	.0729								

OUNCES REDUCED TO DECIMALS OF A POUND.

1 oz.	=	.06 lb.
2 "	=	.13 "
3 "	=	.19 "
4 "	=	.25 "
5 "	=	.31 "
6 "	=	.38 "
7 "	=	.43 "
8 "	=	.50 "

9 oz.	=	.56 lb.
10 "	=	.63 "
11 "	=	.69 "
12 "	=	.75 "
13 "	=	.81 "
14 "	=	.88 "
15 "	=	.94 "
16 "	=	1 "

LEGAL WEIGHTS OF GRAIN, SEEDS, Etc.

The table shows the number of pounds per bushel required, by law or custom, in the sale of articles specified, in the several States of the Union.

States.	Barley.	Buckwheat.	Coal.	Corn, Shelled.	Corn Meal.	Onions.	Oats.	Potatoes.	Rye.	Wheat.	Salt.	Turnips.	Beans, White.	Clover-seed.	Timothy.
Maine	48	48	...	56	50	52	32	60	...	60	...	50	60	...	...
New Hampshire	...	...	...	56	50	...	32	60	56	60	...	...	62	...	...
Vermont	48	48	...	...	...	...	32	60	56	60	70	...	62	60	45
Massachusetts	48	48	...	56	50	52	32	60	56	60	...	...	...	...	45
Connecticut	...	48	...	56	...	...	32	60	56	60	...	...	...	...	...
New York	48	48	...	58	...	...	32	60	56	60	...	...	62	60	44
New Jersey	48	50	...	56	...	...	30	60	56	60	...	...	...	64	...
Pennsylvania	47	48	...	56	...	...	32	56	56	60	85	...	...	62	...
Delaware	...	...	...	56	...	...	...	...	...	60	...	...	...	...	...
Maryland	48	48	...	56	...	57	32	60	56	60	56	...	62	64	45
District of Columbia	47	48	...	56	48	57	32	56	56	60	50	55	62	60	45
Virginia	48	48	...	56	50	...	32	60	56	60	...	56	60	64	45
West Virginia	48	52	80	56	48	...	32	60	56	60	...	60	60	60	45
North Carolina	48	50	...	54	46	...	30	...	56	60	...	...	...	64	...
South Carolina	48	56	80	56	50	57	33	60	56	60	50	...	60	60	...
Georgia	40	...	80	56	48	57	35	56	...	60	56	...	...	60	45
Louisiana	32	...	...	56	...	...	32	...	...	60	...	...	...	...	...
Arkansas	48	52	80	56	50	57	32	60	56	60	50	...	60	60	45
Tennessee	48	50	...	56	50	56	32	60	56	60	...	...	60	...	45
Kentucky	48	52	...	56	50	57	33	56	56	60	50	...	60	60	45
Ohio	48	50	...	56	...	...	32	60	56	60	...	...	60	60	45
Michigan	48	48	80	56	...	54	32	60	56	60	56	58	60	60	45
Indiana	48	50	70	56	50	48	32	60	56	60	50	...	60	60	...
Illinois	48	52	...	56	48	57	32	60	56	60	50	...	60	60	...
Wisconsin	48	50	...	56	...	57	32	60	56	60	...	...	...	60	...
Minnesota	48	42	...	56	...	...	32	60	56	60	...	...	...	60	...
Iowa	48	52	...	56	...	57	33	60	56	60	50	...	60	60	45
Missouri	48	52	...	56	...	57	32	60	56	60	50	...	60	60	45
Kansas	50	50	...	56	50	57	32	60	56	60	50	55	60	...	45
Nebraska	48	52	...	56	50	57	34	60	56	60	50	55	60	60	45
California	50	40	...	56	...	...	32	...	54	60	...	...	...	...	...
Oregon	46	42	...	56	...	...	36	60	56	60	...	...	...	60	...

COMPARISONS OF FAHRENHEIT, CENTIGRADE (CELSIUS), AND REAUMUR THERMOMETER SCALES.

Fahren- heit.	Centi- grade.	Réaumur.	Fahren- heit.	Centi- grade.	Réaumur.
+212	+100	+80	+158	+70	+56
211	99.44	79.56	157	69.44	55.56
210	98.89	79.11	156	68.89	55.11
209	98.33	78.67	155	68.33	54.67
208	97.78	78.22	154	67.78	54.22
207	97.22	77.78	153	67.22	53.78
206	96.67	77.33	152	66.67	53.33
205	96.11	76.89	151	66.11	52.89
204	95.55	76.44	150	65.55	52.44
203	95	76	149	65	52
202	94.44	75.56	148	64.44	51.56
201	93.89	75.11	147	63.89	51.11
200	93.33	74.67	146	63.33	50.67
199	92.78	74.22	145	62.78	50.22
198	92.22	73.78	144	62.22	49.78
197	91.67	73.33	143	61.67	49.33
196	91.11	72.89	142	61.11	48.89
195	90.55	72.44	141	60.55	48.44
194	90	72	140	60	48
193	89.44	71.56	139	59.44	47.56
192	88.89	71.11	138	58.89	47.11
191	88.33	70.67	137	58.33	46.67
190	87.78	70.22	136	57.78	46.22
189	87.22	69.78	135	57.22	45.78
188	86.67	69.33	134	56.67	45.33
187	86.11	68.89	133	56.11	44.89
186	85.55	68.44	132	55.55	44.44
185	85	68	131	55	44
184	84.44	67.56	130	54.44	43.56
183	83.89	67.11	129	53.89	43.11
182	83.33	66.67	128	53.33	42.67
181	82.78	66.22	127	52.78	42.22
180	82.22	65.78	126	52.22	41.78
179	81.67	65.33	125	51.67	41.33
178	81.11	64.89	124	51.11	40.89
177	80.55	64.44	123	50.55	40.44
176	80	64	122	50	40
175	79.44	63.56	121	49.44	39.56
174	78.89	63.11	120	48.89	39.11
173	78.33	62.67	119	48.33	38.67
172	77.78	62.22	118	47.78	38.22
171	77.22	61.78	117	47.22	37.78
170	76.67	61.33	116	46.67	37.33
169	76.11	60.89	115	46.11	36.89
168	75.55	60.44	114	45.55	36.44
167	75	60	113	45	36
166	74.44	59.56	112	44.44	35.56
165	73.89	59.11	111	43.89	35.11
164	72.33	58.67	110	43.33	34.67
163	72.78	58.22	109	42.78	34.22
162	71.22	57.78	108	42.22	33.78
161	71.67	57.33	107	41.67	33.33
160	71.11	56.89	106	41.11	32.89
159	70.55	56.44	105	40.55	32.44

COMPARISONS OF FAHRENHEIT, CENTIGRADE (CELSIUS), AND REAUMUR THERMOMETER SCALES.

Fahren- heit.	Centi- grade.	Réaumur.	Fahren- heit.	Centi- grade.	Réaumur.
+104	+40	+32	+50	+10	+8
103	39.44	31.56	49	9.44	7.56
102	38.89	31.11	48	8.89	7.11
101	38.33	30.67	47	8.33	6.67
100	37.78	30.22	46	7.78	6.22
99	37.22	29.78	45	7.22	5.78
98	36.67	29.33	44	6.67	5.33
97	36.11	28.89	43	6.11	4.89
96	35.55	28.44	42	5.55	4.44
95	35	28	41	5	4
94	34.44	27.56	40	4.44	3.56
93	33.89	27.11	39	3.89	3.11
92	33.33	26.67	38	3.33	2.67
91	32.78	26.22	37	2.78	2.22
90	32.22	25.78	36	2.22	1.78
89	31.67	25.33	35	1.67	1.33
88	31.11	24.89	34	1.11	0.89
87	30.55	24.44	33	0.55	0.44
86	30	24	32	0	0
85	29.44	23.56	31	-0.55	-0.44
84	28.89	23.11	30	1.11	0.89
83	28.33	22.67	29	1.67	1.33
82	27.78	22.22	28	2.22	1.78
81	27.22	21.78	27	2.78	2.22
80	26.67	21.33	26	3.33	2.67
79	26.11	20.89	25	3.89	3.11
78	25.55	20.44	24	4.44	3.56
77	25	20	23	5	4
76	24.44	19.56	22	5.55	4.44
75	23.89	19.11	21	6.11	4.89
74	23.33	18.67	20	6.67	5.33
73	22.78	18.22	19	7.22	5.78
72	22.22	17.78	18	7.78	6.22
71	21.67	17.33	17	8.33	6.67
70	21.11	16.89	16	8.89	7.11
69	20.55	16.44	15	9.44	7.56
68	20	16	14	10	8
67	19.44	15.56	13	10.55	8.44
66	18.89	15.11	12	11.11	8.89
65	18.33	14.67	11	11.67	9.33
64	17.78	14.22	10	12.22	9.78
63	17.22	13.78	9	12.78	10.22
62	16.67	13.33	8	13.33	10.67
61	16.11	12.89	7	13.89	11.11
60	15.55	12.44	6	14.44	11.56
59	15	12	5	15.00	12
58	14.44	11.56	4	15.55	12.44
57	13.89	11.11	3	16.11	12.89
56	13.33	10.67	2	16.67	13.33
55	12.78	10.22	1	17.22	13.78
54	12.22	9.78	0	17.78	14.22
53	11.67	9.33	-1	18.33	14.67
52	11.11	8.89	2	18.89	15.11
51	10.55	8.44	3	19.44	15.56

COMPARISONS OF FAHRENHEIT, CENTIGRADE (CELSIUS), AND REAUMUR THERMOMETER SCALES.

Fahren- heit.	Centi- grade.	Réaumur.	Fahren- heit.	Centi- grade.	Réaumur.
-4	-20	-16	-23	-30.55	-24.44
5	20.55	16.44	24	31.11	24.89
6	21.11	16.89	25	31.67	25.33
7	21.67	17.33	26	32.22	25.78
8	22.22	17.78	27	32.78	26.22
9	22.78	18.22	28	33.33	26.67
10	23.33	18.67	29	33.89	27.11
11	23.89	19.11	30	34.44	27.56
12	24.44	19.56	31	35	28
13	25	20	32	35.55	28.44
14	25.55	20.44	33	36.11	28.89
15	26.11	20.89	34	36.67	29.33
16	26.67	21.33	35	37.22	29.78
17	27.22	21.78	36	37.78	30.22
18	27.78	22.22	37	38.33	30.67
19	28.33	22.67	38	38.89	31.11
20	28.89	23.11	39	39.44	31.56
21	29.44	23.56	40	40	32.00
22	30	24			

Formula for Converting Degrees Centigrade to Fahrenheit, and vice versa :

$$n^{\circ} \text{ C.} = \left(\frac{9n^{\circ}}{5} + 32 \right)^{\circ} \text{ F.};$$

$$n^{\circ} \text{ F.} = \left(\frac{5(n^{\circ} - 32)}{9} \right) \text{ C.}$$

For Degrees Réaumur, substitute 4 for 5 in the preceding formulas.

SPECIFIC GRAVITY OF VARIOUS SUBSTANCES.

(TRAUTWINE.)

	Average Specific Gravity.	Average Weight of 1 cu. foot, in Pounds.
Aluminum.....	2.6	162.
Anthracite, 1.3-1.84, usually.....	1.5	93.5
" broken, of any size, loose.....		52-56
(A ton, loose, averages from 40 to 43 cubic feet.)		
Ash, American white, dry.....	.61	38.
" " perfectly dry.....	.752	47.
Asphaltum, 1-1.8.....	1.4	83.3
Boxwood, dry.....	.96	60.
Brass (copper and zinc) cast, 7.8-8.4.....	8.1	504.
Bronze (copper 8 parts, tin 1 part, gun metal), 8.4-8.6.....	8.5	529.
Cement, English Portland.....		81-102
Charcoal, of pines and oaks.....		15-30
Cherry, perfectly dry.....	.672	42.
Chestnut, perfectly dry.....	.66	41.
Coal, bituminous 1.2-1.5.....	1.35	84.
broken, of any size, loose.....		47-52
(A ton occupies from 43 to 48 cubic feet.)		
Copper, cast, 8.6-8.8.....	8.7	542.
Cork.....	.25	15.6
Coke, loose, of good coal.....		23-32
(A ton occupies 80 to 97 cubic feet.)		
Elm, perfectly dry.....	.56	35.
Fat.....	.93	58.
Glass, 2.5-3.45.....		
Gold, cast, pure.....	19.258	1204.
Gravel, about the same as sand, which see.		
Hemlock, perfectly dry.....	.4	25.
Hickory, perfectly dry.....	.85	53.
Ice, .917-.922.....	.92	574.
India rubber.....	.93	58.
Iron, cast, 6.9-7.4.....	7.15	446.
Lard.....	.95	59.3
Lead, 11.38-11.47.....	11.38	709.6
Lime, quick.....	1.5	95.
" " ground loose, per struck bu. 62-72 lbs..		
Limestone and marbles.....	2.6	164.4
Mahogany, Spanish, dry.....	.85	53.
Maple, dry.....	.79	49.
Mercury, at 60° F.....	13.58	846.
Oak, white, perfectly dry, .66-.88.....	.77	48.

SPECIFIC GRAVITY OF VARIOUS SUBSTANCES.—

Continued.

	Average Specific Gravity.	Average Weight of 1 cu. foot, in Pounds.
Oak, red, black, etc.....		32-45
“ live, .88-1.02.....	.95	59.3
Oils, olive, whale.....	.92	57.3
Peat.....		20-30
Petroleum	.878	54.8
Pine, white, perfectly dry, .35-.45.....	.40	25.
“ yellow, Northern, .48 to .62.....	.55	34.3
“ “ Southern, .64-.80.....	.72	45.
Platinum, 21-22.....	21.5	1342.
Quartz, common, pure, 2.64-2.67.	2.65	165
Rosin.....	1.1	68.6
Salt, coarse, per struck bu., Syracuse, N.Y., 56 lbs.		45.
Sand of pure quartz, dry and loose, per struck bu. 112-133 lbs... ..		90-106
Sand of pure quartz, wet.....		118-129
Silver.....	10.5	655.
Snow, fresh fallen.....		5-12
“ moistened and compacted by rain.....		15-20
Soils, common loam, perfectly dry, loose.....		72-80
Soils, common loam, perfectly dry, moderately rammed		90-100
Soils, common loam, slightly moist, loose.....		70-76
“ “ “ as a soft, flowing mud.....		104-112
Spruce, perfectly dry.....	.4	25.
Sulphur.....	2.0	125.
Steel, 7.7-7.9.....	7.85	490.
Sycamore, perfectly dry.....	.59	37.
Tar.....	1.0	62.4
Tin, cast.....	7.35	459.
Walnut, perfectly dry.....	.61	38.
Water, pure rain or distilled, at 32° F. (barometer 30 in.).....		62.417
Water, pure rain or distilled, at 62° F. (barometer 30 in.).....	1.0	62.355
Water, pure rain or distilled water at 212° F. (barometer 30 in.).....		59.7
Water, sea, 1.026-1.030.....	1.028	64.08
Wax, bees'.....	.97	60.5
Zinc, 6.8-7.2.....	7.0	437.5

NOTE.—Green timbers usually weigh from one fifth to nearly one half more than dry and ordinary building timbers when tolerably seasoned; about one sixth more than perfectly dry.

Countries.	Standard.	Monetary Unit.	Value in Terms of U.S. Gold	Coins.
Argentina Re-public	Gold and s.	Peso (= 100 centesimos)	\$.96,5	Gold—Argentine (\$4.82,4) and $\frac{1}{2}$ Argentine; <i>silver</i> —peso and divisions.
Austro-Hungary	Gold.	Crown (= 100 heller)	.20,3	Gold—20 crowns (\$4.05,2) and 10 crowns.
Belgium	Gold and s.	Franc (= 100 centimes)	.19,3	Gold—10 and 20 francs pieces; <i>silver</i> —5 francs.
Brazil	Gold.	Milreis (= 1000 reis)	.54,6	Gold—5, 10, and 20 milreis; <i>silver</i> — $\frac{1}{2}$, 1, and 2 milreis.
Chili	Gold and s.	Peso (= 100 centavos)	.91,2	Gold—escudo (\$1.82,4), doubloon (\$4.56,1), and condor (\$9.12,8); <i>silver</i> —peso and divisions.
Cuba	Gold and s.	"	.92,6	Gold—doubloon (\$5.01,7); <i>silver</i> —peso.
Denmark	Gold.	Crown (krone) (= 100 oere)	.26,8	Gold—10 and 20 crowns.
Egypt	Gold.	Pound (= 100 piasters)	4.94,3	Gold—10, 20, 50, and 100 piasters; <i>silver</i> —1, 2, 10, and 20 piasters.
Finland	Gold.	Mark (= 100 penni)	.19,3	Gold—10 and 20 marks (\$1.93 and \$3.85,9).
France	Gold and s.	Franc (= 100 centimes)	.19,3	Gold—5, 10, 20, 50, and 100 francs; <i>silver</i> —5 francs.
Germany	Gold.	Mark (= 100 pfennig)	.23,8	Gold—5, 10, and 20 marks.
Great Britain	Gold.	Pound sterling (= 20 shillings)	4.86,6 $\frac{1}{2}$	Gold—sovereign (pound sterling and half sovereign).
Greece	Gold and s.	Drachma (= 100 lepta)	.19,3	Gold—5, 10, 20, 50, and 100 drachmas; <i>silver</i> —5 drachmas.
Haiti	Gold and s.	Gourde	.96,5	<i>Silver</i> —gourde.
Italy	Gold and s.	Lira (= 100 centesimi)	.19,3	Gold—5, 10, 20, 50 and 100 lire; <i>silver</i> —5 lire.
Libria	Gold.	Dollar (= 100 cents)	1.00	
Netherlands	Gold and s.	Florin (= 100 cents)	.40,2	Gold—10 florins; <i>silver</i> — $\frac{1}{2}$, 1, and 2 $\frac{1}{2}$ florins.
Norway	Gold.	Crown (krone) (= 100 oere)	.26,8	Gold—10 and 20 crowns.
Portugal	Gold.	Milreis (= 100 reis)	1.08	Gold—1, 2, 5, and 10 milreis.
Spain	Gold and s.	Peseta (= 100 centesimos)	.19,3	Gold—25 pesetas; <i>silver</i> —5 pesetas.
Sweden	Gold.	Crown (krone) (= 100 oere)	.26,8	Gold—10 and 20 crowns.
Switzerland	Gold and s.	Franc (= 100 centimes)	.19,3	Gold—5, 10, 20, 50, and 100 francs; <i>silver</i> —5 francs.
Turkey	Gold.	Piaster (= 100 lira)	.04,4	Gold—25, 50, 100, 200, and 500 piasters.
Venezuela	Gold and s.	Bolivar	.19,3	Gold—5, 10, 20, 50, and 100 bolivars; <i>silver</i> —5 bolivars.

FLUCTUATING CURRENCIES.

			about
Bolivia.....	Silver.	Boliviano (= 100 centavos)	\$.46,5
Central America.	Silver.	Peso	.46,5
China.....	Silver. {	Shanghai tael	.68,6
Colombia	Silver.	Haikwan tael (customs)	.76,5
Equador.....	Silver.	Peso	.46,5
India.....	Silver.	Peso	.46,5
Japan.....	Gold (nominally),	Rupee (= 16 annas)	.22,1
	silver.	Yen (= 100 sens)	.50,1
Mexico.....	Silver.	Dollar (peso) (= 100 centavos)	.50,5
Peru... ..	Silver.	Sol (= 100 centesimos)	.46,5
Russia.....	Silver.	Rouble (= 100 kopecks)	.37,2
Tripoli.....	Silver.	Mahbub (= 20 piasters)	.41,9

	Ox.			Fat Calf.	Sheep.						Swine.		
	Well.	Half.	Fat.		Lean.	Well.	Half.	Fat.	Very.	Well.	Fat.		
COMPOSITION OF LIVE ANIMALS.													
Fat.....	7.1%	14.9%	26.8%	13.1%	8.6%	13.2%	13.3%	28.1%	37.2%	22.5%	40.2		
Protein	15.8	15.5	13.7	15.3	15.4	14.8	13.8	12.2	10.0	13.9	11.0		
Ash.....	4.8	4.4	3.9	4.5	3.4	3.3	3.2	2.9	2.8	2.7	1.8		
Water.....	54.3	50.2	43.6	60.1	56.6	53.7	50.7	44.8	39.0	53.9	42.0		
Contents of stomach and intestines.....	18.0	15.0	12.0	7.0	16.0	15.0	14.0	12.0	10.0	7.0	5.0		
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
THE SAME, LESS CONTENTS OF STOMACH AND INTESTINES.													
Fat	8.7	17.5	30.5	14.1	10.2	15.5	21.3	31.9	41.4	24.2	42.3		
Protein.....	19.2	18.3	15.6	16.5	18.3	17.4	16.0	13.9	12.2	15.0	11.9		
Ash....	5.9	5.2	4.4	4.8	4.0	3.9	3.8	3.3	3.1	2.9	1.9		
Water	66.2	59.0	49.5	64.6	67.5	63.2	58.9	50.9	43.3	57.9	43.9		
Total.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		
MINERAL MATTERS IN 100 PARTS OF LIVE ANIMAL.													
Phosphoric acid.....	1.92	1.76	1.56	1.64	1.33	1.29	1.25	1.13	1.09	1.10	0.73		
Lime	2.14	1.96	1.74	1.93	1.40	1.35	1.31	1.19	1.15	1.15	0.77		
Magnesia.....	0.06	0.06	0.05	0.06	0.05	0.04	0.04	0.04	0.04	0.05	0.03		
Potash.....	0.18	0.16	0.14	0.29	0.16	0.16	0.15	0.14	0.13	0.15	0.10		
Soda.....	0.14	0.13	0.12	0.07	0.15	0.15	0.14	0.13	0.12	0.10	0.07		
Silica	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	.....	.....		
Sulphuric acid, chlorine, and carbonic acid	0.34	0.32	0.28	0.50	0.29	0.29	0.29	0.25	0.25	0.15	0.10		
Total	4.80	4.40	3.90	4.50	3.40	3.30	3.20	2.90	2.80	2.70	1.80		

VII. STATISTICS.

CHEESE, BUTTER, AND CONDENSED-MILK FACTORY PRODUCT IN THE UNITED STATES.

(Tenth and Eleventh Census.)*

	1880.	1890.
Number of establishments.....	3,932	4,712
Capital invested, million dollars	9.6	16.6
Number of employés	7,903	14,921
Wages paid, million dollars.....	1.55	5.39
Cost of materials used, million dollars	18.36	51.36
Value of products, million dollars	25.74	62.69

CHEESE, BUTTER, AND CONDENSED-MILK FACTORIES, ACCORDING TO STATES.

(Eleventh Census.)

State.	No. of Factories.	Employés.	Value of Products.
New York.....	1,308	3,075	\$14,385,966
Wisconsin.....	966	1,817	6,960,711
Iowa.....	497	2,545	10,545,182
Ohio.....	330	890	3,001,606
Pennsylvania.....	300	904	5,319,434
Illinois.....	262	1,540	8,004,991
Vermont.....	123	310	1,602,641
Minnesota.....	106	855	2,958,476
Kansas.....	101	312	919,787
Michigan.....	100	424	1,179,139
Missouri.....	61	186	400,551
Nebraska.....	58	475	1,183,000
Indiana.....	52	187	402,556
Connecticut.....	49	162	881,327
Other States.....	239	687	2,890,338
Total for the United States....	4,552	14,369	\$60,635,705

* Including cheese and butter, urban dairy product.

DAIRY PRODUCTS PRODUCED ON FARMS, ACCORDING TO THE ELEVENTH CENSUS.

(U. S. Dept. of Agriculture.)

States and Territories.	Butter.	Cheese.	Milk.
	Pounds.	Pounds.	Gallons.
Maine.....	15,593,315	696,052	57,969,791
New Hampshire.....	7,942,840	341,235	42,633,268
Vermont.....	23,314,063	609,586	90,712,230
Massachusetts.....	8,358,703	122,900	82,571,924
Rhode Island.....	965,456	24,631	10,610,547
Connecticut.....	7,196,095	112,566	54,413,822
New York.....	98,241,813	4,324,028	663,917,240
New Jersey.....	8,367,218	23,613	64,003,953
Pennsylvania.....	76,809,041	439,060	368,906,480
Delaware.....	2,026,498	359	10,699,362
Maryland.....	9,999,602	9,573	46,601,218
Virginia.....	17,949,966	109,187	78,143,459
North Carolina.....	13,129,374	60,760	55,250,665
South Carolina.....	5,737,557	2,476	23,833,631
Georgia.....	14,483,323	12,833	52,234,508
Florida.....	867,195	1,731	5,056,790
Alabama.....	14,548,435	6,131	55,508,687
Mississippi.....	12,988,637	4,898	50,803,371
Louisiana.....	2,089,774	3,930	12,881,927
Texas.....	32,100,560	145,730	118,475,320
Arkansas.....	15,724,144	21,328	54,325,673
Tennessee.....	28,314,389	69,919	107,657,116
West Virginia.....	14,063,627	74,372	59,449,066
Kentucky.....	29,038,406	64,822	118,497,289
Ohio.....	74,990,307	1,068,083	326,925,396
Michigan.....	50,197,481	328,682	224,537,488
Indiana.....	48,477,766	360,948	200,510,797
Illinois.....	57,121,486	343,456	367,269,464
Wisconsin.....	46,295,623	906,266	303,701,134
Minnesota.....	34,766,409	676,642	182,968,973
Iowa.....	72,893,079	1,038,358	486,961,411
Missouri.....	43,108,521	288,620	193,931,103
Kansas.....	46,117,076	759,210	201,608,099
Nebraska.....	27,818,078	463,831	144,768,263
South Dakota.....	13,127,244	303,951	59,666,523
North Dakota.....	5,712,566	131,374	26,566,112
Montana.....	1,062,185	11,512	6,038,096
Wyoming.....	428,269	15,196	3,064,588
Colorado.....	3,282,086	87,183	19,680,791
New Mexico.....	86,042	18,931	717,155
Arizona.....	115,203	10,855	709,225
Utah.....	1,759,354	163,539	8,614,694
Nevada.....	489,657	51,207	2,532,052
Idaho.....	1,078,103	207,213	5,085,863
Washington.....	3,482,225	71,281	19,873,281
Oregon.....	4,786,277	265,576	25,042,276
California.....	26,776,704	3,871,575	111,191,186
Total, 1889.....	1,023,821,770	18,725,218	5,207,121,309
Total, 1869.....	514,088,188	53,492,153	235,374,522
Total, 1879.....	777,229,367	27,272,489	529,632,966

ESTIMATED NUMBER AND VALUE OF MILCH COWS ON FARMS, JANUARY, 1894.

(U. S. Department of Agriculture.)

States and Territories.	Number.	Average Price.	Value.	States and Territories.	Number.	Average Price.	Value.
Maine.....	177,602	21.37	3,795,355	Michigan.....	468,711	28.27	13,250,460
New Hampshire.....	112,585	21.81	2,455,479	Indiana.....	656,982	24.16	15,872,685
Vermont.....	246,022	25.25	6,212,056	Illinois.....	1,030,121	25.12	26,102,720
Massachusetts.....	178,135	32.50	5,789,388	Wisconsin.....	787,390	24.34	19,165,073
Rhode Island.....	24,765	26.60	658,749	Minnesota.....	577,106	19.42	11,209,146
Connecticut.....	137,582	28.94	3,981,623	Iowa.....	1,278,231	23.57	30,127,905
New York.....	1,572,443	25.78	40,537,551	Missouri.....	784,841	17.67	13,868,140
New Jersey.....	190,734	35.20	6,713,837	Kansas.....	668,914	18.15	12,140,789
Pennsylvania.....	938,382	25.55	23,975,660	Nebraska.....	535,536	19.61	10,501,861
Delaware.....	33,836	24.50	828,982	South Dakota.....	590,550	19.12	5,555,316
Maryland.....	147,526	23.63	3,486,039	North Dakota.....	140,700	19.79	2,784,453
Virginia.....	276,617	18.08	5,001,235	Montana.....	36,419	24.67	898,457
North Carolina.....	274,794	14.99	4,119,162	Wyoming.....	17,815	24.60	438,249
South Carolina.....	125,619	20.47	2,571,421	Colorado.....	76,124	23.06	1,755,419
Georgia.....	312,742	16.44	5,141,478	New Mexico.....	18,400	20.00	368,000
Florida.....	114,332	13.68	1,564,062	Arizona.....	14,878	17.50	260,365
Alabama.....	311,743	12.45	3,881,200	Utah.....	56,143	18.00	1,010,574
Mississippi.....	302,959	12.91	3,911,201	Nevada.....	18,196	29.30	533,143
Louisiana.....	175,784	16.50	2,900,436	Idaho.....	30,419	21.67	659,180
Texas.....	808,515	13.84	11,189,848	Washington.....	108,535	28.72	3,117,125
Arkansas.....	328,697	10.76	3,536,780	Oregon.....	110,398	21.35	2,356,997
Tennessee.....	351,499	16.45	5,782,159	California.....	329,161	25.82	8,408,937
West Virginia.....	182,265	19.15	3,490,375	Oklahoma.....	20,275	18.00	364,950
Kentucky.....	329,552	20.39	6,719,565				
Ohio.....	767,735	25.94	19,915,046	Total.....	16,487,400	21.77	358,998,661

NUMBER AND VALUE OF FARM ANIMALS IN THE UNITED STATES, 1870-94.

(U. S. Department of Agriculture.)

Farm Animals.	Jan. 1, 1870.	Jan. 1, 1880.	Jan. 1, 1890.	Jan. 1, 1894.
Horses, number.	8,248,800	11,201,800	14,213,837	16,081,139
Value.....	\$671,319,461	\$613,296,611	\$978,510,562	\$769,224,799
Mules, number..	1,179,500	1,729,500	2,331,027	2,352,231
Value.....	\$128,584,769	\$105,948,319	\$182,394,099	\$146,232,811
Milch cows, No.	10,095,600	12,027,000	15,952,883	16,487,400
Value.....	\$394,094,745	\$279,899,420	\$352,152,133	\$358,998,661
Oxen and other cattle, number	15,388,500	21,231,000	36,849,024	36,608,168
Value..	\$346,926,440	\$341,761,154	\$560,625,137	\$536,789,747
Sheep, number..	40,853,000	40,765,900	44,336,072	45,048,017
Value.....	\$93,364,433	\$90,230,537	\$100,659,761	\$89,186,110
Swine, number..	26,751,400	34,034,100	51,602,780	45,206,498
Value.....	\$187,191,502	\$145,781,515	\$243,418,336	\$270,384,626
Total value of farm animals..	\$1,822,327,377	\$1,576,917,556	\$2,418,766,028	\$2,170,816,754

DOMESTIC EXPORTS OF BUTTER AND CHEESE.

	1870	1879	1889	1893
Butter, Pounds.....	2,019,288	38,248,016	15,504,978	8,920,107
Value, dollars	592,229	5,421,205	2,568,765	1,672,690
Cheese, Pounds	57,296,327	141,654,474	84,999,828	81,350,923
Value, dollars.....	8,881,934	12,579,968	7,889,671	7,624,648
1884.				
Imitation butter, Pounds ..	.....	1,537,682	2,192,047	3,479,322
Value, dollars.....	.....	171,119	250,605	416,386
Neutral oil, Pounds.....	.....	37,785,159	28,102,534	113,939,363
Value, dollars.....	.....	4,671,243	2,664,492	11,207,250

AVERAGE ANNUAL CONSUMPTION OF DAIRY PRODUCTS PER CAPITA. (EISBEIN.)

120 liter milk (126.8 qts. or 272.6 lbs.).

15 kilogram butter (33.1 lbs.).

7.5 kilogram cheese (16.5 lbs.).

It is estimated that 30-32 cows are required per 1000 inhabitants to supply these quantities.

VIII. DIRECTORY.

DIRECTORY OF OFFICIAL AGRICULTURAL
INSTITUTIONS.*

U. S. Department of Agriculture, Washington, D. C.

SECRETARY OF AGRICULTURE—Hon. Sterling J. Morton.

ASSISTANT-SECRETARY OF AGRICULTURE—C. W. Dabney, Jr.

*Scientific Bureaus and Divisions.*WEATHER BUREAU—M. W. Harrington, *Chief*.BUREAU OF ANIMAL INDUSTRY—D. E. Salmon, *Chief*.DIVISION OF STATISTICS—H. A. Robinson, *Statistician*.DIVISION OF ENTOMOLOGY—L. O. Howard, *Entomologist*.DIVISION OF CHEMISTRY—H. W. Wiley, *Chemist*.DIVISION OF BOTANY—F. V. Coville, *Botanist*.DIVISION OF FORESTRY—B. E. Fernow, *Chief*.DIVISION OF ORNITHOLOGY AND MAMMALOGY—C. Hart Merriam, *Ornithologist*.DIVISION OF POMOLOGY—S. B. Heiges, *Pomologist*.DIVISION OF VEGETABLE PATHOLOGY—B. F. Galloway, *Chief*.DIVISION OF MICROSCOPY—T. Taylor, *Microscopist*.OFFICE OF EXPERIMENT STATIONS—A. C. True, *Director*.

* Largely from the Report of the Director of the Office of Experiment Stations, U. S. Dept. of Agriculture, for 1893.

The Locations, Directors, and Principal Lines of Work of the Agricultural Experiment Stations in the United States.

State.	Location.	Director.	Year Estab- lished.	Principal Lines of Work.
Alabama (College)...	Auburn.....	W. L. Broun.....	1883	Meteorology; analysis and control of fertilizers; botany; mycology; field experiments.
Alabama (Canebrake)	Uniontown.....	H. Benton.....	1885	Field experiments.
Arizona.....	Tucson.....	T. B. Comstock.....	1889	Field experiments with crops and fruits; irrigation.
Arkansas.....	Fayetteville.....	R. L. Bennett.....	1888	Analyses of soils, fertilizers, and feeding stuffs; field experiments with crops and fruits; veterinary science.
California.....	Berkeley.....	E. W. Hilgard.	1876	Soils; composition and cultivation of field crops, grapes, and orchard fruits; diseases of plants and seeds; composition of feeding stuffs; entomology; technology; drainage and irrigation.
Colorado... ..	Fort Collins... ..	Alston Ellis.....	1888	Systematic botany; meteorology; field experiments with crops; testing varieties of vegetables and fruits; entomology; irrigation.
Connecticut (State)..	New Haven.....	S. W. Johnson.....	1875	Methods of analysis; analysis and inspection of fertilizers; field experiments; analysis of feeding stuffs; chemistry of milk and its products; tests of forage plants.
Connecticut (Storrs).	Storrs	W. O. Atwater.....	1888	Chemistry of foods and feeding stuffs; bacteriology of milk and its products; field experiments with crops.
Delaware.....	Newark.....	A. T. Neale.....	1888	Chemistry; field experiments with crops; horticulture; diseases of plants and animals; dairying.
Florida	Lake City.....	O. Clute.....	1888	Chemistry; field experiments with crops; horticulture.
Georgia.....	Experiment	R. J. Redding.....	1888	Field experiments with fertilizers and crops; horticulture; dairying.
Idaho.....	Moscow.....	C. P. Fox.....	1892	Field crops; fruits and vegetables; irrigation.

Agricultural Experiment Stations.—Continued.

State.	Location.	Director.	Year Estab- lished.	Principal Lines of Work.
Illinois.....	Champaign.....	G. E. Morrow.....	1883	Chemistry; field experiments with crops; horticulture; diseases of plants; feeding experiments and dairying.
Indiana.....	Lafayette.....	C. S. Plumb.....	1887	Field experiments; horticulture; feeding experiments; diseases of plants and animals
Iowa.....	Ames.....	James Wilson.....	1888	Chemistry; field experiments; horticulture; diseases of plants; entomology; dairying.
Kansas.....	Manhattan.....	Geo. T. Fairchild.....	1888	Field experiments; horticulture; diseases of plants and animals; feeding experiments; entomology.
Kentucky.....	Lexington.....	M. A. Scovell.....	1885	Chemistry; analysis and inspection of fertilizers; field experiments; horticulture; diseases of plants; entomology; dairying.
Louisiana (Sugar)....	New Orleans.....	W. C. Stubbs.....	1885	Field experiments; horticulture; sugar-making; drainage; irrigation.
Louisiana (State)....	Baton Rouge.....	W. C. Stubbs.....	1886	Chemistry; field experiments; horticulture; diseases of plants and animals; entomology.
Louisiana (North)....	Calhoun.....	W. C. Stubbs.....	1886	Field experiments.
Maine.....	Orono.....	W. H. Jordan.....	1885	Field experiments; horticulture; diseases of plants; digestibility of feeding stuffs; feeding experiments with milch cows and pigs; dairying.
Maryland.....	College Park.....	R. H. Miller.....	1888	Chemistry; field experiments with fertilizers, crops, vegetables, and fruits.
Massachusetts (State)	Amherst	C. A. Goessmann....	1882	Chemistry; analysis and control of fertilizers; field experiments; diseases of plants; analysis of feeding stuffs; feeding experiments.
Mass. (Hatch).....	Amherst	H. H. Goodell.....	1888	Meteorology; field experiments with fertilizers and fruits; entomology.
Michigan	Agricultural College	L. G. Gorton..	1888	Field crops; vegetables and fruits; ensilage; feeding animals.
Minnesota.....	St. Anthony Park...	W. M. Liggett.....	1888	Chemistry; field experiments with vegetables and fruits; entomology; dairying.

Agricultural Experiment Stations.—Continued.

State.	Location.	Director.	Year Estab- lished.	Principal Lines of Work.
Mississippi.....	Agricultural College	S. M. Tracy.....	1888	Botany; field experiments; feeding experiments; veterinary science; entomology; dairying.
Missouri.....	Columbia.....	E. D. Porter.....	1888	Chemistry; field crops; vegetables and fruits; feeding experiments; veterinary science and practice.
Montana.....	Bozeman.....	S. M. Emery.....	1893	Chemistry; meteorology; soils; field experiments; entomology.
Nebraska.....	Lincoln.....	C. L. Ingersoll.....	1887	Soils; field crops; horticulture; diseases of plants; entomology; dairying.
Nevada.....	Reno.....	S. A. Jones.....	1888	Chemistry; field experiments; feeding experiments; dairying.
New Hampshire.....	Durham.....	G. H. Whitcher.....	1888	Chemistry; analysis and control of fertilizers; field experiments.
New Jersey (State)..	New Brunswick....	E. B. Voorhees.....	1880	Botany; diseases of plants; weeds; feeding experiments with milch cows; entomology.
New Jersey (College)	New Brunswick....	Austin Scott.....	1888	Field crops; vegetables and fruits; entomology.
New Mexico.....	Las Cruces.....	H. Hadley.....	1889	Chemistry; meteorology; analysis and control of fertilizers; field experiments with fertilizers, crops, vegetables, and fruits; diseases of plants; feeding stuffs; dairying.
New York (State)....	Geneva.....	Peter Collier.....	1882	Field crops; field and greenhouse experiments with vegetable and fruits; feeding experiments; entomology; dairying.
New York (Cornell)..	Ithaca.....	I. P. Roberts.....	1879	Chemistry; meteorology; analysis and control of fertilizers; field experiments with fertilizers; analysis of feeding stuffs.
North Carolina.....	Raleigh.....	H. B. Battle.....	1877	Botany; field experiments; forestry; diseases of plants.
North Dakota.....	Fargo.....	J. B. Power.....	1890	Field experiments with fertilizers, crops, vegetables, and fruits; entomology.
Ohio.....	Wooster..	C. E. Thorne.....	1882	

Agricultural Experiment Stations.—Continued.

State.	Location.	Director.	Year Estab- lished.	Principal Lines of Work.
Oklahoma	Stillwater.....	H. E. Alvord.....	1891	Field experiments with crops, vegetables, and fruits.
Oregon	Corvallis.....	J. M. Bloss.....	1888	Soils; field experiments; and entomology.
Pennsylvania	State College.....	H. P. Armsby.....	1887	Chemistry; analysis of fertilizers; field experiments; composition of feeding stuffs; feeding experiments; dairying.
Rhode Island.....	Kingston.....	C. O. Flagg.....	1888	Chemistry; analysis and control of fertilizers; field experiments; veterinary science and practice; agriculture.
South Carolina.....	Clemson College....	E. B. Craighead....	1888	Analysis and control of fertilizers; field experiments.
South Dakota.. ..	Brookings	L. McLouth.....	1888	Meteorology; field experiments; forestry; entomology; dairying.
Tennessee.....	Knoxville.....	C. F. Vanderford...	1882	Botany; soils; field experiments; feeding experiments.
Texas.	College Station... ..	J. H. Connell.....	1888	Field experiments; diseases of plants; feeding experiments; veterinary science and practice; dairying.
Utah.....	Logan	J. H. Paul.....	1889	Field experiments; feeding experiments; irrigation.
Vermont.	Burlington.....	J. L. Hills	1886	Chemistry; analysis and control of fertilizers; field experiments; diseases of plants; feeding experiments; entomology; dairying.
Virginia.....	Blacksburg.....	J. M. McBryde.....	1888	Field experiments; veterinary science and practice.
Washington	Pullman	E. A. Bryan	1891	Field experiments; forestry.
West Virginia	Morgantown	J. A. Myers	1888	Analysis and control of fertilizers; chemistry; botany; field experiments; entomology.
Wisconsin.....	Madison.....	W. A. Henry.....	1883	Chemistry; soils; field experiments; feeding experiments; dairying; bacteriology.
Wyoming.....	Laramie	A. A. Johnson	1891	Botany; soils; field and feeding experiments; entomology; irrigation.

Canada.

MINISTERS OF AGRICULTURE—Hon. John Carling, Ottawa.
 Hon. John Dryden, Toronto.
 Hon. J. H. Turner, Victoria,
 B. C.

Canadian Experiment Stations.

CENTRAL EXPERIMENTAL FARM—Wm. Saunders, *Director*.
 EXPERIMENTAL FARM—Napan, N. S.; W. S. Blair, *Superintendent*.
 “ “ Brandon, Manitoba; S. A. Bedford,
Superintendent.
 “ “ Indian Head, N. W. T.; Angus
 MacKay, *Superintendent*.
 “ “ Agassiz, B. C.; Thos. A. Sharpe,
Superintendent.
 EXPERIMENT STATION—Guelph Agricultural College; James
 Mills, *President*.

FACTS ABOUT THE AGRICULTURAL EXPERIMENT STATIONS IN THE UNITED STATES.

Agricultural Experiment Stations are now in operation, under the act of Congress of March 2, 1887, in all States and Territories of the Union except Alaska. Some States have established State or Branch Stations, so that the total number of Stations at the present is 55.

The total income of the Stations during 1893 was \$950,073, of which \$705,000 was received from the National Government. While this is a much larger aggregate expenditure for this purpose than has ever been made by any other nation, it involves the use of only 30 cents for each \$1000 of our annual agricultural product in an attempt to improve the quality and quantity of that product.

The Stations employ 532 persons in the work of administration and inquiry; the number of officers engaged in the different lines of work is as follows: Directors, 70; chemists, 119; agriculturists, 54; horticulturists, 62; botanists, 37; entomologists, 42; veterinarians, 26; meteorologists, 13; biolo-

gists, 11 ; physicists, 4 ; geologists, 4 ; mycologists and bacteriologists, 5 ; irrigation engineers, 4 ; in charge of substations, 33 ; secretaries and treasurers, 25 ; farm foremen, 25 ; dairymen, 7 ; miscellaneous (clerks, librarians, etc.), 60.

During 1893 the Stations published 48 annual reports and 298 bulletins, and also a number of press bulletins which were widely reproduced in the agricultural and country papers. The mailing-lists of the Stations now aggregate about half a million names. The publications of the different Stations are free to farmers in the respective States, and are sent upon application to the director of the Station. Correspondence with farmers and calls upon Station officers for public addresses at institutes and other meetings of farmers are constantly increasing.

The following is a list of Agricultural Experiment Stations in the United States and Canada with principal lines of work.

SECRETARIES OF STATE DAIRYMEN'S ASSOCIATIONS.

- California*—Samuel E. Watson, San Francisco.
Connecticut—W. L. Bartholomew, Putnam.
Georgia—M. L. Duggan, Linton.
Illinois—W. R. Hostetter, Mt. Carroll.
Indiana—W. S. Commons, Centreville.
Iowa—C. L. Gabrilson, New Hampton.
Kansas—H. M. Brandt, Topeka.
Maine—B. W. McKeen, Augusta.
Massachusetts—Geo. M. Whitaker, Working Exec. Officer,
 Mass. Dairy Bureau, Boston.
Michigan—S. J. Wilson, Flint.
Minnesota—Prof. T. L. Haecker, St. Anthony Park.
Nebraska—S. C. Bassett, Gibbon.
New Hampshire—J. L. Gerrish, Webster.
New York—B. D. Gilbert, Utica.
North Dakota—Prof. E. F. Ladd, Fargo.
Ohio—L. P. Bailey, Tacoma.
Oregon—H. M. Williamson, Portland.
Pennsylvania—Geo. H. St. John, Meadville.
Vermont—G. W. Pierce, Brattleboro.
Utah—J. Faust, Jr., Salt Lake City.

Wisconsin—D. W. Curtis, Fort Atkinson.

Canada—J. W. Wheaton, London, Ont., Sec'y Dairymen's Asso. of Western Ont.; H. Ashley, Belleville, Ont., Sec'y Dairymen's Asso. of Eastern Ont.; John Hannah, Seaforth, Sec'y Creameries' Asso. of Ontario.

NATIONAL DAIRY UNION—D. W. Willson, Elgin, Ill., Sec'y.

NATIONAL DAIRY CONGRESS—D. P. Ashburn, Gibbon, Neb., Sec'y.

NATIONAL BUTTER AND CHEESE-MAKERS' ASSOCIATION—E. J. Burrige, Chicago, Ill.

MINNESOTA BUTTER AND CHEESE-MAKERS' ASSOCIATION.

NORTHWESTERN FACTORY CHEESE-MAKERS' ASSOCIATION—A. Schoenman, Plain, Wis., Sec'y.

OHIO AND INDIANA BUTTER, EGG, AND POULTRY ASSOCIATION—Joseph Swindell, Plymouth, Ind.

STATE DAIRY AND FOOD COMMISSIONERS AND MILK INSPECTORS.

Delaware—T. B. Wolff, Newark.

Iowa—W. K. Boardman, Des Moines.

Minnesota—Berndt Anderson, St. Paul.

New Jersey—Geo. W. McGuire, Trenton.

Ohio—Dr. F. B. McNeal, Columbus.

Oregon—H. B. Luce, Salem.

Pennsylvania—E. Reeder, Harrisburg.

Wisconsin.

Boston—Prof. Chas. Harrington, Inspector of Milk and Vinegar.

Chicago.—Dr. Adolph Gehrman, Superintendent of Milk and Food Department of Health.

Canada—Prof. James W. Robertson, Ottawa.

South Carolina—Dr. W. B. Niles, Columbia, State Veterinarian.

Vermont—State Bd. of Agriculture, *ex-officio*, State Cattle Commission.

Wisconsin—Dr. F. G. Touissant, Milwaukee, State Veterinarian.

STATE VETERINARIANS AND LIVE STOCK COMMISSIONERS.

Connecticut.—Commissioners on Diseases of Domestic Animals: E. H. Hyde, Stafford; T. S. Gold, West Cornwall; W. G. French, Watertown.

Illinois.—Dr. M. R. Trumbower, Springfield, Ill., State Veterinarian; A. M. Browlee, Springfield, Ill., Secretary State Board of Live Stock Commissioners.

Iowa.—Dr. M. Stalker, Des Moines, State Veterinarian.

Massachusetts.—C. P. Lyman, Boston, Secretary Massachusetts Board of Cattle Commissioners.

Michigan.—Dr. E. A. A. Grange, Lansing, State Veterinarian; J. J. Woodman, Paw Paw, Secretary Michigan Live Stock Commission.

Minnesota.

Missouri.—Dr. T. J. Turner, Columbia, State Veterinarian.

Ohio.—Dr. T. P. Shields, Watkins; Mr. W. L. Miller, Chillicothe; Dr. D. N. Kinsman, Columbus, Live Stock Commissioners.

Pennsylvania.—Dr. F. Bridge, Philadelphia, Veterinary Surgeon to State Board of Agriculture.

ANNOUNCEMENTS OF COURSES IN DAIRYING AT AMERICAN STATE DAIRYING SCHOOLS, 1895.

VERMONT DAIRY SCHOOL: *State Agricultural College, Burlington*.—The fourth annual session will begin Jan. 14, 1895, and close Saturday, Feb. 9. The course of instruction will include:

Lectures on Dairying—(1) 24 lectures on milk, constitution and production, Prof. J. L. Hills. (2) 18 lectures on various dairy topics, as follows: Hon. G. S. Fassett, Building up a Dairy Herd; Hon. C. M. Winslow, Ayrshires; Hon. V. I. Spear, Vermont as a Dairy State; Hon. H. W. Vail, Jerseys; Hon. J. O. Sanford, Marketing Dairy Products; Hon. H. M. Arms, Practical Dairying; Dr. F. A. Rich, Milk Fever, Anthrax, Tuberculosis, Diseases of Milk Cows. (4) Prof. L. A. Jones, Vermont Pastures and Meadows; Prof. A. W. Ayer, Care and Management of Engine, Boiler, and Separator. (5) Mr. D. D. Howe, The Experiment Station Herd.

Practical work at separators and in butter-making, Mr. W. E. Simpson, Princeton, Ind.; Milk Testing, Mr. Duncan Stuart.

There is no charge for tuition. Twenty to twenty-five dollars will cover the entire expenses of the school.

Prof. J. L. Hills, Burlington, Vt.

NEW YORK DAIRY COURSE: *Cornell University, Ithaca, N. Y.*—The course extends through the winter term of the university, and is eleven weeks long, beginning Jan. 3, 1895. Instruction is offered in the following branches:

Lectures on Milk and its Products, 2 hours per week; Lectures on subjects related to dairying, 4 hours per week; Cheese-room practice, 2 days per week; Butter-room practice, 2 days per week; Dairy laboratory practice, 2 days per week; Problems and book-keeping, 2 hours per week.

Special instruction in the use of the Babcock tests. Eight courses are given during 1894-95 for instruction in the use of the Babcock test lasting 3 weeks each, viz.: Jan. 3-24; Jan. 24-Feb. 14; Feb. 14-March 7; March 7-23 inclusive. Laboratory breakage fee only required. Prof. I. P. Roberts, Director of College of Agriculture of Cornell University. Ithaca, N. Y.

PENNSYLVANIA DAIRY SCHOOL: *Pennsylvania State College, State College, Pa.*—The following courses are offered:

(1) *Creamerymen's Course*, opens Jan. 2, 1895, and continues six weeks. Instruction is given in Dairy Chemistry, 15 lectures, Dr. Wm. Frear; Feeding of Dairy Stock, 10 lectures, Dr. H. P. Armsby; Dairy Breeds and Breeding, 10 lectures, Prof. H. J. Waters and Mr. Harry Hayward; Veterinary Science, 10 lectures, by Dr. L. Pearson; Steam-engine, 2 lectures, by Prof. L. E. Reber; Creamery Work, Mr. H. B. Gurber; Milk-testing, Dr. Wm. Frear and Mr. J. W. Fields.

(2) *Private Dairymen's Course*, opens Feb. 13, 1895, and continues six weeks. Two lectures each day will be given on the following subjects: Dairy Breeds and Breeding, 20 lectures; Chemistry of Milk and its Products, 15 lectures; Dairy Feeding, 15 lectures; Veterinary Science, 14 lectures; Dairy Work. The entire expense of either course need not exceed \$35.

H. J. Waters, Professor of Agriculture, State College, Pa.

OHIO: *Special Course in Dairying, State University, Columbus, Ohio.*—The course will begin Jan. 2, 1895, and last twelve

weeks. The lectures and practical exercises will be as follows :

Milk Chemistry and Milk-testing, lectures and laboratory practice, by Prof. H. A. Weber ; Dairy Farming, lectures and recitations on Breeds, Breeding, Feeding, etc., of Dairy Stock, Equipment and Management of Dairy Farms, by Prof. Thos. F. Hunt ; Bacteria in their Relation to Milk, Butter, and Cheese, lectures by Prof. A. M. Bleile ; The Common Diseases of the Dairy Cow, lectures by Prof. H. J. Detiners ; Care of the Boiler and Engine, lectures by W. C. McCracken ; Butter-making and Separator Practice, D. Goodrich and O. J. Bailey ; Cheese-making, B. B. Herrick. Special lectures by prominent dairy-men and others are also expected to be given.

Total expenses in attending dairy course estimated at \$72.

Prof. W. R. Lazenby, Secretary School of Agriculture, Columbus, Ohio.

MICHIGAN DAIRY SCHOOL: *Michigan Agricultural College, Agricultural College, P. O., Mich.*—A six weeks' course in practical dairy husbandry will be given, beginning Jan. 2, 1895. The instruction will be divided into five sub-courses :

(1) Daily Practice in Butter Making ; (2) Dairy Chemistry, lectures and laboratory work ; (3) Breeding, Selection, and Feeding of Dairy Stock ; (4) Judging and Scoring Butter ; (5) A Study of Dairy Literature.

Total expenses while at the college need not exceed \$25.

I. H. Butterfield, Secretary Agricultural College, Mich.

WISCONSIN DAIRY SCHOOL: *University of Wisconsin, Madison, Wis.*—The course beginning January 1 and ending March 22, 1895, is the sixth since the establishment of the dairy school proper.

The instruction given is arranged as follows :

Sub-course I.

1. Twenty-four lectures by Dr. S. M. Babcock, on the Chemistry of Milk and its products.

2. A Course in Bacteriology in Relation to the Dairy, by Dr. H. L. Russell.

3. Ten lectures on the Theory and Art of Cheese-making, by Mr. J. W. Decker.

4. Dairy Book-keeping, by Prof. Farrington, assisted by Mr. A. Schoenman.

5. Ten lectures and demonstrations on the Care and Management of the Boiler and Engine, by Prof. E. W. Richter.

6. Eight lectures on Physical Problems Connected with the Dairy, by Prof. F. H. King.

7. Eight lectures on the Breeds and Breeding of Dairy Cows, by Prof. John A. Craig.

8. Eight lectures on the Feeding and Management of Dairy Cows, by Prof. W. A. Henry.

9. Eight lectures on the Diseases of Dairy Cows, by Dr. W. G. Clark.

Sub-course II.

Milk-testing, by Prof. Farrington, assisted by Mr. Schoenman.

Sub-course III.

Butter-making, by Prof. Farrington, assisted by Messrs. Fulmer, Biddick, and Simons.

Sub-course IV.

Cheese-making, by Mr. J. W. Decker, assisted by Messrs. Berg and Kiltz.

Dairy certificates are given graduates of the school who have successfully operated a creamery or cheese factory for at least two seasons of not less than seven months each.

Advanced Dairy Instruction lectures, with practical and experimental dairy work, by Profs. Babcock, Farrington, and Russell, and Mr. J. Decker.

The school is arranged for the accommodation of 100 students.

Prof. E. H. Farrington, in charge of Dairy School.

MINNESOTA DAIRY SCHOOL.—The Factorymen's Dairy School course will begin Jan. 3, 1895, and continue for four weeks.

Instruction as follows :

1. Lectures covering the entire field of dairy husbandry.
2. Practical work daily in the butter-room.
3. Practical work daily in the cheese-room, where the manu-

facture of flats, cheddars, Swiss, brick, Edam and Gouda cheese will be carried on.

4. Examination of milks and making dairy and composite tests.

5. Practical engineering, steam-fitting, and plumbing.

Applications for admission to be addressed to Prof. T. L. Haecher, St. Anthony Park, Minn.

IOWA DAIRY SCHOOL: *State Agricultural College, Ames, Iowa.*
—Three courses in dairying are offered :

1. *The One-year Course*, beginning February 26, 1895, and ending November 13, 1895, with an intermission of one month in midsummer (June 19 to July 16). Students completing the course will receive certificates. The course of study pursued is as follows :

First Term.—Dairy laboratory, 7 hours daily ; dairy lectures, 40 hours per term ; dairy machinery, 32 hours per term ; breeding and feeding, 30 lectures ; book-keeping, 30 lectures ; dairy chemistry, 16 lectures.

Second Term.—Dairy laboratory, 7 hours daily ; dairy lectures, 32 hours per term ; bacteriology of milk, 16 lectures ; chemical laboratory, 3 hours per week ; dairy stock, 16 lectures ; original experimental work.

2. *The Summer Schools.* Two summer schools are held, each lasting 16 weeks. The first begins with the regular college year, February 26, 1895, and the second July 16. The course of study in both schools is as follows :

Work in dairy buildings, 6 half days per week ; dairy lectures, 50 per term ; breeding and feeding, 30 lectures per term ; dairy chemistry, 16 lectures per term ; chemical laboratory, 3 hours per week ; bacteriology of milk, 16 lectures per term ; book-keeping, 32 lectures per term.

3. *The Winter School* begins Jan. 2, 1895, and continues 8 weeks. The following course of study is pursued :

Work in dairy building, 6 half days per week ; dairy class-work, 60 lectures ; stock-breeding and feeding, 20 lectures ; dairy chemistry, 20 lectures ; bacteriology of milk, 10 lectures ; book-keeping, 20 lectures.

Prof. James Wilson, Director of Experiment Station, Ames, Iowa.

NORTH DAKOTA : *Course in Dairying at N. D. Agricultural College, Fargo, N. D.*—The course lasts 6 weeks, beginning Jan. 2, 1895. Sixty lectures on the principles of dairying are given, including the care and handling of milk and dairy utensils, and the manufacture of butter. Lectures are also given on the care and feeding of farm animals, the chemistry of dairy products and animal foods, the bacteria in milk and cream, and their influence on the final product.

Practical work in the dairy, the separator-room, and the milk-testing laboratory.

Number of students in this course limited to sixteen.

The entire expenses of the course need not exceed fifty dollars.

J. B. Power, President, Fargo, N. Dakota.

ONTARIO DAIRY SCHOOL: *Ont. Agricultural College, Guelph, Canada.*—The school will open January 14, and remain in session to March 15. Two special courses in practical instruction are offered—Factory course and Home Dairy course.

I. Factory Course.—Cheese and butter making on a large scale are taught; also running of cream separators; use of Babcock tester and lactometer; directions as to the simplest and fairest way of paying patrons for their milk, etc.

II. Home Dairy Course.—Milk-testing, running of separators, butter-making on the farm, etc., are taught. Special instruction in cheese-making given when required. Fifteen to twenty students can be accommodated in this course.

A course of fifty lectures will be given as follows:

Thirty lectures on milk and dairy products, milk-testing, butter and cheese-making, breeding and feeding of dairy cows, etc.

Three lectures on general agriculture in relation to dairying.

Three lectures on the diseases and treatment of dairy stock.

Two lectures on geology and two on botany.

Four lectures on the nomenclature and general principles of chemistry and its relation to dairying.

Six lectures on mathematics and book-keeping.

Certificates of standing are given to those who pass all prescribed written and practical examinations. Also special dairy certificates to holders of a general certificate who have proved their ability to manage a creamery or cheese-factory.

Tuition free to residents of the province of Ontario ; to non-residents, five dollars.

Special provision has been made for ladies who wish to take either course. Six ladies were in attendance last year.

H. H. Dean, professor in charge Ontario Agricultural College, Guelph, Ont.

UTAH : *Agricultural College, Logan, Utah.*—In connection with the short course in agriculture, special work is offered in dairying—covering milk-testing, butter and cheese-making. One day a week during the winter term will be given to cheese-making, and two days a week to butter-making and milk-testing.

B. F. Linfield, B.S.A., Instructor in Dairying and Animal Husbandry.

ONTARIO, CANADA : *Course in Dairying, School of Mining and Dairying, Kingston, Ont.*—Eight courses especially adapted for cheese and butter makers will be given during 1894-95, each lasting two weeks. Each course will include practical instruction in cheese-making or butter-making or both, and milk-testing. A course of lectures will also be given on the following subjects :

Dairy-farming.—Utilization of By-products of the Dairy ; Cheese-making ; Butter-making ; Milk-testing ; and the Chemistry and Botany of the Farm.

The two first courses began December 13 and 27, 1894 ; the other courses will begin on the following dates : January 10 and 24, February 7 and 21, March 7 and 21.

Students must be sixteen years of age and be a member of the Dairymen's Association of Eastern Ontario or of the Ontario Creamery Association ; any one may become a member by enclosing an annual fee of one dollar to the bursar of the school.

J. A. Ruddick, Superintendent, Kingston, Ontario.

GERMAN DAIRY SCHOOLS AND DAIRY EXPERIMENT STATIONS.—According to Fleischmann, eighty-five dairy schools have in all been established in Germany since 1869 ; of these thirty-nine are for male students, twenty-nine for female students, and seventeen are for both sexes. Fifty-six dairy schools are in active operation at the present.

There are six dairy experiment stations, viz. : in Raden, Kiel,

Proskau, Weihestephan, Kleinhof-Tapian, and Menningen. The Munich Polytechnic and the Universities of Halle, Breslau, Königsberg, Leipzig, and Göttingen furthermore offer advanced instruction in dairy science.

The institutions mentioned in the preceding are scattered over a territory only about as large as all seven Middle Atlantic States put together ; the population of Germany consists of about fifty-six million people, making one dairy school in active operation for each million people, against one school for every nine million people in the United States.

FARMERS' INSTITUTES, 1895.

Jan. 2. Drayton, W. Wellington; Galt, S. Waterloo; Waterford, N. Norfolk; Freelon, N. Wentworth; Embro, N. Oxford; Weston, W. York; Oshawa, S. Ontario; Blackstock, Durham; Oxford Mills, N. Grenville; Lancaster, Glengarry.

Jan. 3. Clifford, W. Wellington ; New Hamburg, S. Waterloo; Port Dover, S. Norfolk; Waterdown, N. Wentworth; Innorkip, N. Oxford; Woodbridge, W. York ; Pickering, S. Ontario; Tweed, E. Hastings; Kemptville, N. Grenville.

Jan. 3 and 4. Vankleek Hill, Prescott.

Jan. 4. Paisley, C. Bruce ; Port Rowan, S. Norfolk ; Bond Head, S. Simcoe; Tamworth, Addington.

Jan. 4 and 5. Mitchell, S. Perth ; Jordan, Lincoln ; Elmira, N. Waterloo; Agincourt, E. York; Winchester, Dundas.

Jan. 5. Port Elgin, N. Bruce; Delhi, N. Norfolk; Thornton, S. Simcoe; Centerville, Addington; Maxville, Glengarry.

Jan. 7. Niagara Falls, S. Welland.

Jan. 8. Tara, N. Bruce; Brucefield, S. Huron; Norwich, S. Oxford; Crowland, Welland; Minesing, C. Simcoe; Alma, C. Wellington; Uxbridge, N. Ontario; Napanee, Lennox.

Jan. 8 and 9. Newington, Stormont; Duncanville, Russell.

Jan. 9. Durham, S. Grey ; Exeter, S. Huron ; Mt. Elgin, S. Oxford ; Pelham, Town Hall, Monk ; Erin, S. Wellington ; Wyevale, C. Simcoe; Woodville, W. Victoria.

Jan. 9 and 10. Stella, Lennox.

Jan. 10. Ayton, S. Grey; Parkhill, N. Middlesex; Attercliffe

Station, Monk ; Orangeville, Sufferin ; Coldwater, E. Simcoe ; Beaverton, N. Ontario ; Stittsville, Carleton.

Jan. 10 and 11. Aylmer, E. Elgin ; Shannonville, E. Hastings ; Cornwall Centre, Cornwall.

Jan. 11. Kenilworth, E. Wellington ; Thedford, E. Lambton ; Shelburne, Dufferin ; Orillia, E. Simcoe ; Lindsay, W. Victoria ; Carp, Carleton.

Jan. 11 and 12. Fisherville, Haldimand.

Jan. 12. Damascus, E. Wellington ; Camlachie, E. Lambton ; Shedden, W. Elgin ; Flesherton, C. Grey ; Meaford, N. Grey ; Fenelon Falls, E. Victoria ; Wellington, Pr. Edward ; Spencerville, S. Grenville ; Almonte, N. Lanark.

Jan. 14. Teeswater, S. Bruce ; Rodney, W. Elgin.

Jan. 14. Glanford, S. Wentworth ; Owen Sound, N. Grey ; Thornbury, C. Grey ; Bobcaygen, E. Victoria ; Demorestville, Pr. Edward ; North Augusta, S. Grenville ; Pembroke, N. Renfrew.

Jan. 14 and 15. Brigden, W. Lambton.

Jan. 15. Holywood, S. Bruce ; Alemheim, E. Kent ; Binbrook, S. Wentworth ; Palermo, Halton ; Grafton, W. Northumberland, New Dublin, Brockville ; Micksburg, N. Renfrew.

Jan. 15 and 16. Collingwood, W. Simcoe.

Jan. 16. Ripley, C. Bruce ; Appin, W. Middlesex ; Merlin, W. Kent ; Acton, Halton ; Peterboro, W. Peterboro ; Coldsprings, W. Northumberland ; Athens, Brockville.

Jan. 16 and 17. Brantford, S. Brant ; Renfrew, S. Renfrew.

Jan. 17. Wingham, W. Huron ; Mount Bridges, W. Middlesex ; Amherstburg, S. Essex ; Lakefield, W. Peterboro ; Orona, Durham ; Delta, S. Leeds.

Jan. 17 and 18. Guelph, S. Wellington.

Jan. 18. Brussels, E. Huron ; Byron, E. Middlesex ; Bell River, N. Essex ; Keene, E. Peterboro ; Bowmanville, Durham ; Smith's Falls, S. Lanark.

Jan. 18 and 19. St. George, N. Brant ; Mount Albert, N. York ; Lansdowne, S. Leeds.

Jan. 19. Attwood, N. Perth ; Ilderton, E. Middlesex ; Stony Point, N. Essex ; Norwood, E. Peterboro ; Perth, S. Lanark.

Jan. 21. Milverton, N. Perth ; Coldstream, N. Middlesex ; Chatham, W. Kent ; Sunbury, Frontenac ; Lanark, N. Lanark.

Jan. 21 and 22. Brampton, Peel ; Warkworth, E. Northumberland.

Jan. 22. Thamesville, E. Kent; Sydenham, Frontenac.

SECRETARIES OF CATTLE-BREEDERS' ASSOCIATIONS.

American Aberdeen Angus Asso., Thos. McFarlane, Harvey, Ill.

American Devon Cattle Club, L. P. Sisson, Wheeling, W. Va.

American Galloway Breeders' Asso., L. P. Muir, Independence, Mo.

American Guernsey Cattle Club, Wm. H. Caldwell. Peterboro, N. H.

American Holderness.

American Hereford Cattle Breeders' Asso., C. R. Thomas, Independence, Mo.

American Jersey Cattle Club, J. J. Hemingway, New York City.

American Polled Durham Breeders' Asso., A. E. Burleigh, Mazon, Ill.

American Short-horn Breeders' Asso., J. H. Pickrell, Springfield, Ill.

Association of Ayrshire Breeders, C. M. Winslow, Brandon, Vt.

Association of Ohio Short-horn Breeders, L. D. Hagerty, Columbus, Ohio.

Brown-Swiss Breeders' Asso., N. S. Fish, Groton, Conn.

Dominion Ayrshire Breeders' Asso., Henry Wade, Toronto.

Dominion Short-horn Breeders' Asso., Henry Wade, Toronto, Can.

Dutch Belted Cattle Association of America, H. B. Richards, Easton, Pa.

Guernsey Breeders' Asso., Wm. B. Harvey, West Grove, Pa.

Holstein-Friesian Association of America, F. L. Houghton, Brattleboro, Vt.

Indiana Jersey Breeders' Asso., W. S. Budd, Indianapolis, Ind.

Indiana Short-horn Breeders' Association, W. S. Robbins, Horace, Ind.

Iowa Improved Stock Breeders' Asso., Geo. Franklin, Atlantic, Iowa.

Maine State Jersey Cattle Asso., N. R. Pike, Winthrop, Me.

Michigan Asso. of Breeders of Improved Live Stock, J. H. Butterfield, Agricultural College.

North Holland Herd-book Asso., F. H. Beach, Dover, N. J.

Red Polled Cattle Club of America, J. McLain Smith, Dayton, Ohio.

Western Holstein-Friesian Breeders' Asso., J. H. Coolidge, Jr., Galesburg, Ill.

SECRETARIES OF SWINE-BREEDERS' ASSOCIATIONS.

American Berkshire Association, Chas. F. Mills, Springfield, Ill.

American Duroc-Jersey Swine Breeders' Association, S. E. Morton, Camden, O.

American Essex Association, F. M. Stout, McLean, Ill.

American Poland-China Record Company, W. H. McFadden, West Liberty, Iowa.

American Small-Yorkshire Club, Geo. W. Harris, New York City.

American Suffolk Association, W. F. Watson, Winchester, Ind.

Central Poland-China Swine Association, W. H. Morris, Indianapolis, ind.

Cheshire Record Association, R. D. Button, Cottons, N. Y.

Cheshire Swine Breeders' Association, G. S. Button, Chittenango, N. Y.

Dominion Swine Breeders' Association, F. W. Hodson, London, Ont.

Indiana Swine Breeders' Association, Scott Barnett, Logansport, Ind.

National Berkshire Record Association, E. K. Morris, Indianapolis, Ind.

National Duroc-Jersey Record Association, R. J. Evans, El Paso, Ill.

National Swine Breeders' Association, Jno. G. Springer, Springfield, Ill.

Northwestern Poland-China Association, J. B. Besack, Washington, Kan.

Ohio Poland-China Record Company, Carl Freigan, Dayton, O.

Standard Chester White Record Association, W. H. Morris, Indianapolis, Ind.

Standard Poland-China Record Company, Geo. F. Woodworth, Maryville, Mo.

Todd's Improved Chester White Record Association, C. W. Baker, Delaware, O.

Victoria Swine Breeders' Association, Geo. F. Davis, Dyer, Ind.

AMERICAN DAIRY PAPERS.

American Cheese-Maker. Grand Rapids, Mich. Monthly, 50 cents.

American Creamery. Chicago, Ill. Monthly, \$1.00.

American Dairyman. New York City. Weekly, \$1.50.

Bulletin American Devon Cattle Club. Wheeling, W. Va. Monthly, 50 cents.

Chicago Produce. Chicago, Ill. \$1.50.

Creamery Journal. Waterloo, Ia. Monthly, \$1.00.

Dairy World. Chicago, Ill. Monthly, \$1.00.

Elgin Dairy Report. Elgin, Ill. Weekly, \$1.00.

Farm and Dairy. Ames, Ia. Semi-monthly, 50 cents.

Jersey Bulletin. Indianapolis, Ind. Weekly, \$2.00.

Hoard's Dairyman. Fort Atkinson, Wis. Weekly, \$1.00.

Holstein-Friesian Register. Brattleboro, Vt. Semi-monthly, \$1.50.

The National Dairyman. Kansas City, Mo. Monthly, \$1.00.

MAIN FOREIGN DAIRY PAPERS.

The Dairy. 144 Fleet Street, London, England. Monthly, 3s.

The Dairyman. 17 New Castle Street, Farringdon St., London, England.

The Dairy Review. Woodbridge, Suffolk, England. Monthly, 3s.

The Dairy World and British Dairy Farmer. 310 Strand, London, England. Monthly, 3s.

Nordisk Mejeri-Tidning. Stockholm, Sweden. Weekly, 5 kr.

Mælkeritidende. Odense, Denmark. Weekly.

Milch-Zeitung. Bremen, Germany. Weekly, 8 mk.

Molkerei-Zeitung. Berlin, Germany. Weekly, 8 mk.

Molkerei-Zeitung. Hildesheim, Germany. Weekly, 6 mk.

L'Industrie Laitière. 33 Rue J. J. Rousseau, Paris, France. Weekly, 20 fr.

La Laiterie. 18 Rue des Martyrs, Paris. Bi-weekly, 13. fr.

Schweizerische Molkerei Zeitung. Zurich. Weekly, 6.60. fr.

Die Milch Industrie. Berne, Switzerland.

MORE IMPORTANT WORKS ON DAIRYING.

American.

Grotenfelt-Woll, Modern Dairy Practice. New York, 1894, 285 pp. \$2.00.

Gurler, American Dairying. Chicago, 1894. \$1.00.

Schoenman, Milk Testing. Madison, Wis., 1894. 39 pp. 75 cents.

Decker, Cheddar Cheese Making. Madison, Wis., 1893. 118 pp. \$1.00.

Monrad, A. B. C. in Cheese Making. Winnetka, Ill. Second ed., 68 pp. 50 cents.

Georgeson, Dairy Industry of Denmark. Washington, D. C. 1893. 133 pp.

Russell, Outlines of Dairy Bacteriology, Madison, Wis., 1894. 186 pp. \$1.00.

English.

Sheldon, Dairy Farming. London. 570 pp., 4to.

Sheldon, The Farm and the Dairy. London, 1889. 2s 6d. 154 pp.

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