

Final report of the Committee on the Production and Distribution of Milk.

Contributors

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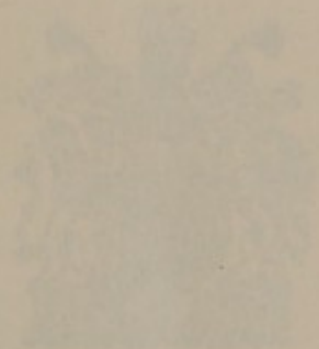
1913-1914

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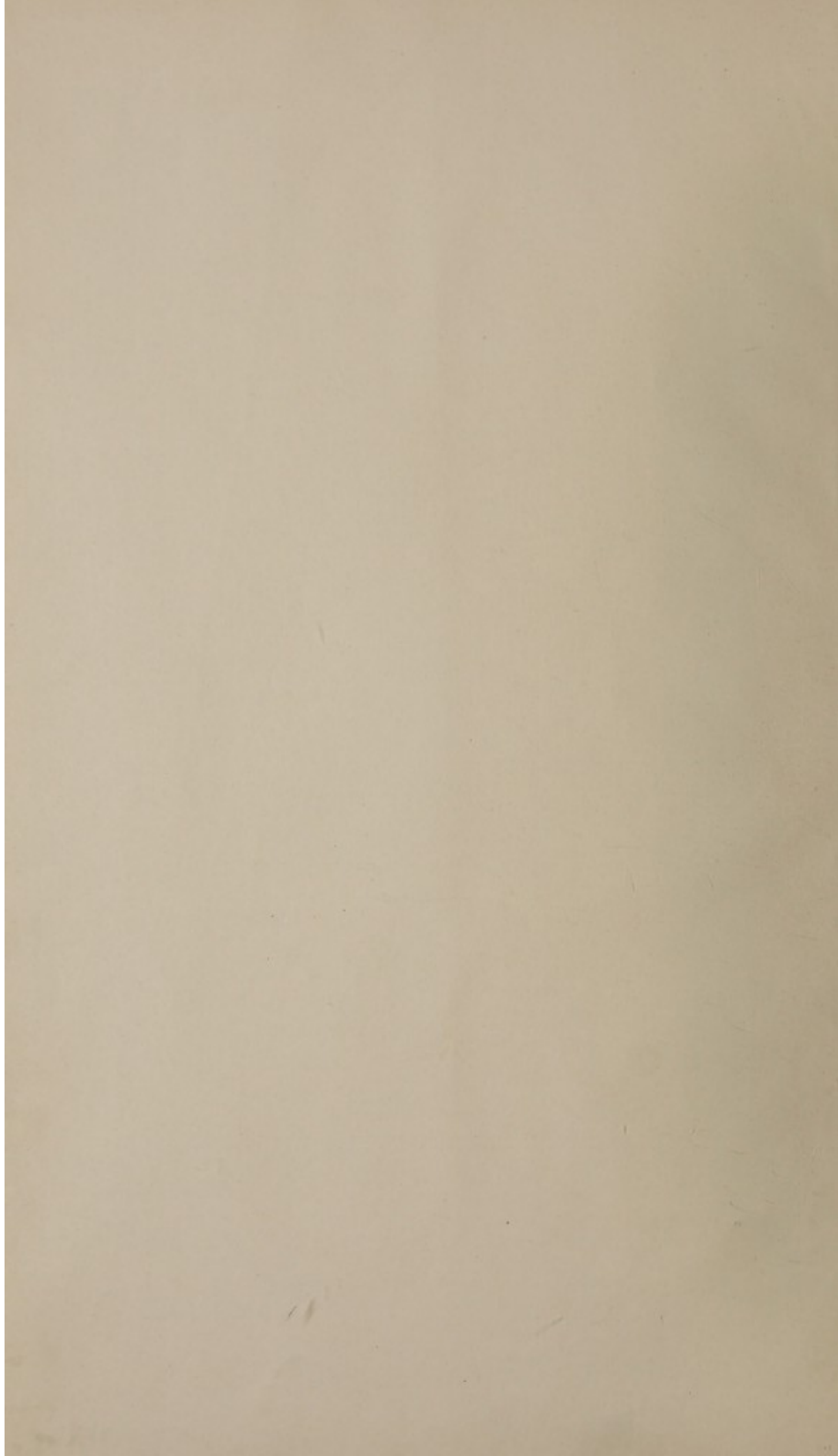
DISTRIBUTION OF MILK.

Presented to both Houses of Parliament by Command of His Majesty.



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FINAL REPORT
OF THE
COMMITTEE ON THE PRODUCTION
AND
DISTRIBUTION OF MILK.

Presented to both Houses of Parliament by Command of His Majesty.



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REPORT

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COMMITTEE

ON THE

PRODUCTION AND DISTRIBUTION OF MILK.

→ TO THE PRESIDENT OF THE BOARD OF AGRICULTURE AND FISHERIES.

I. POLICY AND WORK OF THE COMMITTEE.

1. *Appointment of the Committee.* This Committee was appointed on the instruction of the Cabinet in April, 1917, by the President of the Board of Agriculture and Fisheries (Lord Ernle) with the concurrence of the Food Controller (Lord Rhondda.).

2. *Terms of Reference.* The terms of reference of the Committee were as follows:—

“To report on the production and distribution of milk, including the consideration of the steps which should be taken:—

- (i) to stimulate production;
- (ii) to conserve milk supplies during any period of excess;
- (iii) to provide for the special needs of children in urban centres;
- (iv) to effect economies in the cost of production and distribution;
- (v) to organise supplies by administrative action, so as to reach all sections of the community; and
- (vi) other kindred subjects.”

3. The main Committee have held in all 39 meetings, the first of which was held on the 21st May, 1917, and the last on the 22nd October, 1919, and have met representatives of all sides of the milk industry.* The Committee have, however, neither found it possible nor thought it desirable to do the whole of their work as one body, and, accordingly, Sub-Committees were set up to investigate special aspects of the problem, such as:—

- (1) Agricultural questions.
- (2) Labour in dairy farming.
- (3) Education in dairying.
- (4) Handling of milk.
- (5) Pasteurization.

87 meetings in all were held by the various Sub-Committees. The reports of those mentioned above will be found on pages 28-54 of the Appendix. Other reports have already been published. (C.D. 9095 and C.D. 315.)

4. *Changes in Membership of the Committee.* Since the Committee was set up two of the original members have resigned, viz., Prof. T. B. Wood and Mr. J. O'Grady, M.P., Mr. J. F. Blackshaw, O.B.E., Mr. Wilfred Buckley, Mr. C. T. Cramp, Sir Douglas Newton, K.B.E., and Sir Beville Stanier, M.P., have been appointed members. On the appointment of Lord Astor as Parliamentary Secretary to the Ministry of Food, Col. W. E. G. A. Weigall, M.P., was appointed Deputy Chairman.

5. *Interim Reports.* The duties of the Committee have been two-fold:—

- (a) To advise as to measures for dealing with problems arising immediately out of war conditions;
- (b) To consider the general conditions of the dairying and milk distributing industries apart from the war, with a view to their being placed on a more satisfactory basis for the future.

6. The Committee's 1st and 2nd Interim Reports (C.D. 8608 and C.D. 8886) issued respectively on the 8th June and the 30th November, 1917, dealt almost entirely with questions of immediate urgency, and were chiefly devoted to the problems of keeping up the supply of milk and providing for its equitable distribution in the winter of 1917. Various measures were recommended to and adopted by the Ministry of Food. Among these were the granting of priority in supply of feeding stuffs to dairy cattle, and the preserving of surplus supplies of summer milk in order to form a reserve for use in winter months. A priority scheme for the supply of milk was put forward by the Committee, as it was agreed that a scheme of rationing such as those which had been applied to certain other articles of food was impracticable in the case of milk.

7. In the 3rd Interim Report (C.D. 315) published in November, 1918, more attention was given to problems which, though not due only or mainly to war conditions, had nevertheless been disclosed and emphasised during the war, examples of such problems being the effect on dairy farming of the Corn Production Act, 1915, the desirability of the keeping of proper farm accounts, and the provision of further instruction for agriculturalists as to more modern and economical methods of feeding dairy cattle.

8. *Scope of Final Report.* The present and final report accordingly deals chiefly with matters affecting the milk industry and its development in the future, including both the period of post-war abnormal conditions which must continue for some time, and the subsequent period when the temporary effects of war will no longer operate.

II. PRESENT STATE OF THE MILK SUPPLY.

(a) PRODUCTION.

9. *Numbers of Dairy Stock during the War.*—During the war the numbers of dairy stock in the United Kingdom have shown a slight increase in spite of the lessened area under pasture and the diminished supplies

* For a list of the names of the witnesses interviewed, see Appendix, page 27.

of concentrated foods. The following table shows the numbers of cows and heifers in milk and in calf in Great Britain and the United Kingdom in June for the last eight years:—

Year.	Great Britain.	United Kingdom.
1912	2,784,389	4,400,816
1913	2,695,391	4,317,957
1914	2,937,923	4,595,128
1915	2,883,696	4,494,750
1916	2,870,458	4,499,321
1917	2,906,596	4,514,803
1918	3,030,255	4,603,841
1919	3,008,775	

10. *Changes in the Rate of Milk Production.*—While the above figures are important as indicating that the national dairy herd has increased in numbers, the Committee are aware that in spite of this increase there has been a decrease in the total quantity of milk produced, particularly in winter. The reasons for this decrease are given in para. 16.

The principal materials at present available for estimating changes in the rate of milk production are:—

- (1) The Census of Production figures for 1908-9 in Great Britain.
- (2) The preliminary figures of the Irish Census 1912-13.
- (3) Ministry of Food Census figures for 1918.
- (4) Information obtained from the statistics of Milk Recording Societies and large commercial milk producers.

11. *Milk Production in Great Britain.*—The 1908-9 census for Great Britain gave a yield of 550 gallons per annum for each cow in milk, exclusive of milk used for calf-rearing. The corresponding figure given by the Ministry of Food Census for 1918 was 436 gallons.

The statistics obtained from Milk Recording Societies show for 1910-11 to 1914-15 a considerable increase in the yield. A large part of this was probably due to the selection of cows in the societies, but there appears to have been an increase also in the average yield. In the early years of the war, 1915-16, the figures show a decrease, which was accentuated in 1917 and 1918, owing to the shortage of feeding-stuffs and of skilled labour.

12. The evidence available suggests the following variations in the yield per cow in milk:—

	Gallons.	Index.
1908-9	550	100
1909-13	560	102
1914	575	105
1915	550	100
1916	525	95
1917	495	90
1918	436	80

The number of cows in milk remained substantially unaltered except for a temporary increase in 1915-1916. On the rates given above, the total annual production of milk in Great Britain, less milk used for calf-rearing, was approximately as follows:—

1909-13 (average)	1,231 million gallons.
1914	1,253 „ „
1915	1,241 „ „
1916	1,164 „ „
1917	1,086 „ „
1918	955 „ „

13. *Milk Production in Ireland.*—Data supplied by the Irish Department for 1912-13 show an annual total yield of 414 gallons per cow. Irish production is characterised by summer dairying, so that it did not suffer so much from the shortage of concentrated feeding-stuffs, neither was the scarcity of skilled labour so marked. On the other hand, annual production was more liable to be affected by weather conditions in the summer months. In the absence of definite data, the rate of 414 gallons has been retained up to 1916. The year 1917, by common consent, was a very bad year for milk production in Ireland, and for that year the rate has been written down to 375 gallons, a reduction of 10 per cent. A further decrease in 1918 was indicated by reports from the Irish Department and by statistics of the export of dairy produce, into which a very large proportion of Irish milk is converted, and the rate for 1918 has been taken at 350 gallons.

Up to 1917 the numbers of the dairy herd remained very steady, and the decrease in 1918 was very slight. At the rates quoted above, the annual production, inclusive of milk fed to animals, was as follows:—

1909-13	664 million gallons.
1914	671 „ „
1915	669 „ „
1916	663 „ „
1917	601 „ „
1918	550 „ „

14. *Milk Production in the United Kingdom.*—On the figures set out above the total yield for the United Kingdom may be estimated at:—

1909-13 (average)	1,895 million gallons.
1914	1,924 „ „
1915	1,910 „ „
1916	1,827 „ „
1917	1,687 „ „
1918	1,505 „ „

* The figures of the Irish Census for 1919 are not yet complete.

15. *Seasonal variation of yield.*—The index given below indicates the monthly variation in percentages, according to the daily average, of the total milk supply during the years 1917-18. It has been calculated from returns of production from various sources, and takes account of the seasonal variation in calving:—

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
5.9	6.0	6.9	8.1	10.8	11.8	10.3	9.8	9.1	8.3	7.1	5.9 = 100.0

16. The decrease in output shown by the tables in paragraphs 12, 13 and 14 may be attributed to three main causes:—

- (a) the scarcity and high price of feeding stuffs;
- (b) the deterioration in the quality of cakes and meals;
- (c) the lessened efficiency of milkers.

These factors exercise the greatest influence during the winter. In addition, it is probable that the proportion of cows in milk during the winter has been less than under pre-war conditions. Although the total number of cows shows an increase, there is evidence to show that the numbers have been considerably reduced in districts and on farms which formerly specialised in winter milk production. In these districts the production of milk was largely dependent on purchased concentrates and soiling crops, hence the cost of production has risen much more than in districts where retentive soils and pastures and a moister climate reduce the use of soiling crops and purchased foods to a minimum.

(b) CONSUMPTION.

17. *Importance of Milk as Food.*—The Committee have already put on record their opinion that the average consumption of milk in the United Kingdom is much lower than is desirable in the national interest.* Milk contains all the nutritive constituents required by the body—protein, fats, and carbohydrates—in a readily assimilable form, which makes it a valuable food for all classes of the community and especially for children. For infants who may have to depend on artificial feeding it is essential. Milk ought, therefore, to be available in greater quantities than are obtainable at present.

18. *Growth-promoting Substances.*—In addition to the above-mentioned constituents, milk has been shown to possess special properties which promote growth, and are necessary for maintaining the body in a healthy condition. These qualities of milk were first made known by Professor F. Gowland Hopkins at Cambridge, and have since been the subject of research by numerous investigators, notably Professors T. B. Osborne, and L. B. Mendel of Yale University, and Professor E. V. McCollum of the Johns Hopkins University. The exact nature and composition of these growth-promoting substances, or vitamins, as they are provisionally termed, is at present unknown, but their existence is inferred from the effects produced in respect of growth and health by feeding animals on special and carefully controlled diets.

The investigations into this subject so far as they have proceeded at present indicate the existence of at least three growth-promoting substances or vitamins, all of which are present in milk. These have been termed:—

- (i) The ricket preventing vitamin (or fat soluble A), which is necessary to promote growth and to prevent rickets in young animals.† The fat of cream and butter are amongst the richest known sources of this vitamin.
- (ii) The anti-neuritic vitamin (or water soluble B growth substance of American investigators), which is also necessary to promote growth, and in addition is essential to prevent the occurrence of the disease known as beri-beri. This vitamin is found in the germ and in the bran or outer layers of certain grains and in milk, but not in association with the fat of the milk.
- (iii) The scurvy-preventing vitamin, which is essential to prevent the disease known as scurvy. This vitamin is found in fresh untreated cows' milk and in fresh fruits and vegetables in quantities suitable for the satisfactory nutrition of the young.

There is no evidence that the heating of milk destroys to any serious extent the vitamins described in (i) and (ii) above. The scurvy-preventing vitamin (paragraph (iii) above) is, however, sensitive to exposure to heat or to drying, and pasteurised, boiled, dried, or condensed milk may be regarded as inferior in varying degrees to raw milk in scurvy-preventing properties. When milk prepared in these ways is utilised for the feeding of infants over long periods, it is desirable to supplement its scurvy-preventing properties by the addition to the diet of small quantities of vegetable or raw fruit juices, preferably orange juice, which is very rich in this particular vitamin. The very great difficulty of procuring clean milk in this country, and the risk of infection with tuberculosis and other diseases from the use of raw milk, have frequently led to the use of pasteurised, sterilised, dried, or condensed milk for infant feeding.

Skimmed or separated milk is deficient in the ricket-preventing vitamin, and the development of rickets may follow from its extended use in the feeding of young children unless the deficiency is made good by the addition of cream or cod liver oil.

19. Attention may here be called to the inferiority in this respect of margarine to butter as a source of fat in the diet, especially of growing children. Margarine is usually manufactured largely from vegetable oils; these are deficient in the anti-rachitic vitamin, which is characteristic of many animal fats, and the nutritive value of margarine made from such oils is, therefore, inferior, especially for children.

20. Although vegetable oils and fats are generally deficient in the ricket-preventing vitamin, which is also essential for growth, yet the green parts of plants are the chief ultimate source of this vitamin; for, as far as is at present known, animals are unable to build up this or any vitamin within their own bodies, but obtain them directly or indirectly from the vegetable kingdom. For this reason the diet of cows, especially of those whose milk is to be used for infant feeding, should itself contain an abundance of all the

* 1st Interim Report (Cd. 8608), page 1, and 3rd Interim Report (Cd. 315), page 12.

† E. Mellanby, Journ. Physiol. (Proceedings) 52, 11 and 12, 1918. *Lancet*, March 15th, 1919.

necessary growth-promoting substances. The green parts of plants contain all the above vitamins in abundance, and there is evidence* showing that the milk given by cows in the summer, when the diet consists of fresh green pasture, is richer in vitamins than in the winter, when the chief foods are hay, straw, roots and concentrates.

21. *Present-day Average Consumption.*—That enough liquid milk is not consumed is shown by the returns in the following table obtained in January, 1918, through Local Food Control Committees:—

<i>Food Division Area.</i>						<i>Consumption per head per day.†</i>
1. Northern	...	...	...	...	...	0·19 pts. liquid milk.
2. North Eastern	...	...	...	...	...	0·22 " " "
3. Home Counties (S)	...	...	...	...	...	0·29 " " "
4. " " (N)	...	...	...	...	...	0·27 " " "
5. Eastern	...	...	...	...	...	0·18 " " "
6. North Western	...	...	...	...	...	0·27 " " "
7. London	...	...	...	...	...	0·31 " " "
8. South Western	...	...	...	...	...	0·28 " " "
9. South Midlands	...	...	...	...	...	0·27 " " "
10. Midlands	...	...	...	...	...	0·24 " " "
11. North Midlands	...	...	...	...	...	0·23 " " "
12. North Wales	...	...	...	...	...	0·20 " " "
13. South Wales	...	...	...	...	...	0·16 " " "
<i>Scotland.</i>						
Edinburgh	...	...	...	...	...	0·22 " " "
Glasgow	...	...	...	...	...	0·25 " " "
Inverness	...	...	...	...	...	0·10 " " "
Average per head per day for Great Britain						0·25 pts. liquid milk.

22. From the above table it will be seen that the consumption of milk per head per day in Great Britain varied in January, 1918, from $\frac{1}{10}$ of a pint in Inverness to $\frac{3}{4}$ of a pint in London; the average for the country was $\frac{1}{4}$ pint per head per day. Working-class consumption has been put by the Board of Trade‡ at 1·8 pints per head per week, which also works out to $\frac{1}{4}$ pint per head per day. This is less than half the normal average consumption of the City of New York. Consumption in Great Britain is uneven and varies, according to the available returns in the large towns, from '63 pints per head per day in Hornsey to '08 pints per head per day in Dudley, and in the smaller towns from '67 pints per head per day in Winchester to '06 pints per head per day in Llanelly. Though there must be some uncertainty attached to the returns of retail sales on which these figures, particularly those relating to rural and small urban areas, are based, it is clear that the average daily consumption of milk throughout Great Britain is much lower than is desirable.

23. *Production and Priority Requirements.*—The diagram on the opposite page shows in block form the requirements of the various classes of the population under the priority scheme put forward in the Second Interim Report (Cd. 8886),§ together with curves of the total supply of liquid milk available, and the supply available for consumption as liquid milk.

It will be seen that if children up to 6 years of age had taken the full quantities necessary to them no milk would have been available for use by adults in the months of November, December, January, and February, and the supply would not even have sufficed for the children of 6 to 14 years of age. In practice, unfortunately, children do not get enough milk. In many industrial centres there are known to be whole streets where no fresh milk is taken.

24. *Milk Supply in Rural Districts.*—The position of the rural inhabitant requires special mention. It is often more difficult for people living in the country to obtain milk than it would be if they were living in cities. This is mainly due to the fact that it is easier for farmers to sell the whole of their milk output to one large contractor than to retail it themselves over a scattered population. This difficulty could be avoided by an arrangement whereby the local consumers would register themselves with the village shopkeeper, who would buy the necessary number of gallons of milk from the farmer and retail it as required. Such a scheme is in successful operation in several villages in England, and obviates the objection of the farmer to the sale of milk in small quantities at the farm itself, while it ensures that fresh milk shall be available for all those who have taken the trouble to register their requirements. The extension of the keeping of goats would also do much to provide a supply of milk for rural areas. Goats can support themselves on the roughest grass, are easily tethered and kept, and are quite hardy. Many small-holders in certain districts on the Continent get all their milk from goats kept in small sheds and fed on wayside strips of grass.||

* Barnes and Hume, *Lancet*, August 23rd, 1919.

† The actual consumption per head would be slightly above the figures given, as milk produced and consumed on farms, etc., does not appear in the returns, whereas the figures include the rural population. This error would be most marked in preponderantly rural areas. The London figures are approximately correct.

‡ Report of another Enquiry by the Board of Trade into Working Class Rents and Retail Prices, together with the Rates of Wages in Certain Occupations. (Cd. 6955.) 1913.

§ Group 1.—(a) Children from birth to 9 months to receive not more than 1½ pints a day under a medical certificate, stating that the infant cannot be breast fed or can only be partially breast fed.

(b) Children from 10 to 18 months 1½ pints a day.

(c) Milk on a medical certificate.

Group 2.—Children 19 months to 5 years 1 pint per day.

Group 3.—Children from 6 to 14 years 1 pint per day.

Group 4.—All other persons ½ pint per day, or according to supplies available.

|| For Report of Sub-Committee on Goats, see page 17 of 3rd Interim Report. (Cd. 315.)

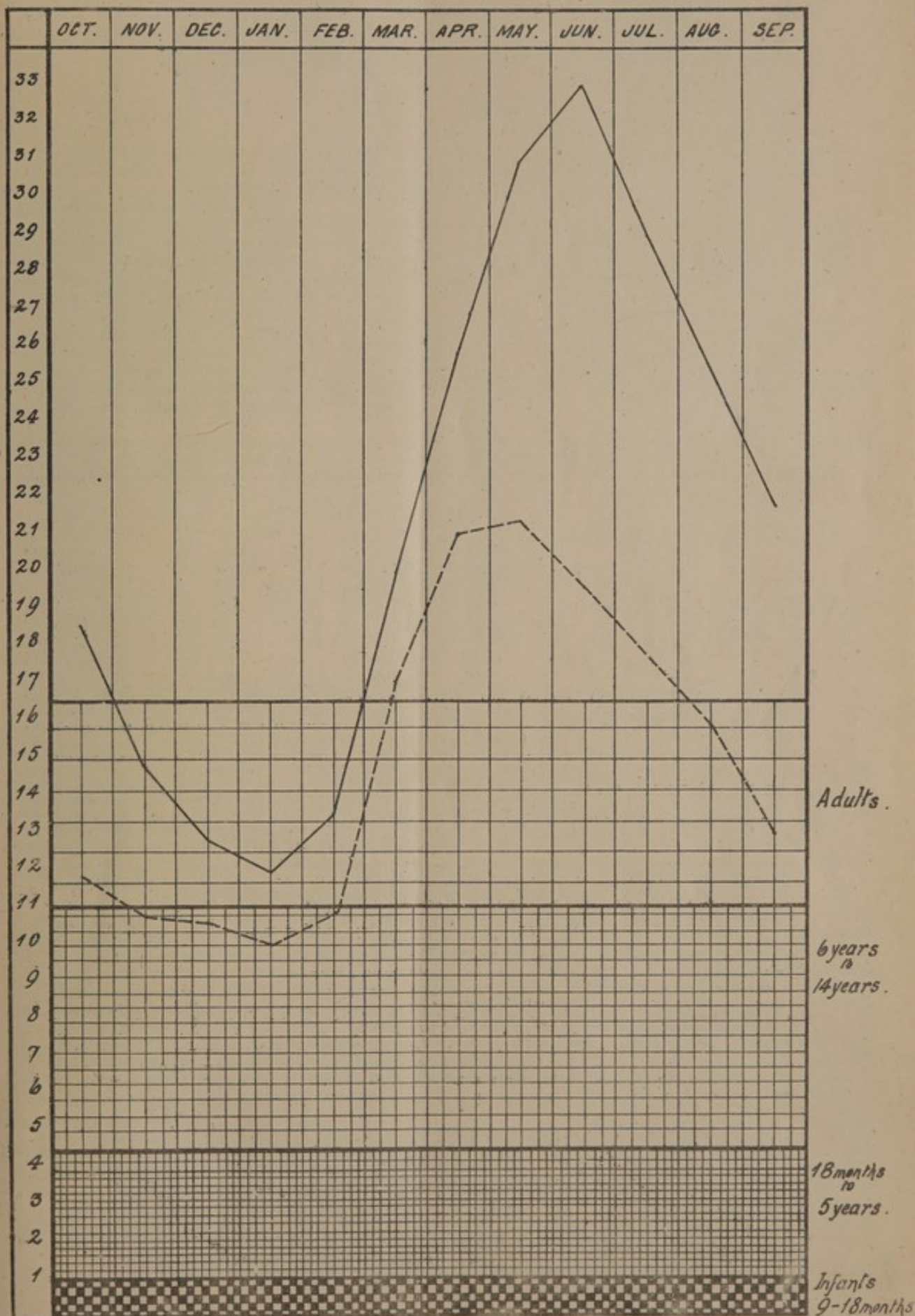
ESTIMATES OF SUPPLIES & REQUIREMENTS FOR GREAT BRITAIN

———— = Weekly production of milk for all purposes.

----- = Weekly consumption of liquid milk.

The horizontal blocks represent the total amounts which the committee estimated each age group ought to get.

Scale = Million Gallons per week.



STATISTICS OF EXPORTS & REQUIREMENTS
FOR GREAT BRITAIN

EXPORTS		REQUIREMENTS	
Year	Value	Year	Value
1870	1,234,567	1870	2,345,678
1871	1,345,678	1871	2,456,789
1872	1,456,789	1872	2,567,890
1873	1,567,890	1873	2,678,901
1874	1,678,901	1874	2,789,012
1875	1,789,012	1875	2,890,123
1876	1,890,123	1876	2,901,234
1877	1,901,234	1877	3,012,345
1878	2,012,345	1878	3,123,456
1879	2,123,456	1879	3,234,567
1880	2,234,567	1880	3,345,678
1881	2,345,678	1881	3,456,789
1882	2,456,789	1882	3,567,890
1883	2,567,890	1883	3,678,901
1884	2,678,901	1884	3,789,012
1885	2,789,012	1885	3,890,123
1886	2,890,123	1886	3,901,234
1887	2,901,234	1887	4,012,345
1888	3,012,345	1888	4,123,456
1889	3,123,456	1889	4,234,567
1890	3,234,567	1890	4,345,678
1891	3,345,678	1891	4,456,789
1892	3,456,789	1892	4,567,890
1893	3,567,890	1893	4,678,901
1894	3,678,901	1894	4,789,012
1895	3,789,012	1895	4,890,123
1896	3,890,123	1896	4,901,234
1897	3,901,234	1897	5,012,345
1898	4,012,345	1898	5,123,456
1899	4,123,456	1899	5,234,567
1900	4,234,567	1900	5,345,678
1901	4,345,678	1901	5,456,789
1902	4,456,789	1902	5,567,890
1903	4,567,890	1903	5,678,901
1904	4,678,901	1904	5,789,012
1905	4,789,012	1905	5,890,123
1906	4,890,123	1906	5,901,234
1907	4,901,234	1907	6,012,345
1908	5,012,345	1908	6,123,456
1909	5,123,456	1909	6,234,567
1910	5,234,567	1910	6,345,678
1911	5,345,678	1911	6,456,789
1912	5,456,789	1912	6,567,890
1913	5,567,890	1913	6,678,901
1914	5,678,901	1914	6,789,012
1915	5,789,012	1915	6,890,123
1916	5,890,123	1916	6,901,234
1917	5,901,234	1917	7,012,345
1918	6,012,345	1918	7,123,456
1919	6,123,456	1919	7,234,567
1920	6,234,567	1920	7,345,678
1921	6,345,678	1921	7,456,789
1922	6,456,789	1922	7,567,890
1923	6,567,890	1923	7,678,901
1924	6,678,901	1924	7,789,012
1925	6,789,012	1925	7,890,123
1926	6,890,123	1926	7,901,234
1927	6,901,234	1927	8,012,345
1928	7,012,345	1928	8,123,456
1929	7,123,456	1929	8,234,567
1930	7,234,567	1930	8,345,678
1931	7,345,678	1931	8,456,789
1932	7,456,789	1932	8,567,890
1933	7,567,890	1933	8,678,901
1934	7,678,901	1934	8,789,012
1935	7,789,012	1935	8,890,123
1936	7,890,123	1936	8,901,234
1937	7,901,234	1937	9,012,345
1938	8,012,345	1938	9,123,456
1939	8,123,456	1939	9,234,567
1940	8,234,567	1940	9,345,678
1941	8,345,678	1941	9,456,789
1942	8,456,789	1942	9,567,890
1943	8,567,890	1943	9,678,901
1944	8,678,901	1944	9,789,012
1945	8,789,012	1945	9,890,123
1946	8,890,123	1946	9,901,234
1947	8,901,234	1947	10,012,345
1948	9,012,345	1948	10,123,456
1949	9,123,456	1949	10,234,567
1950	9,234,567	1950	10,345,678
1951	9,345,678	1951	10,456,789
1952	9,456,789	1952	10,567,890
1953	9,567,890	1953	10,678,901
1954	9,678,901	1954	10,789,012
1955	9,789,012	1955	10,890,123
1956	9,890,123	1956	10,901,234
1957	9,901,234	1957	11,012,345
1958	10,012,345	1958	11,123,456
1959	10,123,456	1959	11,234,567
1960	10,234,567	1960	11,345,678
1961	10,345,678	1961	11,456,789
1962	10,456,789	1962	11,567,890
1963	10,567,890	1963	11,678,901
1964	10,678,901	1964	11,789,012
1965	10,789,012	1965	11,890,123
1966	10,890,123	1966	11,901,234
1967	10,901,234	1967	12,012,345
1968	11,012,345	1968	12,123,456
1969	11,123,456	1969	12,234,567
1970	11,234,567	1970	12,345,678
1971	11,345,678	1971	12,456,789
1972	11,456,789	1972	12,567,890
1973	11,567,890	1973	12,678,901
1974	11,678,901	1974	12,789,012
1975	11,789,012	1975	12,890,123
1976	11,890,123	1976	12,901,234
1977	11,901,234	1977	13,012,345
1978	12,012,345	1978	13,123,456
1979	12,123,456	1979	13,234,567
1980	12,234,567	1980	13,345,678
1981	12,345,678	1981	13,456,789
1982	12,456,789	1982	13,567,890
1983	12,567,890	1983	13,678,901
1984	12,678,901	1984	13,789,012
1985	12,789,012	1985	13,890,123
1986	12,890,123	1986	13,901,234
1987	12,901,234	1987	14,012,345
1988	13,012,345	1988	14,123,456
1989	13,123,456	1989	14,234,567
1990	13,234,567	1990	14,345,678
1991	13,345,678	1991	14,456,789
1992	13,456,789	1992	14,567,890
1993	13,567,890	1993	14,678,901
1994	13,678,901	1994	14,789,012
1995	13,789,012	1995	14,890,123
1996	13,890,123	1996	14,901,234
1997	13,901,234	1997	15,012,345
1998	14,012,345	1998	15,123,456
1999	14,123,456	1999	15,234,567
2000	14,234,567	2000	15,345,678
2001	14,345,678	2001	15,456,789
2002	14,456,789	2002	15,567,890
2003	14,567,890	2003	15,678,901
2004	14,678,901	2004	15,789,012
2005	14,789,012	2005	15,890,123
2006	14,890,123	2006	15,901,234
2007	14,901,234	2007	16,012,345
2008	15,012,345	2008	16,123,456
2009	15,123,456	2009	16,234,567
2010	15,234,567	2010	16,345,678
2011	15,345,678	2011	16,456,789
2012	15,456,789	2012	16,567,890
2013	15,567,890	2013	16,678,901
2014	15,678,901	2014	16,789,012
2015	15,789,012	2015	16,890,123
2016	15,890,123	2016	16,901,234
2017	15,901,234	2017	17,012,345
2018	16,012,345	2018	17,123,456
2019	16,123,456	2019	17,234,567
2020	16,234,567	2020	17,345,678
2021	16,345,678	2021	17,456,789
2022	16,456,789	2022	17,567,890
2023	16,567,890	2023	17,678,901
2024	16,678,901	2024	17,789,012
2025	16,789,012	2025	17,890,123
2026	16,890,123	2026	17,901,234
2027	16,901,234	2027	18,012,345
2028	17,012,345	2028	18,123,456
2029	17,123,456	2029	18,234,567
2030	17,234,567	2030	18,345,678
2031	17,345,678	2031	18,456,789
2032	17,456,789	2032	18,567,890
2033	17,567,890	2033	18,678,901
2034	17,678,901	2034	18,789,012
2035	17,789,012	2035	18,890,123
2036	17,890,123	2036	18,901,234
2037	17,901,234	2037	19,012,345
2038	18,012,345	2038	19,123,456
2039	18,123,456	2039	19,234,567
2040	18,234,567	2040	19,345,678
2041	18,345,678	2041	19,456,789
2042	18,456,789	2042	19,567,890
2043	18,567,890	2043	19,678,901
2044	18,678,901	2044	19,789,012
2045	18,789,012	2045	19,890,123
2046	18,890,123	2046	19,901,234
2047	18,901,234	2047	20,012,345
2048	19,012,345	2048	20,123,456
2049	19,123,456	2049	20,234,567
2050	19,234,567	2050	20,345,678
2051	19,345,678	2051	20,456,789
2052	19,456,789	2052	20,567,890
2053	19,567,890	2053	20,678,901
2054	19,678,901	2054	20,789,012
2055	19,789,012	2055	20,890,123
2056	19,890,123	2056	20,901,234
2057	19,901,234	2057	21,012,345
2058	20,012,345	2058	21,123,456
2059	20,123,456	2059	21,234,567
2060	20,234,567	2060	21,345,678
2061	20,345,678	2061	21,456,789
2062	20,456,789	2062	21,567,890
2063	20,567,890	2063	21,678,901
2064	20,678,901	2064	21,789,012
2065	20,789,012	2065	21,890,123
2066	20,890,123	2066	21,901,234
2067	20,901,234	2067	22,012,345
2068	21,012,345	2068	22,123,456
2069	21,123,456	2069	22,234,567
2070	21,234,567	2070	22,345,678
2071	21,345,678	2071	22,456,789
2072	21,456,789	2072	22,567,890
2073	21,567,890	2073	22,678,901
2074	21,678,901	2074	22,789,012
2075	21,789,012	2075	22,890,123
2076	21,890,123	2076	22,901,234
2077	21,901,234	2077	23,012,345
2078	22,012,345	2078	23,123,456
2079	22,123,456	2079	23,234,567
2080	22,234,567	2080	23,345,678
2081	22,345,678	2081	23,456,789
2082	22,456,789	2082	23,567,890
2083	22,567,890	2083	23,678,901
2084	22,678,901	2084	23,789,012
2085	22,789,012	2085	23,890,123
2086	22,890,123	2086	23,901,234
2087	22,901,234	2087	24,012,345
2088	23,012,345	2088	24,123,456
2089	23,123,456	2089	24,234,567
2090	23,234,567	2090	24,345,678
2091	23,345,678	2091	24,456,789
2092	23,456,789	2092	24,567,890
2093	23,567,890	2093	24,678,901
2094	23,678,901	2094	24,789,012
2095	23,789,012	2095	24,890,123
2096	23,890,123	2096	24,901,234
2097	23,901,234	2097	25,012,345
2098	24,012,345	2098	25,123,456
2099	24,123,456	2099	25,234,567
2100	24,234,567	2100	25,345,678

25. *Growth of Human and Cow Populations and of Imports of Dairy Produce.*—As may be seen from the following table, the production of milk in Great Britain in recent years has not kept pace with the increase in the human population, nor with the demand by the latter for milk products.

	1871.	1914.	Increase per cent.
Population	26,100,000	41,700,000	60
Number of cows and heifers	2,091,000	2,937,000	40
Weight of cheese imported (cwts.) ...	1,216,400	2,373,091	95
" butter imported (cwts.) ...	1,334,783*	3,882,116	304
" margarine imported (cwts.) ...		1,501,520	
" condensed milk imported (cwts.)		771,239	128
" dried milk imported (cwts.) ...	(1888)	30,601	(since 1888).
Total weight of dairy produce imported (cwts.)	2,551,200	8,558,567	235

An increase in the human population since 1871 of 60 per cent., with an increase in the number of cows and heifers of only 40 per cent., as compared with an increase in the weight of imported dairy products of 235 per cent., cannot be considered satisfactory. The increased importation of condensed and dried milk should be particularly noted.

26. *Value of Imported Dairy Products.*—The value of dairy products imported into the United Kingdom has risen steadily for the last 50 years, until in 1914 it had reached a total of £38,000,000. Of this total, over £27,000,000 was paid to Denmark and Russia for butter, and to Holland for margarine, cheese and condensed milk, while the balance (something over £10,000,000) was paid to Australia and New Zealand for butter, and to Canada and New Zealand for cheese.

27. *Comparison of British and Continental Dairy Farming.*—Holland and Denmark have no natural advantages of climate or soil which are not possessed to an even greater degree by large sections of the United Kingdom, which also offers to the British dairy farmer the advantage of proximity of markets.

28. A table given below shows the density of population, numbers of live stock per 100 acres of cultivated land and proportion of permanent grass land to the total cultivated area in the United Kingdom and in the more progressive European countries.

Table showing proportion of permanent grass land, density of population and number of livestock per 100 acres of cultivated land in the United Kingdom and other European countries.

Country.	Total Cultivated Area.	Permanent Grass.		Density of Population.		Number of Live Stock per 100 Acres Cultivated.						
		Total Area.	Percentage of Total Cultivated Area.	Per Square Mile.	Per 100 Acres Cultivated.	Total Cattle.	Dairy Cows.	Other Cattle.	Pigs.	Sheep.	Horses.	Goats.
	Acres.	Acres.	Per cent.									
Belgium	4,472,382	1,223,979	27.3	658	167.7	40.9	20.9	20.0	30.1	—†	5.8	—†
Holland	5,343,452	2,996,291	56.7	479	112.7	38.1	20.1	18.0	23.7	16.7	6.1	4.1
Denmark	6,910,922	778,106	11.2	180	40.5	32.5	18.5	14.0	21.2	10.5	7.7	.5
Sweden	12,252,566	3,224,901	26.3	32	45.0	21.9	15.0	6.9	7.7	7.7	4.8	.5
Switzerland	5,503,160	—	—	243	63.0	26.2	14.5	11.7	10.3	2.9	2.6	6.6
Germany	78,632,139*	19,463,884†	24.7	311	82.6	24.5	12.7	11.8	26.6	7.0	5.7	4.3
Ireland	14,673,778	9,685,227	66.0	135	29.8	33.0	10.8	22.2	9.0	26.6	3.7	—
United Kingdom ...	46,669,802	27,020,948	57.8	381	97.0	25.4	9.4	16.0	8.5	61.8§	4.2	—
Scotland	4,821,334	1,496,307	31.0	156	98.3	24.5	9.0	15.5	3.3	145.2	4.0	—
England and Wales ...	27,174,690	15,839,414	58.2	633	135.8	21.4	8.6	12.8	9.1	66.4	4.5	—
France	90,369,368	24,938,627	27.5	193	44.2	16.2	8.6	7.6	7.6	18.0	3.5	1.5

* Excluding rough grazing.

† Including rough grazing.

‡ Not enumerated since 1895.

§ Sheep kept on mountain land not classed as cultivated are included in these figures.

England and Wales, though almost as densely populated as Belgium, had in 1912 some 58 per cent. of the total cultivated area under permanent grass and maintained 8.6 cows per 100 acres as compared with Belgium's 27.3 per cent. of permanent grass and 20.9 cows per 100 acres. Holland alone showed a percentage (56.7) of permanent pasture approaching that of England and Wales, and Holland maintained 20.1 cows per 100 acres. Denmark, with a comparatively sparse population, but with easy access to British and German markets, maintained 18.5 cows per 100 acres with only 11.2 per cent. of permanent grass land. The outstanding feature of this comparison is the greater attention given to dairying as indicated by the greater proportion of cows kept in all these countries (with the exception of France) than in the United Kingdom.

There seems no good reason why the United Kingdom should have per 100 acres only (i) 45 per cent. cows as compared with Belgium, (ii) 47 per cent. compared with Holland, (iii) 51 per cent. compared with Denmark, (iv) 62 per cent. compared with Sweden, (v) 65 per cent. compared with Switzerland, and (vi) 74 per cent. compared with Germany.

29. The reasons for the relative importance of dairying probably differ from country to country. In Holland, and to a lesser degree in Switzerland, the possession of suitable grass land and of breeds of stock of great dairy capacity has made the development of a great dairy industry natural and easy. In Denmark, on the other hand, previous to the Prussian War of 1864, the chief type of farming was corn-growing, and in the subsequent period of reconstruction, when the financial position of the country necessitated the utmost economy and the best use of the land, dairying, associated with bacon production, gradually came to be recognised as the most reliable and profitable branch of farming.

* No separate statistics for butter and margarine before 1888.

† No separate statistics for condensed or dried milk in 1888.

30. *Value of the Cow as a Producer of Human Food.*—In addition, however, to particular reasons in individual countries there has undoubtedly been a widespread recognition on the Continent of the great value of the dairy cow as a producer of human food. As land, labour, and feeding stuffs have increased in price, the dairy cow has more and more displaced the strictly meat-producing farm animals as an economical agent for the conversion into human food of those field crops which are not suitable for direct human consumption. The relative economy of the different classes of farm animals for this purpose received but little study in this country before 1916, and the position of the cow in such a comparison is not yet generally realised.

31. In a recent Report* it is stated that:—

“Considerable economy in fodder can be effected by varying the kind of animal to which it is fed. All animals are by no means equally good ‘converters,’ as is shown by the following figures:—
Lb. starch equivalent in fodder required to produce 1,000 calories in the form of—

2.9	...	...	...	...	...	Milk from good cow (800 gallons).
3.0	...	...	...	...	...	Pig meat.
4.7	...	...	...	...	...	Veal.
4.7	...	...	...	...	...	Milk from bad cow (300 gallons).
5.3	...	...	...	...	...	Mutton.
7.0	...	...	...	...	...	Eggs.
7.0	...	...	...	...	...	‘Baby’ beef.
9.0	...	...	...	...	...	‘Steer’ beef.

These figures justify the agricultural policy of most Continental countries which rely on dair products, pig meat and veal, for a very large proportion of their supply of animal food. A given supply of fodder is capable of producing a far greater amount of protein and calories in these forms than if it is used to a very large extent, as in Great Britain, for the production of mutton and beef.”

Much might be written in qualification of these figures, such as the dependence of the pig on foods which are suitable for direct human consumption, the importance of the sheep as a source of wool and as a factor in the successful cropping of light arable land, and the greater labour required by cows, but in spite of all possible qualifications it is indisputable that a good cow surpasses all other farm animals in ability to convert the crops of the field into human food. Further, the supplies of human food from the pig, steer, and sheep are obtained only after these animals are killed, whereas the cow produces more human food from the same amount of fodder while alive, and still has a food value when killed.

32. *Some Reasons for the Slow Development of Dairying in Great Britain.*—Other factors which have contributed greatly to the development of dairying and associated branches of farming on the Continent are (1) the national system of education, including technical education and research in dairying, (2) co-operation, (3) peasant occupancy, (4) systems of credit for farmers, (5) State assistance.

The important part played by these various agencies in the development of Continental dairying which has taken place during the last 50 years has been described fully in numerous reports issued from time to time in this country. It is, therefore, unnecessary to discuss the subject further here. For a variety of reasons the factors which made for the development of dairying on the Continent did not operate to the same extent in Great Britain. From 1870 onwards, although the population of this country increased rapidly, there was not a corresponding increase in the production of milk and dairy products. Milk production did increase to a certain extent, and this may be taken as a recognition of the importance of the dairy cow as a producer of food, but this increase, as indicated in the table in paragraph 25, fell very far short of meeting the national requirements in respect of dairy products.

The system of tenancy instead of ownership must bear a share of the responsibility for the slow and inadequate development of dairying in Great Britain. During the agricultural depression of the eighties and nineties, when tenant farmers were threatened with ruin, landlords reduced rents to enable their tenants to carry on, but these reduced agricultural rents impoverished the landowners, and rendered many of them unable to assist in transforming buildings on grain-growing farms or in erecting new buildings for the purposes of dairying. The slow development of co-operation amongst farmers in this country also hindered the development of British dairying. Further, the defective system of agricultural and dairying education, and the almost total neglect of research in dairying subjects have severely handicapped the British farmer. His competitors in other countries have had scientific discoveries of great value brought to their knowledge years before similar information was made available in this country. Lastly, a large share of the responsibility must be attributed to the lack of any constructive Government policy.

The Committee, while fully realising the essential difference in national temperament between the population of the United Kingdom and the populations of Continental countries, are convinced that the dairying industry here would be greatly benefited by the adoption, with whatever modifications may be thought necessary, of methods which have brought about excellent results in other countries, and they make recommendations accordingly in later sections of this Report.

III.—RELATION BETWEEN PRICE AND CONSUMPTION.

33. *Variation in Supply and Price in Winter and Summer.*—During the war the increase in the cost of production of milk, and consequently in the cost to the consumer, has been so great that the consumption is unlikely to be higher than in pre-war times, and during the winter is probably considerably lower. Changing war conditions have caused successive Food Controllers to make more frequent alterations in the prices of milk than were previously brought about by ordinary commercial influences. In pre-war days the farmer made yearly or half-yearly contracts, winter prices being from 2d. to 3d. per gallon above those ruling in the summer. It was not contended that this variation represented the difference in the cost of production between the two periods, in fact, the difference in cost was as a rule considerably more than 2d. per gallon, but the stability of the cost of labour, imported feeding stuffs, &c., was such that many farmers were content to produce milk in winter at little or no profit, with the knowledge that during the summer there would be a satisfactory margin. At the same time, the price to the consumer, and consequently the consumption, remained practically uniform in winter and summer.

* The Food Supply of the United Kingdom. Report drawn up by a Committee of the Royal Society at the request of the Board of Trade. (9725) 1916.

34. The Committee adhere to the opinion expressed in the 2nd and 3rd Interim Report* that it would be in the ultimate interest of the consumer, if it were to become the recognised practice to charge a higher price for milk in winter when the cost of production is high than that charged in summer when the cost of production is low. They believe that this would assist in the provision of an adequate supply of winter milk, though such a fluctuation in price would, at least so long as high prices continue to rule, probably lead to variation in the consumption.

35. When the prices of feeding stuffs of all kinds rose rapidly during the war, the normal difference between winter and summer costs of production was accentuated. In order to safeguard the supply of winter milk, a much greater increase in price was necessary for that period than for the summer, consequently the price to the consumer instead of remaining uniform in winter and summer varied with the cost of production. This change in price has necessarily resulted in a greater variation in the consumption than was formerly the case.

36. The Committee believe that conflicting interests of producers and consumers in relation to supply can be co-ordinated by the intervention of an intermediary. This intermediary may be either the farmers' own depôt or factory, run on co-operative or other lines, or the large companies which are at present in existence, or the work might be undertaken by some public body.

37. *Growth of Wholesale Trade.*—One of the greatest changes which have taken place in the dairy industry in the course of the war has been the increase in the quantity of milk sold for human consumption which has passed through the hands of the wholesale companies. The following figures give some indication of the extent of this change:—

1918.	Gals.	1919.	Gals.
April	20,980,996	April	24,726,505
May	27,626,911	May	32,880,785
June	28,264,901	June	30,300,027
July	25,775,083	July	32,141,379
August	25,722,331	August	32,954,082

No figures with regard to the period before April, 1918, are available.

38. The chief reasons which have brought about this marked increase have been:—

- (1) the increased reluctance on the part of farmers to undertake the delivery of milk, and the readiness on the part of numerous wholesale companies to collect milk from the farmer's premises;
- (2) the fixing by the Ministry of Food of a definite margin, including a satisfactory profit, for the services rendered by the wholesaler;
- (3) the organisation, in districts where milk was not previously available for human consumption, of wholesale companies for the collection and treatment of milk and for its transportation to large centres of population.

39. *Price—Relation to Dairy Produce.*—An unduly high price for milk is prejudicial to the future of the dairy industry, for in addition to reducing, or at least preventing, any increase in consumption it must make it well-nigh impossible to increase or even to continue the home manufacture of dairy products. Condensed milk, dried milk, butter and cheese manufactured in this country, when the control of price has ceased, must be sold in competition with similar products imported from abroad.

40. At the present time, there is no competition between home-made and imported cheese as the Ministry of Food controls the price and distribution. There is, however, no such control in respect of condensed and dried milk. As the cost of raw milk, and therefore of the products made from it, is considerably less in Norway, parts of North America, New Zealand and Australia, it will be possible, when greater shipping and other facilities are available, for these products to be placed on the British market at a much lower price than similar products manufactured in this country. It is conceivable that imported condensed or dried milk may be offered at such a low price as to compete with liquid milk more acutely than has hitherto been possible. The British farmer has always considered that he was safe from foreign competition as regards liquid milk. Should the cost of milk remain at or near its present level for any considerable time, consumers will increase their purchases of condensed and preserved milk, reducing at the same time their purchases of British liquid milk. No effort or expense has been or is being spared to advertise the different forms of preserved milk. In addition, the ease with which small quantities can be obtained and kept in good condition, and the freedom from the necessity of cleaning utensils and receptacles make these preserved imported milks attractive to the average householder.

IV.—NECESSITY FOR LOWERING THE COST OF PRODUCTION OF MILK.

41. The Committee believe that the immediate and earnest attention of British dairy farmers should be directed towards improving methods of production in order that the cost of milk may be reduced, and consumption not only maintained but also increased.

42. *Variation in Cost of Milk Production.*—The extent of the variation in the cost of milk production throughout Great Britain is seldom realised. Returns from 43 farms collected and analysed by the Food Production Department in 1917 showed a variation in the net costs for the winter of 1916-17 (excluding cost of delivery) of 10d. per gallon. On six farms the cost was less than 10d. per gallon, and on six others it was over 20d. per gallon. These figures show a variation of more than 100 per cent. The increase in the prices of purchased foods since 1916-17 and the variation in the quantities used on farms following different systems of management must have increased the difference in the cost of production.

It is obvious that so long as a maximum price proves to be practically a fixed price which yields a fair profit to a large proportion of producers, the interest of these producers in more economical methods of production cannot be effectively stimulated for the reason that cheaper production will tend to lower maximum prices.

43. *British Cheesemaking.*—Reference has been made to the control of the price and distribution of cheese by the Ministry of Food. When the fixing of prices for milk was first undertaken, the relationship between the price of milk and the price of cheese was the subject of careful consideration. Under pre-war conditions, if the price per lb. which the farmer obtained for his cheese was the same as the price per gallon

of milk, there was little complaint; it was the custom then for the sender to pay the railway carriage, which was on the average 1d. per gallon, thus giving in fact a margin of 1d. in favour of cheesemaking. The sender does not now pay the railway carriage, but owing to the increased cost of manufacture and the difficulty of utilising whey profitably a margin of 2d. per gallon is necessary, that is to say, the price per lb. received for cheese should be 2d. above the price per gallon of milk. It is on this basis that the price for hard-pressed whole milk cheese was fixed for the months of May to September, 1919, inclusive, the average price being approximately 1s. 8½d. per lb. for first grade cheese. During the period of control the Ministry of Food, by pooling the less costly imported cheese with that produced in this country, has been able to make arrangements whereby British-made cheese is sold retail at a price lower than that paid to the maker.

In the future when the control and pooling of home-produced and imported supplies cease, the British cheesemaker cannot expect to receive prices on the level of those of 1918-19. There are indications, however, that the world's output of cheese for some years to come will not be equal to the total demand, and therefore the cheesemakers of this country should find a ready sale for their produce. The choicest qualities of the well-known English varieties have always commanded satisfactory prices, and will continue to do so, but ignorant or slovenly cheesemakers who offer a second or third grade product must expect keen foreign competition. All possible assistance by means of education and research should be provided so that the proportion of British cheese of the highest grade may be increased, and the home manufacturer thus enabled to obtain more remunerative prices.

44. *Effect of Guaranteed Prices for Cereals on the Price of Milk.*—The policy of guaranteeing prices for other farm products must affect the price of milk and milk products. In the past, farmers were content with a small profit on dairying, as this branch of farming was secure against foreign competition. Now, however, that farmers are guaranteed against serious loss in wheat production their whole outlook is altered. A guaranteed price giving reasonable assurance of some profit on one kind of farm produce tends to make farmers demand a higher profit on other produce, the price of which is not guaranteed. If the State guarantees to farmers remunerative prices for wheat, or even guarantees them against serious loss, farmers will require a larger profit than in the past on milk production, which is in many ways more troublesome. Failing this they will, so far as circumstances allow, tend to take up the production of grain and meat, and to reduce their output of milk and dairy produce.

It is pointed out in another part of this Report (page 22) that increased grain production may be brought about simultaneously with the maintenance or even the increase of milk production, but it must be remembered that if a farmer is reasonably assured of a satisfactory profit on grain, he may prefer, because of the lessened labour and worry involved, to utilise his roots and straw and to provide manure for his land by keeping cattle and sheep instead of dairy cows.

V. PRESENT STATE OF THE MILK SUPPLY—QUALITY AND CLEANLINESS.

45. *Present Regulations as to Quality of Milk.*—Not only is the amount of milk consumed in Great Britain much lower than is desirable, but it is known that the quality as regards cleanliness has been and is gravely defective. The regulations at present in force with regard to the quality of milk refer solely to the composition of the milk, and have nothing to do with its cleanliness, wholesomeness, or purity. They were issued by the Board of Agriculture in 1901 and 1912 under powers conferred by Section 4 of the Sales of Food and Drugs Act, 1899.

Certain powers relating to cleanliness and freedom from disease have been provided by means of the Dairies, Cowsheds, and Milkshops Orders issued by the Privy Council, and later by the Local Government Board under the Diseases of Animals Acts and by Section 4 of the Infectious Diseases (Prevention) Act, 1890. These measures have, however, been found to be largely ineffective, and the Milk and Dairies Act, 1914, and the Milk and Dairies (Scotland) Act were passed with a view to providing better means for regulating these matters. These Acts were, however, suspended until after the termination of the war. In the meantime the drafting of the Regulations which will have to be issued has revealed the need for amendments to the Act in several respects, and it was announced in the House of Commons on July 2nd, 1919, that the Departments concerned were considering the question of the necessary amendments. This action has been taken also as a result of the experience gained during the war by the Ministry of Food and the Ministry of Health.

46. *Lack of Cleanliness.*—Such examinations of the bacterial content of milk as have been undertaken in this country have indicated the unsatisfactory nature of the supply. In some cities in the United States, where it is the practice to judge of the cleanliness of milk by the number of bacteria which it contains, no raw milk with more than 30,000 bacteria per cubic centimetre is permitted by the Health Authorities to be sold for human consumption. In 1916-17 Professor Délépine investigated samples of milk delivered to Manchester Hospitals. Out of 30 samples, 64 per cent. contained over 1,000,000 bacteria per cubic centimetre. Under the standard obtaining in the City of New York this 64 per cent., some of which had probably been artificially treated by heat in order to reduce the bacterial growth, could only have been used for cooking and manufacturing purposes. Its sale for consumption by children would have been prohibited.

47. An examination made for the National Clean Milk Society by the Lister Institute, of milk supplied to 21 London hospitals also showed the bacterial content to be excessive, as many as 250,000,000 bacteria per cubic centimetre having been found in one sample. In the Appendix (page 77) will be found a table showing the excessive bacterial content of some of the milk supplied to mothers attending Infant Welfare Centres in London.

48. These bacterial counts do not necessarily mean that the milk contained disease germs, but they indicate a marked deterioration due to dirt, or to its being stale, or not having been kept properly cooled. Contamination of milk takes place partly at the farm, partly on the railways, where milk is often handled with extreme negligence, partly while in the hands of wholesalers and retailers, and again in insanitary houses and tenements after delivery. Detailed recommendations as to the care of milk at all stages,

will be found in the Report of the Sub-Committee on the Handling of Milk (Appendix IV, pp. 31-39). Milk with a high bacterial count containing no disease germs is not necessarily harmful to adults, but such milk, especially if taken in large quantities, may seriously affect the sensitive digestive organs of children. Milk as it comes from a healthy cow contains a negligible quantity of bacteria. It should be the endeavour of the responsible health authorities to see that milk supplied to children is as near as possible to its original condition when drawn from the clean udder of a healthy cow.

49. It has been represented to the Committee that the existing Regulations with regard to the chemical composition of milk require revision. The Committee have already drawn the attention of the Government Departments concerned to the anomalies in the existing Regulations, and they again urge that this subject should receive immediate attention.

VI.—POLICY OF THE FUTURE.

50. In the foregoing paragraphs an attempt has been made to refer to some of the more unsatisfactory conditions of the milk industry in this country, and to show that an increased consumption and production of better and cheaper milk are urgently needed. The Committee are aware, however, that this cannot be accomplished hurriedly, and that real progress will only be made by such methods as will command sympathy and co-operation from both producers and consumers. The initial steps should be such as will meet with the approval of the majority of progressive farmers, and encourage the production of milk. At the same time, measures must be taken to add to the knowledge of the consumer as to the value of milk as a food and thus lead to an increased demand. The aims of an enlightened milk policy should be:—

- (a) To bring about the utmost possible economy in production in order that:—
 - (i) prices may be kept at as low a level as possible to the consumer, and consumption thus increased to the desired standard;
 - (ii) an adequate supply may be brought within the reach of the poorest families.
- (b) To improve the hygienic quality of milk, and to ensure that that portion of the supply which requires or is subjected to pasteurisation is efficiently pasteurised under supervision.
- (c) To increase the total supply in order to meet the extended consumption that should follow improved quality and the education of the public with regard to the nutritive properties of milk.
- (d) To prevent the exploitation of the producer or the consumer by any trust or combination, either of a provincial, national, or international character.

VII.—STEPS TO BE TAKEN TO REDUCE COST OF PRODUCTION.

51. The Committee are of the opinion that dairy farmers should take steps to lessen the cost of production in order that milk may be obtainable at a lower price. The Committee have devoted much time to the consideration of this matter. In their opinion the necessary work cannot be completed at once or by any single action, but they consider that much may be done within a reasonable time if farmers respond with intelligence and goodwill and if adequate assistance is given by the Government.

The cost of milk can be lessened:—

- (1) by reorganising the system of herd management in order to:—
 - (i) reduce loss when high-priced dairy cows are sold for slaughter;
 - (ii) lengthen the milking period of the best cows;
 - (iii) obtain a better distribution of the dates of calving;
 - (iv) reduce as far as possible dependence on purchased foods;
- (2) by improving the milking capacity of dairy stock so as to increase the average yield, and thus diminish the cost of production per gallon;
- (3) by more economical and methodical feeding;
- (4) by the introduction of labour-aiding machinery and equipment, and by a gradual improvement in the arrangement of farm buildings;
- (5) by more businesslike methods of account keeping;
- (6) by greater cleanliness in the production and handling of milk so as to reduce the present waste and loss of milk through souring;
- (7) by the extension of co-operative methods in the purchase of feeding-stuffs and manures, particularly on the part of small farmers;
- (8) by the State provision of veterinary help so as to reduce the present heavy loss to dairy farmers through contagious abortion, tuberculosis, and other preventable diseases.

A further reduction in the cost can be brought about by better organisation of the collection, transport, and distribution of milk.

52. *Re-organisation of Herd Management.—The Town Dairy.*—The management of a herd includes the method of maintaining the herd, whether by breeding or purchase, and if by purchase, the period over which the cows are kept, i.e., whether permanently or for the lactation period only. It also includes the regulation of the time of calving, whether with a view to the production of the maximum amount of milk during the summer or to the maintenance of a uniform output throughout the year. The general study of the cost of production throughout the country, which has become necessary during the period of control of prices, has brought out the fact that there are large cities and industrial districts which are to a great extent dependent for their milk supply on herds kept actually in the towns and managed on a system which involves the replacement of from 75 to 100 per cent. of the cows annually. This leads to very heavy annual depreciation, and so to an increase in the cost of milk production. As concentrated foods are freely used in an attempt to fatten the cows during the latter portion of the milking period, this cost is further increased. The contrast between the above-mentioned system of herd management and that which obtains in the traditional dairy districts of the country is very great. In the latter only from $\frac{1}{3}$ to $\frac{1}{4}$ of the herd is changed annually, and the numbers are kept up almost entirely by home-bred stock. Each farm supplies a proportion of home-grown foods, and the production of milk is much less dependent on imported feeding-stuffs. The abandonment or modification of the system of management followed in "town dairies" and in many suburban and industrial districts would lead to the production of cheaper milk.

53. In addition to the re-organisation of herd management on the large scale described above, there is undoubtedly great need for a closer study of detail on the part of individual farmers. The information contained in the chart on page 81 of the Appendix shows, for instance, the difference in the yields of cows of different ages.

54. *Improvement in Dairy Stock. Increasing Yield of Dairy Cows.*—Probably the greatest economy in the production of milk can be effected by increasing the yield of individual cows. If the average yield per cow in the United Kingdom could be increased by $\frac{1}{10}$ of a gallon per day, the cost of milk at present prices would automatically fall about 2d. per gallon without affecting the profit made by the farmer. The following results obtained on two farms following practically the same system and in the same district illustrate how production can be cheapened:—

	<i>Farm A.</i>	<i>Farm B.</i>
Average number of cows in milk	53	51
Total cost of food per year	£794 15s. 0d.	£774 17s. 3d.
Higher cost of food on Farm A	£19 17s. 9d.	
Total milk produced	46,221 gallons.	36,033 gallons.
Higher milk yield on Farm A	10,188 "	
Cost of food per gallon on Farm A	Winter 1913-14, 5.12d.	
Cost of food per gallon on Farm B	Winter 1913-14, 7.4d.	

55. *Widespread Development of Milk Recording Needed.*—In the opinion of the Committee, milk recording has been by far the most effective agent in the improvement of dairy stock throughout the world. Energetic measures should be taken to increase the membership of existing Milk Record Societies and to form new societies in every dairying district in Great Britain and Ireland. At present there are records of the yield of 1 per cent. of the cows in England and Wales, of 5 per cent. of those in Scotland, and less than 1 per cent. of those in Ireland. Yet in each of these countries there is a National Milk Record Scheme. The chief hindrances to development during the war appear to have been the lack of organising staff and the shortage of milk recorders. The Committee recommend that the Boards of Agriculture should make such addition to their staffs (and in the case of England should give additional assistance to the Live Stock Officers in the different provinces) as may be necessary to facilitate the formation of societies wherever farmers desire to have them. A definite course of training should be provided for intending milk recorders in England and Wales and in Ireland (it is understood that this action has already been taken in Scotland). Milk recorders of proved energy and ability should be advanced under a regular system to higher and more responsible positions.

56. *Study of the Information collected by Milk Record Societies necessary.*—The Milk Record Societies accumulate much varied information as to local methods of management. The Committee believe that the interest of farmers in milk records would be stimulated, and that the systems of management in different districts would be considerably improved if an analysis of the results obtained by a society or group of societies were made available to the dairy farmers concerned. They have had evidence that such an analysis is being carried out in Scotland, but they understand that no provision is at present made for any such study in England and Wales, or Ireland. The educational side of milk record work should be associated with the local centre for agricultural and dairy education, and the Agricultural Colleges should be asked to undertake such an examination and to publish the results in a simple and concise manner.

57. *Milk Record Schemes should encourage Tests of the Quality of the Milk of Individual Cows.*—The milk recording scheme in operation in England and Wales appears to be restricted too exclusively to the obtaining of information as to the yield of milk. The work of Milk Record Societies should be extended so as to include fat tests of herds or at least of the heaviest milkers, i.e., those whose calves are most likely to be retained.

The Committee hope* that the Board of Agriculture and Fisheries will formulate and publish a scheme for the testing of samples of milk from most or all of the cows in herds of members of Milk Record Societies, and encourage the taking of fat tests at regular intervals by increasing the grant to societies which adopt and efficiently carry out a reliable scheme.

58. *Register of Dairy Cows with Authenticated High Yields.*—The Committee welcome the scheme of the Board of Agriculture for the registration of dairy cows which have authenticated records of 8,000 lbs. in one year, or an average of 6,500 lbs. for two or more years, and are of opinion that this measure will lead to a great improvement in dairy stock. This scheme, however, in its present extremely simple form, which classes Jerseys with Friesians, and heifers with mature cows, does not meet the situation adequately. They endorse the recommendation† of their Agricultural Sub-Committee that this scheme should be enlarged so as to (a) provide separate classes for the different breeds and for animals of different ages, and (b) take cognisance of the percentage of fat in the milk as well as of the total yield of individual cows.

59. *Improvement of Dairy Bulls.*—The Committee feel that yet another result which might be obtained from the keeping of milk records has been too often neglected in the past. There is need for the improvement of dairy bulls. This can best be done by giving greater attention to milk record ancestry on the female side. In selecting a bull for a dairy herd, pedigree should be taken to mean not only a list of the bull's progenitors for several generations, but should include authenticated records of the milk yield of the dam and grandams. Frequently also, in judging dairy bulls, too much attention is paid to external appearance and handling properties. In the noted dairy countries of the world, dairy bulls are seldom, if ever, judged by their external characteristics only. The real test of a dairy bull must be the power to beget offspring which will yield large quantities of rich milk. The Committee believe that until the value of this information is more generally recognised, progress in the breeding of the highest class of dairy cows will be slow and disappointing.

Further, bulls are usually disposed of before their value has been proved by the milk records of their progeny. Breeders should find means whereby bulls can either be kept in the herd or be leased to other breeders until the value of their heifers has been ascertained. In this way bulls which transmit the qualities of a large and good milk yield could be discovered before it is too late, and could then be used or sold to the mutual advantage of the owner and of the national dairy stock.

60. *More Economical Methods of Feeding.*—The keeping of milk records usually increases the interest felt by the farmer in the management of his dairy herd, and often induces him to place his system of feeding on a more economic basis.

* See Appendix, page 29.

† See Appendix, page 30.

The wasteful and extravagant practice of giving the same amount of food to all cows has been discarded by all progressive farmers, but is still too common throughout the country. There is much room for instruction in the keeping of food records and in the most economical rations for milk production. The following figures show the saving effected during the winter period in two cases where milk recording and an improved system of feeding were adopted. In both instances the adoption of a proper system of feeding was the direct result of the keeping of milk records:—

Herd A.

December, 1912.

Cost of food per gallon of milk—7·48d.

January to March, 1913.

Cost of food per gallon of milk—5·21d.

Saving approximately 2½d. per gallon on 9,570 gallons ... 39 14 4

December, 1913, to March, 1914.

Cost of food per gallon of milk—5·33d.

Saving approximately 2d. per gallon on 17,392 gallons ... 144 18 8

December, 1914, to March, 1915.

Cost of food per gallon of milk—6·2d.

Saving approximately 1d. per gallon on 17,472 gallons ... 17 16 0

Total saving in feeding for three winter periods in a herd of 60 cows ... £307 9 0

Herd B.

December, 1912, to March, 1913.

Cost of food per gallon of milk—7·32d.

December, 1913, to March, 1914.

Cost of food per gallon of milk—4·79d.

Saving approximately 2d. per gallon on 8,521 gallons ... 71 0 2

December, 1914, to March, 1915.

Cost of food per gallon of milk—4·61d.

Saving approximately 2d. per gallon on 9,443 gallons ... 78 13 10

Total saving in feeding for two winter periods in a herd of 40 cows ... £149 14 0

61. *Improved Pasture in Relation to Cheaper Summer Production.*—In respect of summer feeding, there is ample evidence that the quantity and quality of pasture on many dairy farms could be greatly improved, and the cost of milk production thereby lessened, by greater and wiser expenditure on manuring. The following experiment in manuring for milk carried out at the Midland Agricultural College gives a illustration of the results obtainable.

In April, 1909, two plots of four acres each of poor pasture, similar in every respect, were fenced off and dressed with 10 cwts. per acre of ground lime. Plot A received no further manuring, and plot B received 4 cwts. superphosphate and 1½ cwts. sulphate of potash per acre. The effect of this dressing was measured during the summers of 1909, 1910, 1911, and 1912 by comparing the total weight of milk produced by the cows grazing on both plots, the cows being changed from plot to plot every fortnight.

The yield of milk obtained from each plot over the 4-year period was as follows:—

Year.	Yield from Plot A. (Unmanured.) lb. Milk.	Yield from Plot B. (Manured.) lb. Milk.
1909	5,531	9,020½
1910	6,685	10,333½
1911	5,586½	8,921½
1912	8,740	13,661
Totals	26,545½	41,836½
Yield per acre per annum	1,659	2,614

Increase per acre per annum due to manuring, 955 lbs. = 92 gallons.

After allowing for the cost of the manure, the above increase in milk yield showed a profit of £1 19s. 0d. per acre per annum over four years with milk at 6d. per gallon.

Much of the second-rate grass land in the pastoral districts of England could, by suitable manuring, be made to produce at least 50 gallons more milk per acre annually (thus increasing the output per acre from 175 gallons to 225 gallons per annum). On this basis 40 acres of manured pasture should produce as much milk as 50 unmanured acres.

62. *Further Education in Management and Feeding of Dairy Herds.*—In view of the widespread lack of knowledge as to the best methods of feeding and management of dairy herds, the Committee recommend that this subject should receive closer attention in the courses provided by the Agricultural Colleges and in lectures and advisory work undertaken by the County Councils. Further, they believe that lectures or courses of instruction and demonstrations on appropriate subjects at suitable hours would be appreciated by cowmen and other farm workers, as well as by farmers themselves.

63. *Introduction of Labour-aiding Machinery and Equipment.*—The question of the introduction of labour-aiding machinery and equipment and improvement in the arrangement of farm buildings is becoming of increasing importance in view of the scarcity of labour and the statutory regulation of hours and wages. In many cases the housing and surroundings of dairy cattle and the conditions under which the work of milk production has to be carried out are deplorably bad. Frequently a herd of cows is divided among a number of sheds—an uneconomical arrangement, which necessitates a wasteful expenditure of labour in the conveyance of food to the animals, in the cleaning of the cowsheds, and in the carrying of the

milk to the dairy or milk-house. The workers on such farms are unnecessarily exposed to bad weather, and have to find their way about in winter in the cold and dark amid the mud and slush of the farmyard. There are available in the majority of cases, neither sufficient supplies of water for cleansing nor such equipment as would render the more arduous of the workers' duties (e.g., the removal of manure) as little unpleasant as possible.

This state of affairs is due partly to the adaptation of old buildings for dairy purposes and partly to the erection of new buildings without sufficient consideration of the plan of the farmstead as a whole. The Committee wish to emphasise the fact that when new buildings are being erected a very considerable saving of the labour needed on the farm could be effected by the arrangement of the cowshed, food store, &c., on some such plan as is suggested on page 48 of the Appendix, and by the installation of the labour-aiding machinery referred to.

In this connection the Committee welcome the appointment by the Board of Agriculture of a Departmental Committee to arrange for the testing, adaptation, and improvement of machines likely to prove of value to agriculture; to examine inventions and new devices; and to advise as to what further steps should be taken to promote the development of agricultural machinery.

64. *Milking Machines.*—The Committee have found that a great variety of opinion exists amongst practical men in this country as to the efficiency and value of milking machines as a means of saving labour. According to a Report* on the Use of Milking Machines prepared for the Committee in 1917, some farmers have had machines in constant use for as long as 11 years with thoroughly satisfactory results, while in another instance out of 7 machines installed in 1916 only 2 remained in use in 1917. It is evident, therefore, that there is need for much closer study of mechanical milkers, in order that reliable advice may be supplied to users and prospective purchasers on the selection and installation of milking machines and on their daily management and cleansing. The Committee, therefore, recommend that such assistance as may be necessary should be given to one or more of the Dairy Research Institutes or Colleges to enable them to undertake investigations designed to supply information on the above points, and to carry out comparative trials on machines of different types.

65. *State Assistance for Improvement in Buildings.*—Owing to the present high cost of buildings, the Committee are of opinion that financial assistance should be given, if possible, towards the improvement of existing buildings and the erection of new ones. The Committee believe that conditions could be devised whereby such financial aid could be made available annually for a limited period for the owners and occupiers of dairy buildings only so long as a guaranteed quantity of milk was produced. Unless this is done the high price of building materials will render the very necessary improvement in the housing of dairy cattle uncertain.

66. *Tenure of Land in Great Britain.*—Many farmers realise the necessity for improving their buildings, but tenants cannot be expected to invest their capital on improving existing buildings or on the erection of additional accommodation if their occupancy of the farm is insecure. Similarly, it is often difficult to get landowners to put fresh capital into modern buildings which a succeeding tenant may not desire. Men who farm their own land are much more likely to put up and to pay for proper buildings than tenant farmers. The Committee understand that the question of the improvement of buildings is almost invariably raised by tenants who make application for licences to sell milk of the higher grades. In many instances the improvements necessary to obtain a licence are not carried out on account of the uncertainty of the occupation of the holding.

67. *Improved Methods of Account Keeping.*—In the 3rd Interim Report (Cd. 315) the Committee drew attention to the general lack of any system of farm accounting. No complete system of farm accounts has been devised yet which is universally applicable, owing partly to the widely varying character of the farms themselves and also to the divergent views on questions of principle, which are due to the fact that only a limited number of farmers have kept complete accounts, and that they have not had sufficient opportunity of exchanging views and comparing methods.

Investigations into systems of farm accounts have been made by the Institute for Research in Agricultural Economics at Oxford University, and the Institute has at the same time given help to farmers by keeping the books of those who were prepared to supply them with the minimum of information and records necessary. The Institute has prepared accounts from these records, showing the cost of production of everything sold off the farm and the profit or loss in the various sections or departments, and has returned those accounts with notes and comments to the farmers.

The Committee recommended that similar facilities should be provided for farmers throughout the country, and they, therefore, welcome the formation of the Agricultural Costings Committee which has been instituted by the Boards of Agriculture and the Ministry of Food for the purpose of obtaining costs of production of particular items of agricultural produce and for obtaining permanent information as to the costs and results of farming. They believe that the work of the Research Institute and of the Costings Committee will be of great value to dairy farmers by enabling them to conduct their business with greater knowledge as to the profit or loss accruing from different methods followed in the production and disposal of milk, and generally to improve their systems of farm management. Owing to the differences in soil and climate in the different dairying areas of the United Kingdom, they hope that the information obtained as to the results of different systems of management will be classified according to areas, and that ultimately the agricultural colleges in these districts will be enabled to have an agricultural economic branch. They believe that in this way the improvements which are found to be most desirable in any district can be most readily brought to the notice of the farmer. Further, they consider it most important that work of this nature should be associated with the Agricultural Educational Centres.

68. *Loss of Milk through Souring.*—In their first and second Interim Reports* the Committee drew attention to the very considerable loss and waste of milk through souring during the warmer months of the year. The primary cause of this loss is undoubtedly the dirt and its associated bacteria which gain access to the milk at the farm, at the dépôt, in transit, in the retailer's shop and in the consumer's house.

* See Appendix, page 54.

† (Cd. 8608 and Cd. 8886.)

Detailed recommendations with regard to the production of clean milk and its preservation from contamination at all stages have been made in the report of the Sub-Committee on the Handling of Milk which is appended,* namely:—

- (1) management of milk on the farm—Appendix, page 32;
- (2) methods of management of depots and factories—page 34;
- (3) treatment at railway stations and during rail transit—pages 34-36;
- (4) handling at city depots and methods of distribution—pages 36-38;
- (5) management of milk in the house of the consumer—page 38.

69. *Extension of Co-operative Methods in the Purchase of Feeding Stuff and Manures.*—In pre-war times, the difference between the price at which a large farmer could purchase his winter supply of concentrated foods and the price which the small farmer, with limited capital and storage accommodation, had to pay for small periodical consignments was very considerable, and in several districts farmers and small-holders found it profitable to form a co-operative society to purchase feeding stuffs and manures. The advantages of this were not confined to small farmers, and sometimes large farmers also found it to their advantage to adopt the principles of co-operative purchase. As concentrated foods have increased very considerably in price, and as the charges for the carriage and handling of small quantities have likewise increased, the advantages of co-operative purchase are even greater now than formerly. The Committee are convinced that the adoption of co-operation, particularly by small farmers, would lead to a considerable saving. In many districts the concentrated foods required for the winter feeding of cows constitute by far the largest single item in the cost of production of milk, and economy in the purchase of such foods has a very important bearing on cost.

70. *Provision of Veterinary Assistance.*—The Committee in their third Interim Report (Cd. 315) made certain preliminary recommendations for the provision of increased veterinary assistance to farmers.

They welcome the clause in the Milk and Dairies (Consolidation) Act, 1915, enabling Local Authorities to appoint veterinary officers. They would urge, however, that these officers in England and Wales should be given whole-time appointments such as those made under the Milk and Dairies (Scotland) Act.

71. *Epizootic Abortion.*—Of the diseases which cause most loss to dairy farmers, the most important are contagious abortion and tuberculosis. In the former, while affected animals do not die, there is a great loss in their market value, and a very serious indirect loss in calves and milk. The evidence which the Committee have had on this subject has been to the effect that compulsory notification of the disease has not brought about satisfactory results. The use of the vaccine prepared and issued by the Board of Agriculture has been attended with good results, and the Committee are of the opinion that more active measures should be taken to bring the value of this treatment to the notice of dairy farmers and to encourage them to adopt it. They are informed that the fact that the vaccine may be obtained free of charge is by no means generally known.

72. *Tuberculosis.*—The Committee accept the findings of the Royal Commission on Tuberculosis to the effect that:—

“Primary abdominal tuberculosis in man, as well as tuberculosis of the cervical glands, is commonly due to ingestion of tuberculous infective material.”†

“A considerable amount of tuberculosis of childhood is to be ascribed to infection with bacilli of the bovine type transmitted to children in meals consisting largely of the milk of the cow.”†

They are aware that subsequent work has confirmed this.

At the same time they do not desire to create unnecessary alarm by exaggerating the extent of human tuberculosis due to bovine infection for they realise:—

- (1) That much infantile debility leading to susceptibility to many diseases including tuberculosis is due to inadequate milk consumption.
- (2) That many children must be drinking some tuberculous milk without suffering evil effects.
- (3) That all reacting cows do not necessarily give tuberculous milk.
- (4) That the risk from tuberculous milk may be practically removed by efficient pasteurisation.

73. *Desirability of Increasing the Number of Tubercle-free Herds.*—The Committee think it desirable that tuberculosis should be eradicated from as many herds as possible for the following reasons:—

- (1) Safe raw milk should be available for consumption.
- (2) It is undesirable and contrary to sound hygienic principles that the use of milk containing disease germs, even when the latter are destroyed by heat, should be accepted with complacency, so long as practical means of freeing milking herds from disease are available.
- (3) The presence of reactors in a herd must involve loss—varying in degree—to the owner of the herd, just as the presence of any infectious disease must always be a cause of a potentially large financial loss, owing to the danger of such disease spreading in the herd and to the fact that incipient tuberculosis is apt at any time to develop into the advanced stage.

74. *Methods of Eradication of Tuberculosis.*—There are only two practical ways in which tuberculosis may be eradicated from a herd, namely:—

- (1) The disposal of all reactors.
- (2) The isolation of reactors and the separation soon after birth of calves born of reacting cows before they can become infected.

Both methods raise many practical difficulties. The first probably involves a larger financial loss than most farmers could be expected to face. This would be likely to increase if any considerable number of cow-keepers tried to sell their reactors simultaneously. Further, if many cow-keepers desired to purchase non-reacting stock the price would rise rapidly, as the number of such animals is very limited.

75. *Accredited Herd System.*—The Committee have been informed that there has been a considerable increase in recent years in the number of farmers anxious to eradicate all tuberculous animals from their herds, and that a scheme for this purpose would be welcomed by progressive farmers and would contribute very materially towards the eradication of this disease. Such a scheme should provide for:—

- (1) Official veterinary assistance in the work of diagnosis and eradication;
- (2) The issue of certificates in regard to those herds in which the necessary conditions had been complied with;

* See Appendix, pages 31-39.

† Report of the Royal Commission appointed to inquire into the relations of Human and Animal Tuberculosis (Cd. 5761), 1911, page 39.

- (3) Correlation with a system of milk grading which would provide an official guarantee on which a milk producer could base a claim to receive a better price for tubercle-free milk.

They wish to recommend the following scheme for the introduction of an Accredited Herd System submitted to them by a special Sub-Committee* appointed to consider the question:—

- (1) The manufacture, distribution and the use of tuberculin to be controlled by a central authority.
- (2) The method adopted in the carrying out and the interpretation of the tuberculin test to be standardised.
- (3) Facilities to be provided out of public funds for free tuberculin testing, provided that the farmer can supply satisfactory evidence that he has reasonable facilities for the carrying out of the tests, and is willing to comply with the necessary conditions laid down for freeing his herd from reactors.

A herd which had complied with the specified conditions would be recognised as tubercle free, and a certificate given to that effect. The herd would be subject to periodical retesting.

In the opinion of the Committee more would be gained by contributing towards the initial cost of completely eradicating this infectious disease from a limited number of herds than by giving full compensation for the slaughter of cows in an advanced state of disease to owners who were not prepared to remove all reactors from their herds nor to bear any part of the cost.

76. *Work by Landowners on Home Farms.*—The Committee believe that much could be done by landowners through their home farms. While recognising the value of much of the work which has in many instances been carried out by landowners in the past at a considerable cost, the Committee are obliged to state that too often so-called model farms are run as models of how to farm at a financial loss. Frequently the landowner has but the vaguest idea of the financial or even the agricultural results of his operations. Unless a fair financial return can be shown, farmers cannot be expected to follow these models. There is also much scope for experimental work in agricultural costing, in manuring, feeding, the equipment and arrangement of farm buildings, &c., all of which landowners could carry out, with the assistance which is obtainable from the Agricultural Collegest and from the recently established Agricultural Costings Committee. Further, if landowners obtained the requisite licences for Grade A milk for their home farms, they would be adding to the number of tubercle-free herds and setting an example of the production of clean milk. Many would also find to their surprise that it was necessary for them to alter and improve their methods in order to reach the official minimum standard laid down for producing milk of high hygienic quality.

77. *Re-organisation of Distribution. (1) Collection in the Country.*—The Committee have been impressed by the waste of labour in the conveyance of milk from the farm to the railway station. It is not uncommon to see milk carts belonging to 20 or 30 different farmers delivering milk in small quantities to a single station. This might be obviated by some system of collection, either by co-operation among the farmers themselves in the haulage of milk along the different roads leading to the station or depot, or by collection by motor-lorry, as is already the practice in many districts. A better collection of milk from remote districts would make available for human consumption additional supplies now used for butter-making and calf-rearing, while the producer would benefit by securing a steady market for his produce. This would encourage him to increase milk production both in summer and in winter, as he could then readily dispose of his surplus. It has, however, been brought to the notice of the Committee that the system of collection by motor-lorry as at present organised is by no means completely satisfactory. To remedy this state of affairs we recommend that an attempt should be made to arrange for a better system of collection and distribution under the auspices of the Agricultural Organisation Society or any similar body. In the collecting areas, rival businesses establish depots and organise systems of collection each in its own interest. Further, milk to be collected by motor-lorry is often left for hours in the sun by the roadside waiting for removal. This involves unnecessary exposure and frequently leads to premature souring and deterioration of the milk. There is no co-ordination and no comprehensive view of the requirement of the district and no adjustment of claims to tap the sources of supply. Factories for the manufacture of milk products are in some cases set down in producing districts close to large consuming centres. For example, while London has to go as far as Cornwall for its milk, there are in the milk producing districts within 50 miles' radius of London at least 5 large factories buying milk for conversion into malted milk, patent infant foods, milk chocolate or margarine.

78. *(2) Railway Transport.*—There is at present a complete lack of organisation of railway transport for milk, with resulting delay in bringing supplies into consumption. For example, milk is brought 253 miles from Haverfordwest, through Cardiff, to London, while at the same time Cardiff is being supplied from Bridgewater, 60 miles distant, and Longdon (Worcestershire), 65 miles distant. The Committee realise the difficulty of altering this state of affairs, but they hope that improvements may be effected.

The Committee also desire to recommend that proper refrigerated vans should be provided on the railways for the conveyance of perishable articles such as milk. At present no such vans are used for the transport of milk in this country.†

Milk is usually consigned by rail under conditions which prevent it from being despatched at once. Churns of milk placed on rail at a country station are often consigned to several different destinations. In the case of large urban centres, milk arrives at a single destination from an unnecessarily large number of districts, and sometimes is consigned to different termini from the same country station. This lack of organisation results in unnecessary handling and delay in distribution, with consequent injury to the quality of the milk.

79. *(2) Town Distribution.*—There is much waste of labour and transport in the conveyance of milk between urban centres and retail shops and in its retail delivery. The United Dairies, Ltd., better known as the Milk Combine, a powerful business organisation which, set up in 1915, has gradually absorbed the bulk of the wholesale and retail trade of Greater London and controls approximately 80 per cent. of the milk supply in that area, reduced their rounds from 2,744 to 1,944 and their horses from 1,217 to 517 in the process of amalgamation and reorganisation. Part of this economy was, however, rendered possible by reducing deliveries from twice to once daily in certain districts.

* For the Report of this Sub-Committee, see Appendix, page 30.

† See Report of Education Sub-Committee, Appendix, page 51, §4.

‡ See Report of Sub-Committee on the Handling of Milk, Appendix, page 35, §24.

80. Such trade combinations have undoubtedly a certain value in that their organisation leads to economy in distribution, though the economies effected by their administration have hitherto mainly benefited their shareholders. They are, however, regarded with suspicion by many producers and consumers, who fear respectively that their operations, if uncontrolled, will have a prejudicial effect on the prices paid for milk to the producer, and will place the consumers in the hands of a monopoly. Some central organisation which would organise the distribution of milk so as to secure economy of transport, the prevention of deterioration and loss by souring, and, where necessary, equitable distribution between different areas would be of great national advantage.

81. In this connection the Committee welcome a recent decision of the Government that power should be taken by the necessary amendment of the Milk and Dairies Act:—

- (a) to license all dealers of milk;
- (b) to grade and to define milk according to the way in which it has been produced or treated;
- (c) to empower local authorities to undertake the supply of milk within their areas;
- (d) to fix maximum prices in case of need;
- (e) to regulate distribution in times of short supply;

and believe that this action will do much to remedy the state of affairs which has been described.

• VIII.—IMPROVEMENT IN HYGIENIC QUALITY.

82. It has become generally recognised that if there is to be a real improvement in the cleanliness and hygienic quality of the milk supply of this country, it is essential to abandon the theory that all milk is of one quality, or that it is possible to raise the whole milk supply rapidly to the highest grade. The public realise that the eradication of disease or the use of more skilled labour to produce cleaner milk necessitates additional cost to the farmer, which he will only and can only be expected to bear if he gets in return either some official certificate of the better quality of his milk, which will enable him to charge a compensating price, or to receive a higher price under an official system of fixed prices. Differentiation between the different grades of milk so that producers and distributors of clean milk may be remunerated for the additional labour and expense incurred is essential. Real progress cannot be made without the co-operation of the general body of the community, but in the past they have shown in general little knowledge or understanding of the subject. The average consumer has learned by experience the importance of a pure water supply, but so long as the milk which he drank was not obviously impure he gave the question very little thought.

83. *Grading.*—The situation has shown signs of change in the last two years, and there has been apparent an increased demand on the part of the public for clean milk, accompanied by a willingness to pay a higher price for milk of guaranteed quality. This change is partly attributable to the publicity given to the subject of the national milk supply, and partly to the introduction by the Ministry of Food and the Ministry of Health of a modified system of grading.

The Ministry of Food, the Ministry of Health and the Scottish Board of Health inaugurated in August, 1918, a scheme for the granting of special licences to enable producers of milk of high hygienic quality to charge higher prices than those permitted by the Milk (Prices) Order for the time being in force. During the war, owing to the shortage of staff in all departments, no attempt was made to increase the number of applicants for licences; but the Committee hope that the Departments concerned will in future give increased publicity to the scheme and the fullest possible information and advice to farmers who wish to attain to a standard of production sufficient to qualify them to obtain a licence. When the scheme was introduced in the autumn of 1918, a considerable number of applications was received, but the number of licences granted during that year was only 14. In the course of 1919 the number has grown steadily and by November 30th, 1919, 34 licences had been granted. How much room there still is for improvement can be seen from the fact that there are in Great Britain more than 100,000 dairy farmers. The Committee are, however, informed that the interest of farmers in this subject is increasing, and that no material difficulty has been found in obtaining a market for the milk at a higher price. There are already, in fact, indications that the demand for the highest grade milk is likely to exceed the supply.

84. The Committee consider that the principle of grading is sound as it rewards the farmers who take the necessary care to produce a better and cleaner article, and offers to farmers generally an inducement to improve the quality of their milk. A system of payment by results and education of both producers and consumers so that the one shall produce and the other demand a higher grade of milk is likely to lead to the most beneficial effects. The addition of the principle of grading was advocated in 1909 by Dr. Eastwood, in a Report* presented to the Local Government Board. Since then it has received the support of the Consumers' Council (Ministry of Food), the Central Agricultural Advisory Council (Ministry of Food and Boards of Agriculture), the Travelling Milk Commission (Ministry of Food), and the Associated Milk Producers' Council.

85. *American Experience.*—The adoption in America of the principle of grading milk has resulted in a great improvement in the general supply, and has not deprived the poorer classes of milk. In the City of New York the system of grading according to cleanliness and purity has stood the test of experience for many years. A Report issued by the Board of Health of that City states that when grading was first inaugurated in January, 1912, 40 per cent. of the City's supplies fell within the definition of the lowest grade—Grade C. (Milk for cooking purposes)—but that in July, 1914, the amount of Grade C. milk sold in New York City was negligible. At the present time about one-seventh of the total supply is Grade A. milk, and about six-sevenths is Grade B. There is no longer any demand for Grade C. milk. This result was achieved not only because of the decreasing demand by the public for Grade C. milk, as they learnt to appreciate the value of higher grades, but because the dealers who had previously sold unsatisfactory low grade milk removed the unhygienic conditions which contaminated their supplies when they had to publish the fact that the milk they sold was placed in the lowest category. The steps taken to raise milk from Grade C. to Grade B. were within the capacity of all producers and dealers, and did not involve any increase in the cost of milk to the consumer. In this connection it should be noted that almost all the milk sold in English cities, if offered for sale in New York, would be classified as Grade C. The consumption

* Report on American Methods for the Control and Improvement of the Milk Supply.
Reports to the Local Government Board on Public Health and Medical Matters (New Series, No. 1).

of milk in New York is approximately 58 English pints per head per day, and is almost twice the normal London consumption (*see* page 8), while the poorer districts in New York take about 40 per cent. per head more than the wealthier districts. In the United States also the educational campaigns for the all-round improvement of the milk supply have been accompanied by an increase in the actual amount of milk sold, owing to the information disseminated amongst consumers as to the value of milk as a food.

86. *Method of Grading.*—The two most useful and practicable methods of grading milk are as follows:—

- (1) Supervision through inspectors of the methods of production and handling.
- (2) Examination of the milk as sold in relation to specified chemical and bacteriological standards. (Chemical standards usually require not less than certain definite percentages of milk fat, and solids not fat, and the bacteriological standard requires that samples shall contain not more than a specified number of bacteria per cubic centimetre.)

The first of these demands a large staff of qualified inspectors, since conditions are imposed both as regards the health and housing of the cows and also the care and cleanliness shown over every detail of milk production and distribution. The second demands skilled technical workers for both methods of examination. A combination of both of the above methods would appear to be necessary in order that the nutritive quality of the milk may be guaranteed, and that it may be cleanly produced and kept free from contamination until it reaches the consumer.

87. *Education for Milk Producers.*—Attention has already been drawn to the necessity for the provision of instruction for farmers and cowmen in the management and feeding of dairy herds. The Committee wish to emphasise the necessity for supplementing this instruction by advice and information as to the best methods of handling and treating milk which is to be sold for human consumption. The Report* of the Sub-Committee on Education in Dairying draws particular attention to the defects of the dairy educational system and the lack of research facilities in this country in this respect. In the past, great efforts have been made to provide adequate training in the manufacture of dairy products, also for the production and handling of milk intended for human consumption. As 70 per cent. of the milk produced in this country is sold for the latter purpose, adequate attention should be given to this subject at all educational centres. The Committee wish to emphasise the recommendations of the Education Sub-Committee that the Dairy Colleges and Farm Institutes in dairying counties should provide courses designed for those whose chief business is the production and management of milk. The Committee also consider it essential to the success of such courses that the methods described and advocated in the lectures should be illustrated in the daily routine of the farm associated with the institution.

Valuable educational work has recently been carried out by the National Clean Milk Society in demonstrating the possibility of producing clean milk under the most unfavourable farm conditions. By attention to those details which have been proved to be of greatest importance in the production of clean milk, the demonstrators have shown that it is possible to produce milk with a very low bacterial content without the aid of model buildings or expensive and mechanical equipment.

88. *Education for Milk Distributors and Consumers.*—The Committee wish to endorse the recommendation of the Education Sub-Committee that instruction should be provided for those engaged in the wholesale and retail sale of milk, and to emphasise the need for the provision of free instruction to the general public on the value of milk as a food, the influence of a good or bad supply of milk on the life and health of children and the community as a whole, and the best methods of handling and storing milk in the consumer's home. Had the general public been properly educated in this respect in the past, there would now be a greater demand for milk produced and handled under better conditions than the present day average, and with the demand a willingness to pay a higher price for milk of guaranteed cleanliness and quality. Farmers are continually being told how much better are the methods of milk management in other countries, but the cities, *i.e.*, the consumers, in at least one other country took the lead in propaganda. In addition to the provision of free lectures and printed advice, several cities in recent years have held milk shows with no charge for admission, for the specific purpose of educating the public in the value and management of milk. One such show with the motto "To enlighten not to frighten" held in Philadelphia in 1911 was open for 8 days and was visited by 110,000 people. No milk shows have as yet been held in Great Britain.

89. *Pasteurisation.*—In previous reports, *i.e.*, the 2nd Interim Report, page 6, and the 3rd Interim Report, page 8, and Appendix C, pages 22-27, the Committee have referred to the unsatisfactory methods of pasteurisation at present in use in this country.

They confirm the following recommendations made by one of their Sub-Committees:—

- (1) That a definition of pasteurised milk should be set up.
- (2) That pasteurised milk should be sold as such and not as fresh milk.
- (3) That milk sold as fresh milk should not have been subjected to any process of heating.
- (4) That any method of pasteurisation that may be followed should be such as to provide the greatest measure of protection to the consumer.
- (5) That pasteurisation must never be regarded as a substitute for clean milk production and cleanliness in handling milk, which are the most important of all conditions affecting the milk supply, and which would be greatly promoted by the better education of the public in the demand for clean milk.
- (6) That further research is necessary in respect of the question of the preservation and pasteurisation of milk, particularly in regard to (a) the effect of pasteurisation on the chemical and physical condition of milk, its composition, nutritive value, contained bacteria, bacterial toxins, and keeping properties and (b) the effect of such milk upon the body of the consumer.

IX.—INCREASED PRODUCTION OF MILK IN GREAT BRITAIN.

90. In view of the high prices to which milk has risen, the Committee have dealt in detail with the steps which should be taken to decrease its cost. They also consider it desirable to indicate how the numbers of dairy stock in this country might be increased and the advantages which would follow.

* See Appendix, page 52.

They have no doubt that in a few years time when conditions have become more stabilised there will be an increased consumption of milk. The spread of education as to the value of milk and a higher standard of living on the part of the large majority of the population should lead to a greater consumption per head. Unless this demand is to be met by the diversion of milk from the manufacture of dairy products or by the importation of preserved milk (*see* page 9) the total number of dairy stock in the country must be increased.

91. *Capital*.—Any appreciable increase in the number of dairy stock in the country must involve the investment of further capital in dairy farms, buildings, live stock and equipment. Before the possessors of such capital can be expected to invest it in dairying, they must be assured of a profitable return on their investment. This involves the corollary that prices for milk and milk products should show a return which is satisfactory as compared with the return received for other agricultural products. Before the war sheep farming was the most speculative branch of farming. Next came cereal growing, then cattle fattening, next cattle breeding and rearing, while milk production was the most stable and least liable to fluctuations in profit. Now, as indicated in paragraph 44, the guarantee farmers receive against serious loss on cereals has altered the balance.

92. *Labour*.—An increased production of milk must also entail an adequate supply of labour. The fundamental fact which differentiates conditions of labour in dairying from those in other branches of agriculture and in other industries is that cows are living creatures and not machines. They must be fed regularly and milked 7 days a week every week in the year at intervals as equal as possible. The labour difficulty in dairying is not due so much to the scale of wages obtainable as to the length of hours worked, to the early hours of milking, to the discomfort connected with the industry in most farms, and to the fact that so much Sunday labour is necessary. Men and women will not work 7 days a week, particularly if they are working for someone else, if they see any alternative method of living. The shorter hours, weekly rest days and higher wages obtainable in factories have drawn workers from all forms of agriculture, and especially from dairy farming. The statutory half-holiday now in force in Great Britain, though it alleviates the position of the labourer, has increased the farmer's difficulties, since it has been necessary in many cases to re-organise staffs, and to engage additional labour to carry on the work.

93. The Committee consider that the increased supply of labour required can best be obtained if farmers are willing to recognise the fact that farm labourers not only expect, but have a right to expect, better conditions in the future than they have had in the past. This can be met to a considerable extent by better organisation of all labour on the farm, by improving the buildings and surroundings of cow houses and by the granting of holidays. Every endeavour should be made towards the establishment of good relations between the employer and employee. If a farmer is prepared to take his turn in order to give some members of his staff a day off, the latter will respond cheerfully when any extra pressure of work comes. Such schemes of co-partnership and profit-sharing which have been tried have tended to give the employees a greater interest in the ultimate success of the business.†

94. *Wages*.—The question of wages is one which falls within the scope of the Agricultural Wages Board. The Committee, however, agree that the hours and wages of dairy workers should be at least as favourable as those of other agricultural labourers. This has not been the case, although certain farmers have shown that equally favourable conditions can be provided without financial loss.

95. *Better Agricultural Statistics*.—The Committee hope that the Board of Agriculture will in future classify its agricultural statistics in such a way as to permit of the grouping of farms according to their acreage, as has been done by the Department of Agriculture for Ireland. The consideration of many aspects of policy and the drawing of conclusions from the past and the present would be enormously helped if fuller information were available. It appears that 58·4 per cent. of the total number of cows in the country are on holdings of from 50 to 300 acres. The effect of modern hours and conditions of labour and the possibility of the use of machinery varies very greatly within the limits of this group. The management and working of a farm of from 50 to 100 acres may easily be carried out by the occupier and his family, whereas on a dairy farm of from 200 to 300 acres hired labour is necessary, and there is greater scope for the use of mechanical equipment. A sub-division of the above group of farms is required.

The Committee have also been impressed by the lack of statistical information with regard to winter milk production. A census of cows in milk in June affords no guidance as to the probable output of milk in January. There should also be a more detailed annual classification of cows according to the purpose for which they are kept, *i.e.*, whether for milk or beef.

96. *Arable Dairy Farming*.—In order to maintain satisfactorily the increased number of dairy stock contemplated, the Committee are of the opinion that more home-grown foods should and could be provided by an extension of arable dairy farming such as was practised in Denmark and Germany before 1914 and in this country during the war.

Sir Thomas Middleton, in a recent Report,‡ has shown that:—(1) Germany maintained 24·5 cattle per 100 acres as against 22·2 in Great Britain. That (2) Great Britain was slightly ahead in the production of beef (1·49 tons as against 1·29 tons per 100 acres), but that (3) Great Britain was very much behind in the production of milk (17·4 as against 28·1 tons per 100 acres). This high yield of milk per 100 acres is shown by the following table to be due to the larger proportionate number of cows kept:—

Analysis of Cattle per 100 acres.

GREAT BRITAIN (1914).

Total Cattle.	Cows and Heifers in milk and Cows in calf.	Heifers in calf.	Other Cattle.
22·2	8·1 (= 36·5 per cent.)	1·1 (= 5·0 per cent.)	13·0 (= 58·5 per cent.)
Beef Production	...	...	1·49 tons per 100 acres.
Milk	...	...	17·4 " "

* See Appendix, pages 39–50, for Report of Sub-Committee on Labour.

† Particulars of some such schemes actually in operation are given on pages 44–48 of the Appendix.

‡ "Recent Development of Agriculture in Germany," published by the Board of Agriculture (C.D. 8305)

GERMANY (1913).

Total Cattle.	Cows.	Other Cattle.
24.5	12.7 (= 51.8 per cent.)	11.8 (= 48.2 per cent.).
Beef Production	...	1.29 tons per 100 acres.
Milk	...	28.1 " "

97. Judging from the average British farmer's confidence in pasture land for milk production, one would expect to find a larger proportion of pasture in Germany than in Great Britain. The average British 100-acre farm, maintaining 8.1 cows in milk, had 69 acres under grass and clover, while the average German 100-acre farm, maintaining 12.7 cows in milk, had only 32 acres under pasture. This greater proportion of arable enabled the Germans to produce, per 100 acres of cultivated land, not only 28.1 tons of milk and 1.29 tons of meat, as against 17.4 tons of milk and 1.49 tons of meat produced by the British, but in addition 33 tons of grain and 55 tons of potatoes, as against 15 tons of grain and 11 tons of potatoes in Great Britain.

It is evident, therefore, that a high production of beef and milk does not necessarily involve a low production of grain and that, in fact, the increase of pasture in Great Britain, amounting to 3,800,000 acres in the last 40 years, has resulted in a serious decrease in the total amount of home-produced food, with a corresponding increase in the imported supplies.

98. The above figures for Great Britain refer to the period before the inauguration of the war-time "Plough Policy" of the Food Production Department, which, though intended as a war measure, will have permanent beneficial results. Many farmers have now realised that a reduction in the number of dairy stock kept need not necessarily follow the ploughing up of a certain amount of grass land. On the contrary, an increase in the area of arable land and the introduction of suitable crops, will increase the stock-carrying capacity of the farm, and make the farmer less dependent on purchased foodstuffs during the winter.

In their third Interim Report (Cd. 315, page 13) the Committee made definite recommendations to the Boards of Agriculture with regard to the development and the extension of the growth of soiling crops on dairy farms, and the desirability of providing facilities for the making of ensilage for use during the winter months. In an Appendix to that Report (pages 28-29) illustrations contributed by practical farmers were given of the use of green crops for soiling purposes on dairy farms. Since the issue of the third Interim Report the results of trials in different parts of the country, and particularly the demonstrations at the Harper Adams Agricultural College,* have emphasised further the advantages to be derived from arable dairy farming. In the experiment at the Harper Adams College a small herd of cows has been maintained on a succession of soiling crops and a small allowance of concentrates, without the use of any pasture land for a period of nearly two years, and the results are very encouraging in respect of milk yield and estimated profits. By the system followed, 10 cows require only 15 to 16 acres of arable land, or $1\frac{1}{2}$ acres per cow.

On many dairy farms the heavy nature of the soil will make it always desirable to retain certain fields as pastures and meadows, but there are numerous dairy farms where a proportion of the land formerly under grass is well suited for arable cultivation, and the Committee are convinced that by the adoption of arable dairying in many counties, the density of the cow population can be greatly increased.

99. *Demonstration Small Holdings.*—In this connection, the Committee welcome the scheme under which the Boards of Agriculture are establishing a limited number of Arable Dairy Farming Demonstration Holdings, for the purpose of each of which the Boards will acquire a holding of from 25 to 30 acres of land to be devoted to the growing of arable crops suitable for stall feeding to dairy cows.

The necessity for demonstrations of this nature in different parts of the country has arisen partly because it has been claimed in some milk-producing areas that, as a result of the plough policy of the Boards, it is not now possible to produce as much milk as formerly, and partly because of the necessity for intensifying milk production. Given the fact that much more milk can be produced from an area where the land is under arable cultivation than under grass, what now requires to be demonstrated is whether the return obtained compensates for the extra labour involved. A further purpose to be served by these demonstrations is to show whether it is or is not possible for a holding of 25 to 30 acres conducted on the intensive system to return a net income at least equal to that which can be obtained from a 50-acre holding carried on in accordance with the usual practice.

100. *Value of Lucerne.*—The Committee hope that dairy farmers will study very carefully the advantages to themselves and to the country which can be obtained by maintaining a large proportion of arable on their farms. Greater efforts should also be made to bring to the notice of farmers the enormous value of lucerne. Where the soil is suitable and adequately drained so that a good plant can be obtained, this crop will produce a greater weight of green forage or hay per acre during the season than can be obtained from any other soiling crop. There is also no expense in seed and cultivation after the first year, while the forage or hay obtained is of high nutritive value and the fertility of the soil is greatly increased. The neglect of lucerne on dairy farms in England is one of the weak spots of contemporary farming. If its value were more fully realised, much more systematic and determined attempts would be made to overcome the difficulties of getting a good and lasting plant. The increase in the acreage of arable land and the necessity for obtaining the maximum supply of cattle food for summer and winter, for increasing the fertility of the soil, and for reducing the importation of concentrated feeding-stuffs, all point to the advisability of a greater utilisation of lucerne in the future than in the past.

101. *Increased Dairy Stock.*—Since the chief reason for advocating an increased head of dairy stock is to obtain a larger quantity of milk for consumption as such, it follows that this increase should be chiefly in the breeds yielding milk most suitable for this purpose, such as the Dairy Shorthorn, Ayrshire, Friesian, and such other local breeds as can hold their own in economical production against these better known breeds.

* Harper Adams College Bulletin, 2A, 1918.

There is little need for an increase in the number of Jerseys and Guernseys in the herds of the ordinary dairy farmer, although where butter is required for local or private consumption these breeds are superior to all others.

102. *Comparative Study of Breeds Necessary. Facilities for Importation of Friesians.*—The Committee desire to support the following three recommendations made by their Agricultural Sub-Committee:—

- (i) That for the purpose of obtaining reliable information and that sound advice may be available for farmers as to the breed which is the most economical producer of milk under different conditions, a careful study should be made of the relative economy in the production of milk, under different circumstances of soil and climate of the chief breeds at present in this country.
- (ii) That facilities should be given for the importation of Friesians, provided that they come of a stock of sufficiently high milking record. The standard should be fixed so as to ensure that only the best dairy animals are allowed to enter the country. Their importation should be subject to the most stringent conditions that the Board of Agriculture may consider necessary in order to guard against the introduction of disease. The Committee believe that the previous successful importation of dairy cattle under Government control can be repeated.*
- (iii) That the Board of Agriculture should institute an enquiry into the advisability of the importation of other breeds of proved excellence in milk production.

103. *Government Control of the Wholesale Trade.*—The Committee feel that this Report would be incomplete without some reference to the proposals that have been made for Government control of the wholesale milk trade; and they consider that it may be useful to summarise briefly some of the arguments that have been adduced for and against Control.

For Control:—

- (i) Diversion of supply from one area to another in times of shortage.
- (ii) Regulation of the amount of milk manufactured into milk products.
- (iii) More satisfactory transport of milk.
- (iv) More economical arrangements for wholesale and retail distribution.
- (v) Maintenance of winter supply.
- (vi) Equalisation if necessary of the retail price for winter and summer.
- (vii) Protection of producer and consumer against large wholesale combinations.

Against Control:—

- (i) That it would compel the State to offer a market to all milk wherever produced. That easily accessible and therefore cheap milk would go direct to the retailer without the wholesale intervention of the State, and the State would be compelled to purchase distant and expensive milk.
- (ii) That in times of surplus the State would have large quantities of milk on its hands which could only be used for milk products, and that in competing with imported milk products the State would make a heavy loss.
- (iii) That the result of the above conditions would necessitate either raising the price of milk distributed by the State, or a State subsidy for milk.
- (iv) That it would necessitate the fixing of prices with all the recognised disadvantages.
- (v) That the unsatisfactory conditions of milk production and distribution can be dealt with by methods which would not involve the State in a costly and doubtful experiment.
- (vi) That it would involve an interference with individual enterprise for which there is no sufficient justification in times of peace.

X.—SUMMARY OF RECOMMENDATIONS.

104. I.—*National Policy.*

(a) The aims of an enlightened milk policy should be:—

- (1) to bring about the utmost possible economy in production in order that:—
 - (i) consumption of milk may be increased to the desired level;
 - (ii) an adequate supply of milk may be brought within the reach of the poorest families.
- (2) to improve the hygienic quality of milk and to ensure that that portion of the supply which requires or is subjected to artificial treatment by heat is efficiently pasteurised under supervision;
- (3) to increase the total supply in order to meet the extended consumption that should follow improved quality and the education of the public with regard to the nutritive properties of milk;
- (4) to prevent the exploitation of the producer or the consumer by any trust or combination either of a provincial, national, or international character

Page. Para.

13 50

* Mr. J. R. Campbell does not feel that he can subscribe to this statement.

	Page.	Para.
(b) to arrange for the better distribution of milk so as to secure economy of transport, prevention of deterioration, and loss of milk through souring and, where necessary, equitable distribution between different areas ...	19	80
(c) Dairy farming should be developed as it is one of the most important, most productive, most stable, and most economic branches of agriculture in a country like the United Kingdom ...	7-10	17-32
II.— <i>Education and Research.</i>		
(a) <i>In England and Wales.</i>		
(1) The development of research in dairying should be assisted to the fullest extent ...	53	12
(2) Provision should be made for adequate itinerant instruction in every county with regard to the production, management and utilisation of milk ...	52	10
(3) Longer and better proportioned courses of training should be provided for teachers of dairying and educational centres should demonstrate the best methods of farm and dairy practice ...	52	9
(4) Courses of instruction in dairy factory management should be provided ...	52	11
(b) <i>In Scotland.</i>		
(1) Additional equipment in respect of plant should be provided at the Dairy School for Scotland and provision should be made for longer and more detailed courses in dairying ...	53	16-17
(2) Centres should be established with special respect to the training of small-holders in dairying ...	53	19
(3) Additional facilities should be provided in respect of plant, equipment and staff for research work in dairying ...	53	18
(c) <i>In Ireland.</i>		
(1) More comprehensive courses of scientific instruction should be provided for teachers of dairying ...	54	22
(2) A suitable scheme for research in dairying should be initiated and assisted to the fullest extent ...	54	22
(d) <i>In the United Kingdom.</i>		
(1) Further instruction should be provided for farmers and herdsmen as to:—		
(i) the best methods of feeding and management of dairy herds ...	15	62
(ii) the best methods of handling milk intended for human consumption ...	20	87
(2) Instruction as to handling of milk should be provided for members engaged in the wholesale and retail sale of milk, together with instruction for the general public on the value of milk as a food ...	20	88
(3) Further financial assistance should be given to Dairy Research Institutes to enable them to carry out investigations into the efficacy of milking machines ...	16	64
IX.— <i>Agricultural Statistics.</i>		
(a) Agricultural statistics should be classified so as to permit of the more detailed grouping of farms according to their acreage ...	21	95
(b) There should be a more detailed annual classification of cows according to the purpose for which they are kept, i.e., whether for milk or beef ...	21	95
(c) Further statistical information with regard to winter milk production should be obtained ...	21	95
III.— <i>Economy of Production.</i>		
The cost of production of milk should be reduced, and to attain this:—		
(1) systems of herd management should be improved ...	13	52
(2) only bulls of a good milking strain should be used ...	14	59
(3) economical and scientific feeding of dairy cattle should be studied ...	15	60
(4) pastures should be improved by suitable manuring ...	15	61
(5) the practice of co-operative purchase should be developed ...	17	69
(6) a suitable system of account-keeping should be adopted ...	16	67
IV.— <i>Milk Records.</i>		
(a) The staff of the Boards of Agriculture should be increased so as to facilitate the formation of new Milk Record Societies ...	14	55
(b) Courses of training should be provided for intending Milk Recorders ...	14	55
(c) Milk recording in England and Wales should be extended to include fat tests of individual cows ...	14	57
(d) The scheme at present in existence for the registration of dairy cows should be elaborated and extended ...	14	58
(e) The information collected by the local Milk Recording Societies should be analysed by the Agricultural Colleges, and the results published in a simple and concise form ...	14	56

V.—*Diseases Affecting the Dairy Herd.*

	Page.	Para.
(a) Veterinary Officers appointed in England and Wales under the Milk and Dairies (Consolidation) Act, 1915, should be whole-time officers ...	17	70
(b) The use of vaccine for the prevention of contagious abortion should be encouraged ...	17	71
(c) A scheme for the elimination of tuberculosis in dairy herds should be initiated ...	17	73-75

VI.—*Labour.*

(a) The wages of dairy workers should be at least as favourable as those of other agricultural labourers ...	21	94
(b) The conditions of labour and rate of wages should be the subject of more frequent discussion between the farmer and his men ...	41	11
(c) Schemes should be introduced by farmers wherever possible whereby their employees may be given an interest in the conduct and prosperity of the business ...	41	11
(d) The hours of labour, wages and holidays of women employed partly in dairy farming and partly in domestic work should be dealt with by the Agricultural Wages Board as in the case of other female farm workers ...	43	17
(e) At least one member of the staff of Labour Exchanges in Rural Districts should be thoroughly conversant with farming conditions and the various types of labour required by farmers ...	42	14

VII.—*Improvement of Farm Buildings.*

(a) Assistance should be given by the Government to farmers wishing to provide new accommodation or to improve existing accommodation for dairy cattle ...	16	65
(b) New farm buildings erected should be arranged according to the principles outlined on page 48 of the Appendix, and should be furnished with labour-aiding machinery ...	16	63
(c) An analytical study should be made of the cost of labour and the amount required on farms representing respectively good and bad arrangement and equipment of buildings ...	43	16

X.—*The Improvement of the Hygienic Quality of Milk.*

(a) All producers and dealers in milk should be licensed ...	19	81
(b) A system of grading milk should be introduced based on a bacteriological examination of the milk and on methods of production and treatment ...	20	86

XI.—*The Transport of Milk.*

(a) The railway companies should provide milk trains twice daily ...	35	25
(b) The railway companies should be asked to provide experimental milk vans cooled by air or otherwise ...	35	24
(c) Clearing houses should be set up at railway termini for handling and inspection of milk, expenses to be borne by the Local Authority ...	35	29-30
(d) At all stations where any quantity of milk is received a cool clean room should be provided for churns and used for nothing else, and that at the larger stations refrigerating chambers should be established ...	35	23
(e) The opening of churns on railway stations should be forbidden ...	35	28
(f) All milk sold by wholesale should be in seller's churns, except in certain specified cases, and every churn should have indelibly marked on it the owner's name and address and the date of purchase ...	36	36
(g) Milk should, when sold by wholesale, be dealt in by weight ...	34	17
(h) The 17-gallon railway churn should be replaced by a smaller size, preferably a 10-gallon churn ...	33	9

XII.—*Milk Depots.*

(a) If depots are adopted they should be of three specified types:—		
(1) Chilling depots, drawing milk from a comparatively short radius, say, 10 miles, capable of handling up to 500 gallons;		
(2) Larger depots, still confined to liquid milk, with a capacity of up to 2,000 gallons;		
(3) Depots for dealing with liquid milk, but equipped with cheese-making plant and with a capacity of from 500 to 2,000 gallons ...	34	18-22

XIII.—*Pasteurization.*

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(a) A definition of pasteurized milk should be set up	20	89
(b) Pasteurized milk should be sold as such, and not as fresh milk ...	20	89
(c) Milk sold as fresh milk should not have been subjected to any process of heating or adulteration	20	89
(d) Any method of pasteurization that may be followed should be such as to provide the greatest measure of protection to the consumer	20	89
(e) Pasteurization must never be regarded as a substitute for clean milk production and cleanliness in handling milk, which are the most important of all conditions affecting the milk supply, and which would be greatly promoted by the better education of the public in the demand for clean milk	20	89
(f) Further research should be undertaken into the question of the preservation and pasteurization of milk, particularly in regard to (i) the effect of pasteurization on the chemical and physical condition of milk, its composition, nutritive value, contained bacteria, bacterial toxins, and keeping properties; and (ii) the effect of such milk upon the body of the consumer	20	89

XIV.—*Retail Distribution.*

(a) The system of two deliveries per day should be resumed as soon as possible	36	38
(b) Delivery churns should be sealed, and a control sample taken from each ...	37	40
(c) The ideal to be aimed at in the retail sale of milk is delivery in bottles, and the bottling of milk should be encouraged by allowing a higher price for milk sold in this way	37	41-43

XV.—*Care of Milk in Consumer's House.*

Milk should be kept:—

(1) covered;		
(2) at a low temperature and below 50° F. if possible;		
(3) in a vessel which has been cleansed with boiling water and kept covered until required for use	38	49 & 50

VIII.—*Increased Production of Milk.*

(a) The numbers of dairy stock in the country should be increased as far as possible	21	90
(b) Arable dairy farming should be extended	22	96-99
(c) That a careful study should be made of the relative economy in the production of milk under different circumstances of soil and climate of the chief breeds at present in Great Britain and Ireland ...	23	102
(d) That facilities should be given for further importation of Holstein Friesian cattle	23	102
(e) That there should be an enquiry into the advisability of the importation of other breeds of proved excellence in milk production	23	102
(f) The keeping of goats should be encouraged	8	24

105. The Committee feel that they cannot rate too highly their obligations to our Secretary, Mr. J. Mackintosh, for the valuable assistance he has rendered in the consideration of the complex problems that they have reviewed. His knowledge of the distributive as well as the practical and scientific side of agriculture has been of the greatest value, and they deeply appreciate the tact and untiring industry which he has devoted to the work of the Committee.

They have to express their gratitude for the valuable services rendered in the work of the Sub-Committees and in the preparation of this Report by Miss Mackenzie and Miss Cowper.

They also wish to record their sense of obligation to Viscount Astor for permitting the Committee and Sub-Committees to hold numerous meetings at 4, St. James's Square.

(Signed) ASTOR (Chairman).
W. E. G. ARCHIBALD WEIGALL (Deputy Chairman).
J. F. BLACKSHAW.
WILFRED BUCKLEY.
J. R. CAMPBELL.
C. T. CRAMP.
GERALD LEIGHTON.
A. W. J. MACFADDEN.
J. MACKINTOSH (Secretary).
GEORGE NEWMAN.
DOUGLAS NEWTON.
DERMOD O'BRIEN.
W. ANKER SIMMONS.
BEVILLE STANIER.
ROBERT P. WRIGHT.

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COMMITTEE ON PRODUCTION AND DISTRIBUTION OF MILK.

LIST OF WITNESSES INTERVIEWED BY THE COMMITTEE.

Dr. Stenhouse Williams, University College, Reading.
 Professor R. Wallace, F.R.S.E., F.L.S., the University of Edinburgh.
 Mr. J. C. Corbett, Agricultural Organisation Society.
 Mr. A. Steel, Eastern Counties Dairy Farmers' Co-operative Society, Limited.
 Mr. H. Chadderton, Eastern Counties Dairy Farmers' Co-operative Society, Limited.
 Mr. A. Barnes, Stratford Industrial Co-operative Society.
 Mr. J. H. Bates, Stratford Industrial Co-operative Society.
 Mr. Ben. Davies, Ben. Davies and Son, Limited.
 Mr. H. Trotman, Welford's, Limited.
 Mr. W. Price, Great Western and Metropolitan Dairies, Limited.
 Mr. R. Butler, United Dairies, Limited.
 Mr. E. Mathews, Royal Agricultural Society of England.
 Hon. Cecil Parker, Royal Agricultural Society of England.
 Mr. J. S. Paterson, National Farmers' Union of Scotland.
 Mr. A. Batchelor, National Farmers' Union of Scotland.
 Mr. A. W. Hunter, National Farmers' Union of Scotland.
 Mr. J. Huntley MacDonald, National Farmers' Union of Scotland.
 Mr. P. McConnell, British Dairy Farmers' Association.
 Mr. J. Kendrick, British Dairy Farmers' Association.
 Mr. R. Long, British Dairy Farmers' Association.
 Colonel A. S. Barham, British Dairy Farmers' Association.
 Mr. A. F. Somerville, Bath and Western and Southern Counties Society.
 Mr. W. Ashcroft, Bath and Western and Southern Counties Society.
 Mr. G. Aguet, Nestlé's and Anglo-Swiss Condensed Milk Company, Limited.
 Mr. G. France, Nestlé's and Anglo-Swiss Condensed Milk Company, Limited.
 Mr. C. M. Douglas, C.B., D.Sc., Highland and Agricultural Society of Scotland.
 Mr. J. McCaig, Highland and Agricultural Society of Scotland.
 Dr. J. P. Tocher, Highland and Agricultural Society of Scotland.
 Mr. W. Arkell, Canadian Department of Agriculture.

LIST OF WITNESSES INTERVIEWED BY SUB-COMMITTEES.

Sir Stuart Stockman, Chief Veterinary Officer, Board of Agriculture—Agricultural Sub-Committee.
 Mr. F. H. Thornton, President, Dairy Shorthorn Association—Agricultural Sub-Committee.
 Mr. C. M. Douglas, C.B., D.Sc., Highland and Agricultural Society of Scotland—Agricultural Sub-Committee.
 Mr. Trevor Williams, British Friesian Cattle Society—Agricultural Sub-Committee.
 Mr. J. Speir, Scottish National Farmers' Union—Labour Sub-Committee.
 Mr. J. S. Paterson, Scottish National Farmers' Union—Labour Sub-Committee.
 Mr. J. Lunn, Agricultural and Rural Workers' Union—Labour Sub-Committee.
 Mr. J. Duncan, Scottish Farm Servants' Union—Labour Sub-Committee.
 Mr. W. Cochrane, Workers' Union—Labour Sub-Committee.
 Mr. P. Nutley, Workers' Union—Labour Sub-Committee.
 Mr. J. Park, National Farmers' Union of England—Labour Sub-Committee.
 Mr. J. H. Horton, National Farmers' Union of England—Labour Sub-Committee.
 Mr. W. Osborn, National Farmers' Union of England—Labour Sub-Committee.
 Mrs. Abel Jones, Technical Inspector for Wales—Labour Sub-Committee.
 Mr. J. Drysdale, Scottish Chamber of Agriculture—Labour Sub-Committee.
 Mr. J. Findlay, Scottish Chamber of Agriculture—Labour Sub-Committee.
 Mr. J. Lawrie, Scottish Chamber of Agriculture—Labour Sub-Committee.
 Sir T. H. Middleton, Board of Agriculture and Fisheries—Education Sub-Committee.
 Mr. J. F. Blackshaw, Board of Agriculture and Fisheries—Education Sub-Committee.
 Mr. A. Poole Wilson, Department of Agriculture for Ireland—Education Sub-Committee.
 Principal Paterson, Board of Agriculture for Scotland and West of Scotland Agricultural College—Education Sub-Committee.
 Mr. J. Darlington, Shropshire—Education Sub-Committee.
 Mr. Richmond James, Somerset—Education Sub-Committee.
 Mr. W. Bown, Somerset—Education Sub-Committee.
 Mr. B. Broughton, Somerset—Education Sub-Committee.
 Mr. J. Hugh Mackie, Cheese Inspector, Ministry of Food—Education Sub-Committee.
 Mrs. Lacy Hulbert, British Goat Society—Goats Sub-Committee.
 Mr. W. Paget, British Goat Society—Goats Sub-Committee.
 Mr. H. Holmes Pegler, British Goat Society—Goats Sub-Committee.
 Mr. B. Ravenscroft, British Dairy Farmers' Association—Goats Sub-Committee.
 Mr. P. Dallinger, Board of Agriculture and Fisheries—Goats Sub-Committee.

For list of witnesses interviewed by Sub-Committee on Control of Wholesale Trade, *see* Cd. 9095.

APPENDIX.

REPORT OF AGRICULTURAL SUB-COMMITTEE.

MEMBERSHIP OF THE SUB-COMMITTEE.

Lieut.-Col. W. E. G. A. WEIGALL, M.P. (*Chairman*).

Mr. J. F. BLACKSHAW, O.B.E.
 Mr. WILFRED BUCKLEY.
 Dr. C. CROWTHER.
 Mr. P. A. FRANCIS.
 Mr. R. HOBBS, Jun.
 Major G. R. LEIGHTON, M.D.
 Mr. W. McCracken.

Dr. A. W. J. MACFADDEN, C.B.
 Mr. J. MACKINTOSH.
 Mr. POOLE WILSON.
 Dr. J. ROBERTSON.
 Mr. J. C. ROBINSON.
 Mr. W. ANKER SIMMONS, C.B.E.
 Mr. F. N. WEBB.

1. The Agricultural Sub-Committee have had under consideration the following points bearing on the increased production of milk throughout the United Kingdom:—

- (1) Improvement of Home Breeds.
- (2) Importation of Breeds.
- (3) Veterinary Assistance for Farmers.
- (4) Labour-saving Machinery.

1. IMPROVEMENT OF HOME BREEDS.

2. *Selection of Best Breeds for Improvement.*—The chief dairy breeds in the United Kingdom at the present time are the Ayrshire, the Friesian, the Guernsey, the Jersey, the Kerry, the Lincoln Red, the Red Poll, the South Devon, and the Shorthorn. Of these breeds the Shorthorn is by far the most important numerically in England and Ireland. In Scotland the Ayrshire is the predominant dairy breed. In the above list the Jersey and Guernsey breeds are pre-eminently suitable for butter production. The other breeds—Shorthorn, Ayrshire, Friesian, Lincoln Red, South Devon, Red Poll, Kerry, and their crosses—produce most of the milk which is used for human consumption and for manufacture into cheese, and the milk of these breeds is considered especially suitable for these purposes.

In considering the improvement of the dairying capabilities of home breeds, it is necessary to have in mind the purposes for which any increase in the supply of milk will be utilised, so that the breeds yielding the milk most suitable for these purposes may be the first to be increased in numbers. There appears to be little doubt that the milk will be utilised chiefly for human consumption or for cheese making. The relative

importance of these two methods of utilisation varies according to the district. It appears safe to say that only a small proportion of any increase will be utilised for butter making. It follows, therefore, that the increase in stock should be chiefly in the Dairy Shorthorn, Ayrshire and Friesian breeds and such other local breeds as can hold their own against these in economy of production.

The Sub-Committee have not sufficient information at their disposal to enable them to recommend that special assistance should be given to any one breed in order that its numbers may be increased, but they believe that some of the breeds mentioned above must be better for milk production than others, and also better than other local breeds not specified. They also believe that it is undesirable on national grounds that the numbers of second or third rate dairy breeds should be increased, but that such breeds should be decreased and replaced by those which have proved to be superior.

Recommendation.—In order that reliable information may be obtained, and that sound advice may be available for farmers as to the breed which is the most economical producer of milk under different conditions, they recommend that a careful study should be made of the relative economy in the production of milk under different circumstances of soil and climate of the chief breeds at present in this country.

3. *Improvement by Breeding.*—The Sub-Committee were informed that the Board of Agriculture and Fisheries, under the Live Stock Improvement Scheme, had provided 710 bulls of different breeds in different parts of the country. The bulls were selected or approved by the Live Stock Officers, and in this way a certain standard of excellence was assured. Most of the bulls placed under the above scheme were of the Shorthorn breed, and were selected with special reference to their dairy qualities, but at the present time there is a distinct need for greater attention being given to the milk record ancestry. In selecting a bull for a dairy herd, pedigree must be taken to mean not merely a list of the names of the bull's progenitors for several generations, but authenticated records of production on the part of the dams and grandams. The Sub-Committee are of the opinion that, in the present-day judging of dairy bulls, too much attention is paid to external appearance and handling properties. In the noted dairy countries of the world, dairy bulls are seldom, if ever, judged by their external characteristics only. The real test of dairy capacity in a bull is power to beget offspring with high records of milk yield and butter fat, and they believe that until this test is more clearly recognised in this country, progress in the breeding of the highest class of dairy cow will be slow and disappointing. The dairy capacity of any animal can be reduced to facts of healthiness and regularity in breeding and to figures of production, and these facts and figures are a much surer foundation for a system of breeding than are opinions as to external characteristics.

The Sub-Committee are also aware that at the present time bulls are usually disposed of before their dairy capacity, as proved by the records of their progeny, can be discovered, and they suggest that in the future breeders should find means whereby bulls can either be kept in the herd or be leased to other breeders until the value of their progeny can be ascertained. By this method the exceptionally pre-potent bulls can be discovered before it is too late.

4. *Milk Recording.*—There is general agreement that the first step towards an all-round improvement in dairy farm management and an increase in economical milk production is the development of milk recording.

To develop milk recording it is important that the records should be generally recognised as being of commercial value, and to attain this object it is necessary that they should be strictly checked and supervised and kept in a uniform manner. It is stated that a larger staff is needed by the Board of Agriculture and Fisheries to supervise the 30,000 cows already being recorded under their scheme, and to organise into societies the many farmers who are now anxious to keep milk records. The only action previously taken by this Committee to deal with this question was the passing of a resolution that grants for milk recording assistance should be continued in 1919.

Recommendation.—In view of the fundamental importance of milk recording in the development of the dairy industry, the Sub-Committee urge strongly that energetic measures should be taken to increase the membership of the existing societies or to form new societies in every dairying district in Great Britain and Ireland. At the present time about 1 per cent. of the cows and heifers in milk in England and Wales are recorded, in Scotland about 5 per cent., and in Ireland less than 1 per cent. In each of the countries there is in operation at the present time a National Milk Record Scheme, and the Sub-Committee recommend that all necessary assistance be given in order that the responsible authorities may develop this work rapidly and to the fullest extent.

5. *Recommendation.*—It has been mentioned that one of the hindrances to development is the lack of reliable milk recorders. The Sub-Committee realise that the success of any society and the accuracy of the records depend to a very large extent on the knowledge and ability which the recorder brings to bear on his work, and they wish to recommend the provision of a definite course of training. They understand that such a course is already in existence in Scotland, but that no such course has been instituted in England and Wales or Ireland. They also suggest that the advancement of milk recorders of proved energy and ability to higher and more responsible positions is most desirable.

The duties of a milk recorder enable him to obtain a knowledge of the system of dairy management carried on in the 20 to 25 herds which he supervises, and for this reason these posts are recommended to students who on leaving an Agricultural College wish to gain additional practical experience.

6. *Analysis of Milk Records.*—*Recommendation.*—The Sub-Committee have been impressed by the valuable information which can be obtained from an analysis of milk records. They have had evidence as to the most interesting and useful results obtained in Scotland in respect of the average yield of milk and butter fat from Ayrshire cows of different ages and calving at different times of the year, and they recommend that provision should be made for a similar analysis of the records obtained in England and Ireland from the chief breeds of dairy stock in those countries. They believe also that the interest of farmers in milk records would be developed and considerable improvement in local methods of management would follow if an examination and analysis were made of the information collected by a Milk Record Society or by a group of societies. They understand that at the present time no provision is made for any such provincial study, and they wish to recommend that the Agricultural Colleges should be asked to undertake such an examination and to publish the results in a simple and concise manner. In making this recommendation they have in view the desirability of associating the educational side of milk record work with the local centre for agricultural and dairying education.

Recommendation.—The milk record scheme in operation in England and Wales appears to the Sub-Committee to concentrate attention mainly on the yield of milk. They are of opinion that the work of a Milk Record Society can most usefully be extended to include butter-fat tests of the individual cows in

the herd, or at least of those animals which have been found to be the heaviest producers and the calves of which are, therefore, most likely to be retained. They recommend that the Board of Agriculture be urged to formulate and publish a scheme for the testing of samples of milk from most or all of the cows in herds of members of milk record societies, and that the carrying out of the butter-fat tests at regular intervals should be encouraged by giving an additional grant to societies which adopt and carry out a reliable scheme.

7. *Register of Heavy Milking Cows.*—*Recommendation.*—The Sub-Committee have considered the scheme recently introduced by the Board of Agriculture and Fisheries for the formation of a register of dairy cows. They welcome this scheme, because they are of the opinion that it will assist and encourage the improvement of all dairy breeds, and because they have had evidence to the effect that such schemes have been of great value in other dairy countries. They wish to point out, however, that the scheme, in its present extremely simple form, which groups Jerseys with Shorthorns, and heifers with mature cows, does not meet the needs of the situation. They recommend that it should be developed as rapidly as possible to provide separate classes for the different breeds and for animals of different ages, and to take cognisance of the percentage of butter fat in the milk as well as of the total yield of individual cows.

2. IMPORTATION OF BREEDS.

8. Although there are several dairy breeds of international importance native to Great Britain, there are also breeds of great value which have originated in other dairy countries. The Sub-Committee considered carefully whether it was desirable in the interests of milk production in this country that the importation of dairy stock from any other country should be encouraged. They are agreed that the Friesian or Holstein-Friesian breed is the only one which need be considered from this point of view. This breed has attained a very high standard of excellence in its native country, has earned a great reputation in the United States, Canada and New Zealand, and is becoming increasingly popular in this country. Associated with the question of importation is that of the risk of the introduction of disease, but the Sub-Committee consider that adequate precautions can be taken in this matter.

Recommendation.—The Sub-Committee, therefore, recommend that full facilities should be given for the importation of Friesians, provided that they come of a stock with a sufficiently high milking record. The standard should be fixed so high as to ensure that only the best dairy animals are allowed to enter the country, and their importation should be subject to the most stringent conditions that the Board of Agriculture may consider necessary in order to guard against the introduction of disease.

3. VETERINARY ASSISTANCE.

9. *Recommendation.*—The Sub-Committee have from time to time given attention to the provision of increased veterinary assistance for dairy farmers. In connection with this subject, they welcome the clauses in the Milk and Dairies Act, 1915, which provide for the appointment of Veterinary Officers by the Local Authorities charged with the administration of the Act. In so far as England and Wales is concerned, they wish to urge that the Veterinary Officers appointed should be whole-time officers, as is provided in the Scottish Milk and Dairies Act.

10. In respect of the diseases which cause most loss to dairy farmers, the most important are contagious abortion and tuberculosis. In the former, while affected animals do not die, there is a great loss in their market value, and a very serious indirect loss in calves and milk. The evidence which the Committee have had on this subject has been to the effect that compulsory notification of the disease has not brought about satisfactory results. The use of vaccine prepared and issued by the Board of Agriculture has been attended with good results, and the Sub-Committee are of the opinion that more active measures should be taken to bring the value of this treatment to the notice of dairy farmers and to encourage them to adopt it.

11. In respect of tuberculosis, the Committee consider that it is highly important that further steps be taken to reduce the incidence of this disease, and to increase as rapidly as possible the number of herds which consist solely of non-reacting stock. With this end in view, they submit the following scheme (drafted by a Special Sub-Committee appointed to consider the question) for the provision of free veterinary assistance, and the issue of certificates to farmers whose herds have complied with certain conditions.

(Signed) W. E. G. A. WEIGALL (Chairman).

June, 1919.

REPORT OF THE SPECIAL SUB-COMMITTEE ON THE INTRODUCTION OF THE ACCREDITED HERD SYSTEM IN RESPECT OF BOVINE TUBERCULOSIS.

1. The Sub-Committee have had under consideration the question referred to them in their Terms of Reference:—

“To suggest (as regards bovine tuberculosis) details by means of which a system of accredited herds can be established without unduly diminishing the production of milk.”

2. The Sub-Committee have reviewed the past and present position as regards the incidence of tuberculosis in dairy herds and the advice and assistance which have been available for farmers who wish to take steps towards its eradication. The general position may be summarised briefly as follows:—

- (1) There is reason to believe that the dairy herds of this country contain a large percentage of animals which would react to the tuberculin test.
- (2) Until recently farmers have failed to recognise the advantages of eliminating reactors other than the financial one accruing from the sale of pedigree breeding stock.
- (3) There is a lack of knowledge on the part of farmers of the comparatively simple methods to be followed in obtaining and keeping herds free from tuberculosis and of the economic advantages following therefrom.
- (4) There is a considerable lack of uniformity of system in the method and the interpretation of the tuberculin test.
- (5) There is no control of the use of tuberculin.
- (6) No serious attempt has been made by past Governments to assist the agricultural community in eliminating tuberculosis from the dairy herds.

3. The situation as outlined above is undergoing alteration, and may reasonably be expected in the near future to show an increased demand on the part of the public for tubercle-free milk at a higher price.

The Milk and Dairies (Consolidation) Act, 1915, and the Milk and Dairies (Scotland) Act, which may be expected to become operative at an early date, will also bring about considerable changes, as it will be possible by regulations under these Acts to grade milk, to license milk sellers, to increase inspection, and to improve the administrative machinery employed by the local authorities under the Acts, thus directly bringing an educative influence to bear upon farmers.

4. The Sub-Committee have had evidence to the effect that there has been a considerable increase in recent years in the number of farmers who are anxious to eradicate all tuberculous animals from their herds, and they are of opinion that a scheme which provided for:—(1) official veterinary assistance in the work of diagnosis and eradication; (2) the issue of certificates in regard to those herds in which the necessary conditions had been complied with; and (3) correlation with a system of milk grading, which would provide an official guarantee on which the milk producer could base his claim to receive a better price for a better article, would be welcomed by progressive farmers, and would contribute very materially towards the eradication of this disease. They wish to emphasise the fact that eradication will depend on the thoroughness with which the details of the scheme are carried out, and they realise that to begin with progress must be slow. As the numbers of young stock in the clean herds increase, and as the supply of such stock becomes more abundant, the scheme ought to develop with greater rapidity. The Sub-Committee therefore beg to submit the following scheme as a basis to the introduction of the tubercle-free herd system:—

- (1) The manufacture, the distribution, and the use of tuberculin to be controlled by a Central Authority.
- (2) The method adopted in the carrying out and the interpretation of the tuberculin test to be standardised.
- (3) Facilities to be provided out of public funds for free tuberculin testing, provided that the farmer can supply satisfactory evidence that he has reasonable facilities for carrying out these tests and is willing to comply with the necessary conditions laid down for freeing his herd. Such a herd should be recognised as tubercle-free, and a certificate given to the effect that the herd was tested on a particular date and found free, and will be subject to re-testing periodically.

5. The Sub-Committee are also of opinion that, in view of the provisions of the Milk and Dairies Acts, the authorities deputed to carry out the above scheme should be those required under the Acts to appoint Veterinary Officers. These officers should be engaged whole time on official veterinary work.

The Sub-Committee realise that, owing to the shortage of qualified veterinary surgeons, it may be necessary to make temporary arrangements to meet the deficiency. In view of the difficulties associated with the disposal of reacting animals, the Sub-Committee consider that owners participating in the scheme should be advised as to the best methods of disposal. Should the reactors consist of valuable breeding animals, their progeny might be reared with every hope of obtaining sound stock, provided that proper precautions were taken in the feeding and housing to avoid infection.

In the opinion of the Sub-Committee the universal adoption of the Tuberculosis Order would materially assist the position.

6. Finally the Sub-Committee desire to emphasise the very great importance of the subject dealt with in this report. They would draw attention to the following passages from the report of the Royal Commission on Tuberculosis:—

“There can be no doubt that primary abdominal tuberculosis in man, as well as tuberculosis of the cervical glands, is commonly due to ingestion of tuberculous infective material.”

“A considerable amount of tuberculosis of childhood is to be ascribed to infection with bacilli of the bovine type transmitted to children in meals consisting largely of the milk of the cow.”

Whatever the exact amount of this human infection may be, it is a preventable infection, and as such calls for every effort to be made to deal with it.

(Signed) GERALD LEIGHTON, M.D. (Chairman).
JAMES MACKINTOSH.
A. W. J. MacFADDEN.
J. F. BLACKSHAW.
ROBERT HOBBS (Junr.).

June, 1919.

REPORT OF HANDLING SUB-COMMITTEE.

MEMBERSHIP OF THE SUB-COMMITTEE.

Major J. W. HILLS, M.P. (Chairman).

Mr. J. M. BELL.
Mr. J. F. BLACKSHAW, O.B.E.
Mr. WILFRED BUCKLEY.
Mr. H. CHADDERTON.
Mrs. M. E. COTTELL.
Mr. C. T. CRAMP.
Mr. P. A. FRANCIS.
Mr. R. HOBBS, Junr.

Major G. R. LEIGHTON, M.D.
Dr. A. W. J. MacFADDEN, C.B.
Mr. J. MACKINTOSH.
Dr. T. ORR.
Mr. A. POOLE WILSON.
Mr. C. H. TAYLOR.
Mr. H. TROTMAN.

INTRODUCTION.

1. The Sub-Committee on the Handling of Milk was appointed in 1918 with the following terms of reference:—

“To consider the steps necessary (1) immediately, (2) after the war, to ensure that the condition in which milk is delivered to the consumer is as wholesome as possible, and to reduce the waste due to premature souring and deterioration in quality.”

* Report of the Royal Commission appointed to inquire into the relations between Human and Animal Tuberculosis. (Cd. 5761), 1911, page 39.

2. It will be seen that the nature of the enquiry set before the Committee determined its form. They had to ascertain the best methods of treatment, in the broadest sense of the word, which milk should undergo in transit from the cow to the consumer, and, therefore, their Report naturally follows such milk in its course and lays down for each step what the best method should be. Starting from the cow, it was held advisable to include the farm itself. Then followed the method of milking and treatment at the farm after milking. The practicability of milk depôts was also examined. Next the milk has to be taken to the consumer, either by road or, which is far more common, by train. The milk, therefore, was traced to its departure station, on the train, and to the delivery terminus. Its handling at the terminus was next considered, and its journey thence either to the retailer or to the factory. Its treatment at both of these places was gone into, and its delivery to the consumer. Lastly the risk of contamination in the consumer's house was examined, and rules for its proper care were ascertained.

3. As they followed the milk through its course, the Committee were continually laying down recommendations, either of greater or lesser importance, and in order to save time and to make their work of more practical value the whole Report has been thrown more or less into a series of such recommendations. A further reason for this lies in the nature of the subject. Upon a great many questions there is no dispute at all. There is general agreement as to what the proper method should be, and the difficulties which arise are in its application. The Committee, therefore, had no difficulty in reaching a decision as soon as they examined the subject. On only a few questions was there matter for doubt or difference of opinion. Of these pasteurisation may be cited as an example. The Committee have not expressed any final opinion upon this process for the reason that it has been submitted to a separate Sub-Committee.

4. We wish at the outset to say how grave are the evils which our Report discloses, and how little is being done to meet them. A supply of pure milk at an adequate price is one of the greatest needs of the community. Its value for the preservation of infant life is too well known to require elaboration. The susceptibility of milk to contamination is, on the other hand, extremely great, and yet though both these factors are a commonplace of medical knowledge and social investigation, little has been done to secure that purity which is so greatly needed. The methods of production and supply are in many cases archaic and unsatisfactory. This is not mainly the fault of those concerned in the trade. Enlightened methods have been handicapped, and moreover no one body has been charged with the care of milk. The system adopted has grown haphazard, and though the evils were recognised it has been nobody's duty to put them right.

5. After this short introduction, we will proceed to trace the course of milk from the farm to the home. Our Report contains recommendations both on the human and on the mechanical side, and it is difficult to say which is the more important. Cows may be properly milked and yet the result will be unsatisfactory if the outfit of the farm is imperfect. Milk may be produced under the best possible conditions, cooled immediately after milking, and yet all trouble and expense may be wasted if the churns are unsuitable or the railway vans of a wrong type. It may reach the retailer in a pure state, and all the gain may be thrown away by improper or careless delivery. Lastly it may be received pure into consumers' houses, and unless it is protected from dust, flies, and other contamination all the previous labour will have been in vain. Consequently the whole question hangs together. It is a chain of which one weak link vitiates the whole. It cannot, therefore, be tackled piecemeal, and it is to be hoped that any action taken will be both immediate and complete.

I. TREATMENT AT FARM.

6. We take first the treatment at the farm.

Cows.

Health.—Cows should be healthy and should be examined by a veterinary surgeon once every six months. It is desirable also that they should have passed the tuberculin test, and that they should be tested at least once a year and any reactors removed. Cows that have not been tested should not come into contact with tested cattle. As a precaution, it is suggested that cattle which have not passed the test should not be admitted to shows. When cows are suffering from temporary illness, such as bad quarters or sore teats, the milk should not be used for human food.

Cleanliness.—Cows should be regularly groomed, and all long hairs should be clipped from the udder. Just before milking, the flanks, hind quarters, udder and teats should be thoroughly cleansed by washing, and gone over with clean damp cloths.

Food.—The food provided should be wholesome, clean and sweet. Care should be taken in the use of foods, such as wet grains, silage, decaying cabbages or roots, which tend to give the mangers and cowshed a disagreeable odour, and dusty foods, especially hay, should not be given during milking.

Water Supply.—Drinking water, whether in the field or in the cowshed, should be abundant, fresh and free from contamination.

COWSHED.

Location.—The cowshed should be situated on a dry site and without any dungstead, liquid manure tank, pig-sty, or other source of contamination or breeding place for flies in close proximity. The yards round the cowshed should be kept as free as possible from dust and mud and well drained. All dung and refuse should be removed from the cowshed twice daily, and where not taken to the field should be carried to a suitable distance or deposited in a properly constructed manure pit. The surface of every yard and passage in connection with a dairy or cowshed should be kept in a clean condition.

Construction.—Stalls should be provided for each individual cow, or at most for each pair of cows. The floor should be of a material incapable of absorbing moisture, which can be well scrubbed and washed. The gutter should be sufficiently deep, and so placed that the standing space is kept as clean as possible. Also the gutter should be of sufficient width and slope to allow liquid to drain away at once. The walls should be smooth and impervious for at least six feet from the floor. The roof should be as simple as possible, so that it may be easily cleaned. The feeding troughs should be such as to facilitate cleansing. All gutters in a cowshed should lead to a drain inlet in the open air at some distance from any window or door of the cowshed, or to some other suitable place of disposal. All drains from the cowshed should be properly trapped.

Provision for Light.—The windows or openings admitting light should be so placed as to secure sufficient lighting of every part of the interior of the cowshed, and the total area admitting light should not be less than three square feet for every stall. The sources of artificial light provided should be ample and should be kept in a clean condition.

Ventilation.—Ventilation should be sufficient to maintain at all times a sweet and wholesome atmosphere. There should be outlets through the roof to allow heated air to escape, and air inlets in the walls. The area of inlets and outlets together should equal 36 square inches for each 800 cubic feet. In cowsheds from which the cows are habitually turned out during a portion of each day there should be a minimum air space of 600 cubic feet for each cow, and in other sheds there should be a minimum air space of 800 cubic feet for each cow, but these minima can be reduced for small breeds or where, as in the north of Scotland, climatic conditions are severe.

Cleansing.—All cowsheds should have an adequate supply of pure water for cleansing purposes, and floors, walls, and partitions should be kept well washed and cleaned. The rafters and roof should be free from dust and cobwebs. The manger and all windows and artificial lights must be kept clean and in good working order. All upper walls and roofs should be regularly lime-washed or sprayed with a good disinfectant, according to the nature of the wall or roof.

MILK ROOM AND MILK HOUSE.

7. **Location.**—The milk room should be situated at a sufficient distance from the cowshed and the dungstead or other source of contamination, and care must be taken that the drainage is thoroughly efficient.

Construction.—The entrance of the milk room should be from the open air and not from the dwelling-house, cowshed or any other farm building, and the room should be used for no other purpose than for the treatment of milk. The floor should be smooth, with a slope to provide good drainage. There should be no inside drain but an outlet through the wall to a properly trapped gully. The wall should be smooth, and the roof also should be easily cleaned. The room should be properly lighted and ventilated, and, if possible, no internal equipment should be attached to the walls, as the numerous corners then formed are very difficult to clean. It is desirable that a separate room should be provided for the treatment of the milk, cooling, bottling, &c., and another for the washing of the utensils. The latter room should have an ample supply of hot water, or steam or both.

GENERAL REMARKS AS TO COWSHED AND MILK ROOM.

8. In making the above detailed recommendations, the Committee wish it to be understood clearly that it is not so much costly premises as attention to details which is necessary to produce clean milk. Though up-to-date buildings are desirable, treatment is more important than the type of edifice used.

UTENSILS.

9. **Milking Pail.**—Milking pails should be of well-tinned material, with all seams rendered quite smooth and all joints flushed over with solder, and so constructed that all parts are easily visible and can be thoroughly scrubbed by hand. Some type of small top milking pail should be used in preference to the common open pail.

Cooler.—The cooler used should be in good condition, and sufficiently large for the quantity of milk to be cooled.

Strainer.—Strainers of wire gauze alone are unsatisfactory. Those used should consist of wire gauze with discs of cotton wool, or, in place of the latter, a straining cloth of sufficiently close mesh.

Churns.—All churns should be kept perfectly clean, free from rust and smooth inside.

Type of Churn.—The common 17-gallon railway churn should be replaced by a smaller size, preferably a 10-gallon churn. The Ministry of Food were good enough to submit drawings of the 10-gallon churn selected by them, and it was generally approved, though some of the Sub-Committee prefer a 12-gallon churn. Nine churns of the 10-gallon type, holding 90 gallons, occupy only the same floor space as four 17-gallon churns holding 68 gallons. There is, therefore, a large gain in transportation. The other arguments against the 17-gallon churn are that it is heavy to lift and too heavy for women, and that it is too deep for the bottom to be cleaned properly by hand. Altogether the arguments for the smaller churn are overwhelming.

Cleanliness.—All utensils should be thoroughly washed, then scalded with boiling water or steam, and immediately inverted in pure air to dry. Where possible, a sterilizing box should be used instead, and the utensils left in it till required.

COOLING OR CHILLING.

10. It is eminently desirable that milk should be chilled to 45° F., and that this should be done immediately after milking. In any case, it must be cooled to 60° F., though nothing short of 45° is really satisfactory. In this report chilling is used to mean at least 45° and cooling at least 60°. The Committee recognise, however, that chilling is not always or indeed generally practicable in this country, where ice is neither cheap nor readily available, and where the summer temperature of any water obtainable is often much above 45°. But they have no sort of doubt as to its desirability; so vitally important is it, indeed, that, though it may not be possible to enforce a universal standard of 45°, this should be the ideal aimed at. Two ways were suggested to the Sub-Committee of reaching this standard: First, that the milk should be collected from the farm, taken to local depôts and chilled there; second, that chilled milk should obtain a higher price.

DEPÔT SYSTEM.

11. The Sub-Committee are agreed that milk chilled at the farm should obtain a higher price, but they are not unanimous on the depôt system. In support of the system it is urged that it enables the milk to be chilled to 45°; to be housed in cold storage until despatched by train; it ensures milk being sent from one station in large quantities, instead of from several in small; it saves labour and renders easier the proper equipment of the station; it enables farmers who produce too little milk to make it worth their while to rail it, to find a ready market at the depôt, and less milk is wasted, because it can, if need be, be converted into milk products.

On the other hand, it is urged that it is a retrograde system. It frees the producer from the responsibility for quality, cleanliness, and chilling; it frees him from guarantees of purity; it delays the milk and lengthens the interval between the cow and the consumer; and that the best plan is to insist on proper cooling and production at the farm.

12. The Sub-Committee are unanimous in regarding any delay in reaching the consumer as disadvantageous so far as it goes, but in spite of this, a majority of them consider that the advantages of the depôt system outweigh its disadvantages. They are specially led to this conclusion by what they regard as the impossibility of chilling milk in summer at small dairies.

The proper organisation and equipment of depôts is set out in paragraphs 18-22 inclusive.

PASTEURISATION.

13. The Sub-Committee gave much consideration to the question of pasteurisation. They found that there was no accepted definition of pasteurisation, and that there was acute difference of scientific opinion as to its effects. They therefore make no recommendations thereon. They consider it the duty of the Government Departments concerned to take immediate action to arrive at definite conclusions on the subject.

MILKING.

14. Milkers previous to milking should put on clean milking suits and caps, and wash their hands carefully, and should be careful that their hands remain clean throughout the entire milking period, even though this entails washing before milking each cow. Clean caps and suits should be supplied to the milkers when necessary, and not only at stated intervals. The milking should be done with clean dry hands, and the fore milk should be drawn from each teat on to the floor or into a special receptacle, and not into the milk pail.

HANDLING THE MILK.

15. The milk of each cow should be removed from the cowshed immediately after milking, and carried direct to the cooler without pouring it into another pail. It should then be immediately strained and chilled churn by churn. The temperature to which the milk is chilled should, as has been said, be 45° F., or as near there as possible. Where the cooling is done in a milk-room exposed to wind and draughts, the exposed surface of the cooler should be covered to prevent dust blowing on to the falling sheets of milk. When the churns or bottles are filled they should be immediately closed and set in a cool place not exposed to sunlight, until the time of transportation to the station or purchaser's premises.

TRANSPORTATION TO STATION OR PURCHASER'S PREMISES.

16. Churns should be sealed and should be carried in a properly sprung cart or float. They should be protected when in the cart by suitable covers from mud, dust or rain, and also from the direct rays of the sun. It is advisable that the temperature of the milk in each churn should be marked on it.

CONTENTS BY WEIGHT.

17. Churns are not measures, and disputes often arise between farmers and buyers as to quantity. Then again, old churns get dented, and in particular the convex bottom is driven up into a concave shape, which makes it an unsatisfactory guide to quantity. For these reasons there are strong arguments in favour of dealing in milk by weight, weight being converted into quantity at the rate of 10·33 lb. to the gallon. If this were done all churns should be stamped with tare weight. They would then be weighed by the railway company at the despatch station, and a way-bill made out in triplicate: one part retained by the sender, one by the railway company and the third delivered by the guard to the consignee.

TYPES OF DEPÔTS, IF ADOPTED.

18. If depôts are adopted they should be of three types. First, chilling depôts, drawing milk from a comparatively short radius, say, 10 miles, capable of handling up to 500 gallons. Second, larger depôts, still confined to liquid milk, with a capacity of up to 2,000 gallons. Thirdly, depôts for dealing with liquid milk but equipped with cheese-making plant and with a capacity of from 500 to 2,000 gallons.

EQUIPMENT OF DEPÔTS.

19. All three types of depôt should possess equipment for weighing milk, straining and chilling, cold storage and churn-washing machinery. The outfit would, of course, vary according to the capacity of the depôt. The second and third types of depôt should possess, in addition, tank storage, pasteurising plant and a small laboratory for testing milk, and the third type should also possess a cheese plant.

CHILLING DEPÔTS.

20. Taking these first, farmers within a certain radius should be required to deliver their milk to them. Outside that radius the depôts should collect at stated hours either from the farms direct or at fixed rendez-vous, or suppliers might themselves organise group collections. The milk from the chilling depôt would be delivered either on rail, or direct to the retailer, or to a factory, or to a larger depôt.

LARGER DEPÔTS.

21. These would receive milk either direct from producers or from chilling depôts. They would only be possible in districts where manufacturing plants exist capable of treating the surplus milk in case of emergency. They would deliver the milk either on rail or to the retailer or factory.

DEPÔTS WITH CHEESE PLANT.

22. Those explain themselves. The plant would, of course, vary according to the capacity required.

II. TRANSIT.

RECEPTION AT RAILWAY STATION.

23. The milk has now reached the departure station and we must see what happens to it there and on its journey.

There are very few stations where any provision is made to protect the churns from sun, dust, or dirt, and milk has often to lie for some considerable time under most undesirable conditions. It may be contended that farmers should not deliver milk to the station until just before the arrival of the milk train,

but while this may be possible with the morning consignment, it is not so in the evening, for trains often depart so late that milk must be delivered long before, otherwise the farmers' workers who delivered would get no sleep. The Committee recommend that at all stations where any quantity of milk is received a cool room should be provided for churns, and used for nothing else; and at the larger stations refrigerating chambers should be established. If the *depôt* system were adopted, all stations served by a *depôt* could have cold storage, which is a great advantage.

RAILWAY VANS.

24. The old open type is still mainly in use, but it is unsatisfactory. The ideal would be ice-cooled vans, such as are used in Denmark and the United States; but ice is too dear and scarce for this to be possible in this country. The railway companies should be asked to produce experimental vans, either cooled by air or otherwise, and comparison could then be made of their efficacy. The Committee are unanimous in condemning the present open van, but they are not agreed on the type which should replace it, as they consider that the subject requires further investigation.

TRAIN SERVICE.

25. Since the war the train service has been going from bad to worse, by reason of the depletion of railway staffs and despatch of locomotives, waggons, and rails to France. Peace-time service should be restored immediately. The railway companies should provide a service twice daily.

CARRIAGE BY TRAIN.

26. Milk, having been loaded at the dispatch station, is made up of consignments not only for the terminus but for suburban stations. A non-stop train runs into the terminus, and then a slow train carries back the suburban consignments and drops its load station by station.

ARRIVAL AT TERMINUS.

(a) Taken to Retail Depôts.

27. On reaching the terminus milk is dealt with by one of three alternative methods, each with separate features. It is either taken straight to the large *depôts* or is taken over by wholesale dealers or direct by the retailer. To deal first with the large retail *depôts*: on arrival at the terminus the large retail companies are in waiting with their lorries and vans to convey the churns to their centralised *depôts* for checking quantity, condition, and quality, where by numerous mechanical appliances it is filtered or clarified, pasteurised, chilled, and placed in a fresh set of clean cans or churns for distribution to the retailing branches.

(b) Taken over by Wholesale Firms.

28. If, however, it goes to wholesalers, the proceedings are different. The strictly wholesale dealers who supply individual retailers examine the churns at the railway station. Examination near the station is necessary, for it would be a waste of labour and transport to start a carman out with a load of milk which his customer might reject on delivery. Milk which does not pass this examination is sent to the dairy to be filtered, pasteurised, chilled, or otherwise dealt with. But, while examination near the station is a necessity, the Committee condemn in the severest terms the practice now prevailing in London and other large termini. It is the custom to inspect the milk on the railway platform. The churns are opened on the platform exposed to all the dust, dirt, and risk of contamination which must exist at a busy terminus. Not only are churns opened, but the milk is tested, and the contents of one or more churns may be mixed together; during this process the lids of the churns often lie underside downwards on a filthy platform, and are then replaced on the churns, with consequences which may be imagined. All this is so unsanitary that it only has to be stated in order to be condemned, yet it still goes on. There should be an absolute rule that no churn under any excuse whatever should be opened at a railway station, and to this rule there should be no exception.

EXAMINATION AT TERMINUS BY GOVERNMENT OR LOCAL AUTHORITY.

29. But the milk dealers are not the only sinners. We are informed that Inspectors either from the central Government or the Local Authorities also open and inspect churns at railway stations, and we condemn this with equal emphasis. It is not necessary and should cease at once.

30. If handling milk and opening churns near the terminus is necessary, and the Committee recognise that it is, a proper building or Clearing House should be set apart for this, suitably cooled and equipped and used for nothing else. The Local Authority should bear the expense of providing it.

(c) Milk sent direct to Retailer.

31. There remains one more case to consider: milk which is not consigned to the large retail *depôts* or to wholesalers, but sent direct from the farm to the individual retailer. In the main, the precautions suggested in the previous paragraphs apply to this milk, for in its journey from the cow to the railway terminus it follows the same course. But milk so supplied has certain incidents and difficulties which are peculiar to it, and these require explanation.

32. An ideal source of supply for a large city retailing firm would consist of farmers of four classes. These would be, first of all, farmers within a short distance of the terminus, sending milk twice daily and keeping up approximately the same supply in winter as in summer. Next there would be farmers within a longer distance, also producing an equal supply all the year round, but sending only once daily. Thirdly, some farmers between whose winter and summer supply there is a large margin. Lastly, there are accommodation senders, who normally employ their milk for cheesemaking, but who at week-ends (in order to avoid Sunday cheesemaking) and in winter are willing to sell to the retailer. Between these four classes the retail dairyman had in normal times no difficulty in regulating his supply. The system has much to recommend it. The evening's milk from both the long and short distance farmers is served to customers fresh before 8 o'clock on the following morning, while the morning's milk from short distance farmers is delivered fresh that same evening, and that from long distance farmers is pasteurised.

The war and controlled prices threw this branch of the trade into the greatest confusion. It was difficult for retail dairymen to retain their supply, since, until the recent Milk (Summer Prices) Order, farmers got the same price from the factories. Thus much milk was diverted, and retail dairymen were put to desperate expedients to obtain reliable milk, even in some cases, it is alleged, making secret payments over the controlled price. It is hoped that the trade will soon return to normal conditions.

SPECIAL DIFFICULTIES OF THE SYSTEM.

(i) *Opening of Churns at Railway Stations.*

33. Retail dairymen do not use railway churns for delivery purposes. Therefore, on arrival the milk must be transferred into delivery churns, from which the milk is supplied to the actual consumer. Under proper conditions this transfer should take place on the retailer's premises. His vans should fetch the churns from the terminus: they should arrive at his place of business with seals unbroken, and should then be opened and the milk inspected for quantity and condition, analysed, and measured out into the delivery churns. Unfortunately, this ideal state of things by no means always obtains. It is not unusual for churns to be opened and milk transferred at the railway station, with consequences mentioned in a preceding paragraph. We can only repeat what we have said in paragraph 28. Moreover, the war has made this proceeding more common than before; there being an acute shortage of churns and of labour, retailers have been driven to economise churns by emptying them at the railway terminus, in order to return them more quickly to the farmer and to economise labour by saving the carriage of the full churns from, and the empty ones back to the station.

(ii) *Difficulty of Cleaning Churns.*

34. But this does not represent the whole evil of opening railway churns at stations. There is also the impossibility of cleaning them there. If churns are taken, as they ought to be, to the retailer's premises, they can be properly cleaned and steamed there. But if they are emptied at the station they are then bundled straight back into the train without even being rinsed. This, unfortunately, is happening daily in London to hundreds of churns.

All this reinforces the Sub-Committee's recommendation that clearing houses should be established at all large termini. We regard this as an absolutely essential reform.

LOSS OF CHURNS.

35. The loss of railway churns calls for serious consideration. It is the unanimously expressed opinion of the trade that more churns are lost than ever before, and that the number lost is still increasing. As the value of a 17-gallon churn is at least double that of the milk it will contain, it is obvious that any serious increase in the expense of replacing losses must have an appreciable effect on costings, and consequently on the price to the consumer. Another effect of churn losses is to discourage farmers from direct sending, as continued irregularity in the return of empties frequently leads to an abrupt termination of relations and is fatal to the chance of a renewal of contract. The knowledge of this urges buyers to throw in churn after churn on receipt of complaints from senders. The Sub-Committee are satisfied that the loss of railway churns is aggravated by the mixing-up of churns from many different owners in factory yards, whence they are despatched, not to their rightful proprietors, but indiscriminately all over the country. In circumstances of such confusion, it is impossible to make operative the regulation by which it is an offence to use other people's churns, but of the necessity of such a regulation the Sub-Committee have no doubt.

SUGGESTED REMEDIES.

36. All milk sold by wholesale should be in seller's churns, except in the case of producers selling directly to one customer only, or producers sending directly to one customer by direction of the seller, or milk fetched away by the buyer from the place of sale. Penalties for wrongful possession or use of churns should be rigorously enforced by proceedings taken, not by the aggrieved owner, but by the authorities, on information received. Properly authorised inspectors should have the power to enter at reasonable times any place where they have cause to suspect the presence of stray churns. Every churn should be indelibly imprinted on the body with the owner's name and address, and the date of purchase. On the occasion of a sale, the new owner's name and the date of purchase should be imprinted, but no erasure of the late owner's name should be allowed, thus each churn would bear a record of its history. All churns, or parts of churns, found derelict at railway stations should be collected and sent to a clearing house. It should be an offence for any station master to allow a stray churn to remain longer than a specified time on his station. The owner of a churn, as indicated by its inscription should be offered his property (when derelict) on payment of a reasonable charge for expenses of recovery, and should he refuse to accept the churn on these terms, or fail to reply, then the churn should be sold and marked as prescribed. The question as to who is to bear the charges involved in these suggestions would have to be considered.

III. RETAIL DISTRIBUTION.

37. The milk has now reached the retailer, and its sale by him must be examined. This has different features in different localities.

(i) *LONDON.*

The milk supply in the County of London has one characteristic which cannot be found in any other city or town in the United Kingdom, for the inhabitants of inner London, say a radius of ten miles from Charing Cross, do not obtain their milk from the immediate outer zone as in the provinces, but have to break through a ring of some 40 miles before they begin to pick up supplies. The outer ring or zone consumes nearly all the milk produced in its own area, and therefore compares with the Provinces.

38. Given a train service twice a day and two retail deliveries daily, deliveries would be one milking behind, for the evening milking would be delivered the next morning, and the morning in the afternoon. This was the practice before the outbreak of war. The difficulties that have arisen as a result of war

conditions, shortage of labour, curtailed train service, great shortage of utensils and small cans, together with the employment of women, forced the dairy trade to deliver only once a day, so that to-day it may be taken that deliveries are one day behind production. This is a war necessity and should not be allowed to continue longer than is necessary.

Present Methods of Delivery.

39. Milk is sent out from the retailing depots either in large brass mounted churns or in glass bottles. Taking the churns first, these are fitted with a tap and a suitable size hand-can of 6, 8 or 10 quarts. Each carrier is provided with a measure dipper with which the household supplies are measured out. The hand-can and measure is a survival of the early days of milk vending, and is unquestionably the cheapest form of milk distribution. The disadvantage is that milk is dealt with in the street and exposed to contamination from dirt, dust, and flies.

40. Delivery churns should be sealed and a control sample from each churn retained, so that if a sample is taken by an inspector under the Sale of Foods and Drugs Act, or if any customer makes a complaint, the dairy control sample affords an effective check on the roundsman.

Glass Bottle Service.

41. So much for the ordinary way of delivering milk in London. The delivery cart, either pushed by hand or drawn by donkey or pony, is too common a sight in our London streets to need any elaborate description. But besides milk from delivery churns a small percentage of the total supply is delivered in glass bottles, bottled and sealed at the dairy, and encouragement is given to this method in the present Milk Order, which allows a penny per quart for the bottled milk over the price to be charged for loose milk. The history of the glass bottle service is instructive. The disc-stoppered glass bottle was introduced to this country by a well-known company in 1897-8. It was used for nearly two years at an extra charge of a penny per quart with gratifying results, when another company suddenly started delivering milk in bottles at the same price as loose milk, then fourpence per quart. It is true that this company, after making a heavy loss, gave up the practice, but their intervention caused an upheaval in the trade which did not cease with their departure. It increased the demand for milk in glass bottles, and dealers were driven to supply it at the same price as loose milk. This was an entirely profitless line of business, which could only be made profitable by giving short measure, which, of course, all reputable dealers refused to do. They attempted to impose the extra penny per quart, when another competitor entered the field, made their venture, disorganised the trade, and in turn lost their capital. The foregoing examples show that milk in bottles holding full and proper measure cannot be sold profitably at the same price as loose milk.

After-War Possibilities.

42. Yet the fact remains that a well-organised glass bottle delivery service for milk is to be desired. But it must be commercially profitable. It prevails in America and in Paris. Is it desirable or possible to make it compulsory here? Its advantages are the avoidance of contamination; its drawback the extra cost, extra weight, extra bulk and the impossibility of supplying small quantities, for one pint is the smallest bottle practicable. As to cost, the one penny per quart charged in peace-time would probably scarcely meet the present increased cost of glass bottles. The weight and bulk of milk in pint bottles is about double that in churns, as will be seen from the following figures:—

Taking a round of 36 gallons.

Pint bottles.		36 gallons would require		Dimensions (inches).
Crate containing 12 full bottles,	1½ gallons.	24 crates.	996 lbs.	
	41½ lbs. weight.			11½ by 9½ by 16½ each.

24 crates would require a huge space, 35 by 50 by 30.

Churns.		Weight of milk.	Total.
2 required, 18 gallons each.		372 lbs.	468 lbs.
Weight—48 lbs. each = 96 lbs.			

Space required for churns 20 inches diameter: 40 inches by 20 inches.

Difference in Weight.							
36 gallons in bottles ...	...	...	...	...	...	...	996 lbs.
36 „ „ churns ...	...	...	...	...	...	...	468 „
							528 „

Hence, bottles are more than double the weight of churns.

Quantities less than one pint must be fetched by customers themselves from shops, and seeing how much milk is taken in half-pints or less, this would cause considerable inconvenience. On the other hand the prohibition of the open milk-can in the street would be a great advance in the interests of public health, and consumers would benefit thereby, as a milk service, bottled by machinery at the dairy depot under hygienic conditions, sealed and delivered in bottles, containing full and proper measure, would be advantageous to those customers who take not less than one pint at a time. Customers requiring less than one pint would be less conveniently served as they would have to get their smaller quantity from the dairy shop. The practice in America appears to be that, in addition to the deliveries direct to the consumer's house, milk is on sale in sealed glass bottles at a number of "stores" and the purchaser dealing from the "store" purchases the first bottle as well as the milk, and returns the empty bottle when a fresh full one is required. Assuming that delivery in bottles is best, it is impossible to make a hard and fast order in the first stage, as the needs of smaller customers must be met, and if a change is made the trade must have time to adapt itself to it.

43. We, therefore, recommend that the ideal to be aimed at is a delivery in bottles, but we recognise that this involves a drastic change in the trade and can only be reached gradually. Meantime bottled milk should be encouraged by being allowed a higher price.

(ii) THE PROVINCES.

44. The methods at present in use vary considerably in different towns. For example in many large towns in the north of England and elsewhere a large percentage of the milk is delivered by local farmers who both produce and retail their own milk. On the outskirts of Manchester, again, there are many farmers who have the same method, and most of the milk they sell in normal times is sold "warm from the cow" twice daily. But the bulk of the milk in the Provinces is delivered, as it is in London, from churns. The difference between the Provinces and London lies in the fact already noted that London milk usually has to travel further. The milk is retailed either by being drawn off from a tap at the bottom of the churn, or the churn's lid is lifted and the milk ladled out and measured. The same criticisms can be made on this as were made on the London practice. The system of delivering in bottles has not made much way. It remains, however, the best system, but its introduction must be a matter of time, and some means must be devised for supplying customers requiring less than a pint more convenient than that of compelling them to go to shops.

45. There is, therefore, not much to distinguish the supply of large towns from that of London. In London, it is true, the milk has to travel a longer distance, and direct supply by the producer is, therefore, much commoner in the provinces. But the differences do not call for any comment for they do not involve different treatment. All the evidence is in favour of the recommendations made earlier in the Report; the importance of chilling at the farm, of quick and sanitary transit, of proper distribution.

IV. TREATMENT OF MILK AFTER DELIVERY AT THE CONSUMER'S HOUSE.

46. The strictest precautions may be taken at the cowshed, during transit, and during delivery to ensure a supply of clean milk, yet all these precautions may be nullified if care is not exercised in the consumer's house after delivery.

47. Milk in the house is exposed to contamination from various sources such as dirty milk vessels, dust and flies, and the influence of temperature.

48. While a warm temperature brings about an increase in the number of bacteria present in the milk before delivery, contamination from milk vessels, dust, and flies adds new bacteria. It must be noted that the new additions, especially the bacteria from flies, may be of a dangerous character, producing definite disease in susceptible persons. For example, infantile diarrhoea, enteric fever and possibly diphtheria may be caused in this way.

Most housewives know that milk cannot be kept fresh in a dirty vessel. For this reason, and also because a sufficient supply of hot water for cleansing is usually readily available in the kitchen kettle, contamination from milk vessels is perhaps not the most common cause of deterioration. The contamination of milk in the house from exposure to dust and flies is much more common, since the public generally have not yet recognised the importance of at all times keeping the milk covered, and, as has been noted above, it is more dangerous.

49. The most important factor determining the deterioration of milk in the house is temperature. Bacteria increase with a rise in temperature. Most bacteria are inhibited at 50° F., but they multiply rapidly with rise of temperature until 100° F. is reached when they are again inhibited. The usual temperature of a dwelling house, 65° F. and upwards, is most favourable for the multiplication of bacteria and thus souring occurs.

In summer, therefore, conditions are most favourable for rapid souring unless precautions are taken. The popular view that thunder causes souring of milk is a fallacy; it is the warmth of the atmosphere during thundery weather which brings about this result.

50. Contamination from all three sources can, however, be avoided by the use of simple precautions. Milk vessels should be cleaned with boiling water, and kept covered, not only when holding milk, but before. Milk should be stored in a pantry, cellar, or other cool place. This, of course, is a council of perfection, for unfortunately many dwellings do not contain any cool place; but if they do not, certain precautions can be taken which are within the capacity of the humblest home, such as to place the milk jug in a basin of cold water and allow fresh cold water to trickle into the basin. Another is to cover the jug with a small inverted basin, put a piece of muslin over this, and place the whole under the tap and let cold water trickle over the muslin. Lastly, in very hot weather (but only then) the jug can be covered by a wet cloth, and the milk cooled by evaporation.

The Sub-Committee are glad to note that some Public Health Authorities throughout the country have in recent years been steadily inculcating these ideas, and that from the Infant Welfare Centres and Schools for Mothers, which are being established all over the country, instructions are being given broadcast. But much more still remains to be done. The need for instructing the people with regard to milk, as with regard to other health matters, is great and urgent.

51. Owing to abnormal conditions, souring of milk in the consumer's house has been the cause of serious waste during the war and now. This has been largely due to the delivery of milk taking place only once daily and the milk being older than in normal times. Much milk now being delivered in London is at least 18 hours old, and some at least 24 hours old. On account of the single delivery daily the consumer must keep a portion of this milk in the house until he receives his supply next morning, that is, nearly 24 hours after delivery. Thus the milk for the baby in the morning, not considering the porridge for adults, may be anything from 36 to 48 hours old, or older.

52. Waste from souring is most likely to occur during the warmer months of the year although even in winter a few days of mild weather may cause the same result, especially with the single daily delivery when the milk delivered is many hours old.

53. This waste can be minimised by using the remedies mentioned early in the Report. If milk is properly chilled at or near the farm and delivered cool, souring is less probable. If it cannot be chilled, it should be pasteurised. A delivery twice daily is a great help, and lastly the consumer can protect himself by heating the milk to the boiling point and storing in a cool place.

54. The Sub-Committee were not concerned to decide the debatable question whether more contamination took place at the farm or at the home, for they are satisfied that the risk at the home is so grave and so common as to require immediate action. There is abundant evidence of this, and it comes from New York

as well as from this country. The Sub-Committee are therefore satisfied both of the risk arising in the home and also of the futility of wasting time and money on obtaining pure milk unless at the same time a universal educational campaign is undertaken to teach housewives the danger and folly of buying milk and then allowing it to become contaminated or decomposed when a few simple precautions would maintain its purity.

55. This concludes our enquiry. We can only repeat what we said at the beginning, that the question is one of the most urgent health problems before the country. We believe that if our recommendations are adopted the standard of purity can be raised very greatly; and there is universal agreement as to the benefits which will accrue from this not only to children but also to adults. And we believe also that this can be done without undue increase of price. If our enquiries have the effect of hastening this desirable result we shall be well satisfied.

56. We wish to express our gratitude to our Secretary, Miss Mackenzie, whose knowledge of the subject and business capacity have proved of the greatest assistance to the Committee.

(Signed) J. W. HILLS (Chairman).

June, 1919.

REPORT OF THE SUB-COMMITTEE ON LABOUR IN DAIRYING.

MEMBERSHIP OF COMMITTEE.

Major The Hon. E. F. L. WOOD (*Chairman*).

Mr. J. F. BLACKSHAW, O.B.E.

Mr. WILFRED BUCKLEY.

Mr. C. T. CRAMP.

Mr. P. A. FRANCIS.

Mr. C. M. DOUGLAS, C.B., D.Sc.

Mr. H. M. HOLMAN.

The Hon. Mrs. EDITH LYTTETON.

Mr. J. MACKINTOSH.

Miss M. M. MACQUEEN.

Sir GEORGE NEWMAN, K.C.B., M.D.

Sir DOUGLAS NEWTON, K.B.E.

Mr. GEORGE NICHOLLS.

Mr. HAMAN PORTER.

Mr. POOLE WILSON.

TERMS OF REFERENCE.

1. *Terms of Reference.*—"To consider what steps can be taken to meet the immediate difficulties with which farmers are faced at the present time and also to devise some means of making dairying more attractive and so enabling it to compete with more hope of success with industry."

2. *Meetings and Witnesses.*—The Sub-Committee have held nine meetings and have interviewed witnesses from the National Farmers' Unions of England and of Scotland, the Scottish Chamber of Agriculture, the Agricultural Labourers' and Rural Workers' Union, the Workers' Union, the Scottish Farm Servants' Union, and with reference to labour conditions in Wales.* They have also had before them the opinions expressed by the Royal Agricultural Society of England, the British Dairy Farmers' Association and the Highland and Agricultural Society of Scotland when the representatives of these Societies gave evidence before the Main Committee on the development of the dairy industry.

3. *Immediate difficulties.*—According to their terms of reference the Committee were asked in the first instance to consider what could be done to meet the immediate difficulties of dairy farmers. Since the Sub-Committee was set up hostilities have been suspended and consequently some of those difficulties directly attributable to the war are likely to be less seriously felt. It is, therefore, unnecessary for the Sub-Committee to prepare definite recommendations on these points.

4. *Future conditions of Labour.*—In respect of the second subject of their reference, namely, "to devise some means of making dairying more attractive and so enabling it to compete with more hope of success with industry," they realise that the subject is of profound importance to the continuation and development of dairy farming and that the conditions of the dairy industry are so various, that their Report is likely to be more useful educationally by collating different suggestions as to how the methods and conditions of labour in dairying may be improved, than by formulating definite recommendations with a view to legislation.

5. *Necessity for practical suggestions.*—The conditions under which dairy farm labour is carried on are not susceptible to rapid change, and at the present time the effect of ill-balanced recommendations might well be to increase the tendency of farmers to dispose of or to reduce their herds in order to lessen their labour difficulties.

The increased demand for milk from all towns and cities has brought farming for milk production into existence to a greater or lesser degree in almost every county in Great Britain, and as a result there is an extraordinary variety in the conditions obtaining on dairy farms. Even in the well known dairy districts—South West of Scotland, Cheshire, Lancashire, Derbyshire, South Midlands, Essex, the South Western Counties of England and the South West of Wales—the traditional habits of the farmers and the workers, the climate, the soil, the type of farm buildings all show great variation, and make the formulation of general recommendations well-nigh impossible.

For all these reasons, the Sub-Committee have been impressed with the necessity for making suggestions which would commend themselves to practical farmers, and which could be introduced with the least disturbance into the systems of farm management which are at present followed.

6. *Common Features.*—Throughout all dairy districts, however, there are two important considerations which emerge as common to all dairy farms. These are:—

(a) the necessity for the carrying on of the work of feeding, milking and management of the milk seven days a week and every day of the year;

(b) the desirability of having cows milked twice daily at as equal intervals as possible.

These points are of great importance and must be regarded as fundamental in the arrangement of hours of labour on dairy farms. Their application, however, varies according to the actual nature of the operations carried out on individual farms. On those farms where the milk is made into cheese or

* See page 28.

butter, the intensity of the work varies from season to season and the hours of milking are entirely under the control of the farmer; much the same conditions obtain on farms where the milk is sold wholesale to factories for conversion into milk products with the exceptions that the seasonal intensity is not so marked, and where the milk is called for by lorry, there is not the same latitude in hours of milking.

On farms where it is the object to maintain a uniform output winter and summer, the labour during the winter is considerably greater than on farms which concentrate on summer production; where the milk is sold wholesale the hours of milking are largely governed by the local train service, and where it is sold retail they are fixed in relation to the consumers' requirements as to the delivery of the milk.

The hours of milking show a great divergence from the desired equal intervals on farms selling milk for human consumption. There is no doubt that in many instances a very long night interval (15-16 hours) is harmful to the cows and results in milk of very unequal quality. The morning's milk occasionally contains less than 3 per cent. fat, thus rendering the seller liable to prosecution. This risk would be almost entirely eliminated by uniform intervals between the milkings. At the same time, milking at equal intervals can only be attained by spreading the day's work over a period of 13-14 hours.

7. *Relation of Labour problems to size of farms.*—The problems in respect of labour also vary according to the size of the farm and the number of cows kept. Unfortunately, there is no information available as to the distribution of cows between large, medium, and small herds, the classification of farms into groups of different acreage throws a certain amount of light on the distribution of cows, but this information is not detailed enough to be of material value. The following table shows the agricultural holdings above one acre in England and Scotland divided into four groups, the number of holdings in each group and the number and percentage of cows:—

ENGLAND AND WALES.					IRELAND.				
Class of Holding.	Total Number.	Total Number of Cows.	Percentage of total Cows.	Total Acreage under Crops and Grass.	Class of Holding.	Total Number.	Total Number of Cows.	Percentage of total Cows.	Total Acreage under Crops and Grass.
Above 1 and not exceeding 5 acres.	89,958	43,977	1.9	281,096	Above 1 and not exceeding 5 acres.	47,619	23,186	1.9	157,174
Above 5 and not exceeding 50 acres.	197,218	609,775	26.2	4,087,234	Above 5 and not exceeding 50 acres.	321,335	801,576	51.4	6,061,458
Above 50 and not exceeding 300 acres.	127,864	1,354,834	53.4	16,015,365	Above 50 and not exceeding 100 acres.	57,476	359,328	24.4	3,276,457
Above 300 acres ...	15,041	313,225	13.5	6,964,218	Above 100 and not exceeding 200 acres.	23,159	192,957	13.1	2,422,143
Total ...	430,081	2,321,811	100.0	27,347,913	Above 200 and not exceeding 500 acres.	8,231	70,470	4.8	1,607,154
SCOTLAND.					Above 500 acres ...	1,967	20,792	1.4	771,227
Above 1 and not exceeding 5 acres.	18,136	23,101	5.4	59,699	Total ...	459,787	1,473,309	100.0	14,295,613
Above 5 and not exceeding 50 acres.	34,601	96,836	22.9	637,766					
Above 50 and not exceeding 300 acres.	23,138	255,677	60.5	2,951,270					
Above 300 acres ...	2,673	46,834	11.2	1,214,738					
Total ...	78,548	422,448	100.0	4,863,473					

From the above it appears that some 28 per cent. of the dairy herd in Great Britain is maintained on holdings of under 50 acres; that is to say, on holdings where the labour can be largely carried out by the occupier and his family. Approximately 60 per cent. is kept on farms of between 50 and 300 acres. From the point of view of finding out the proportion of the national dairy herd kept on farms where labour problems may be acute, further sub-division of this group is desirable, but unfortunately, statistics for this purpose are not available. The Sub-Committee consider that in the future a method of classification should be adopted similar to that used in Ireland. The labour requirements of holdings of 50 to 100 acres may be largely met by the owner and his family, whereas on farms of 200-300 acres additional labour is essential. It is probable that the greatest difficulty in obtaining an adequate supply of labour will be experienced on medium-sized dairy farms depending very largely on hired labour, but with only a moderate mechanical equipment. As regards Ireland the table shows that the Irish dairy herd is maintained to a much greater extent on small farms than is the case of Britain, *e.g.*, 56 per cent. on holdings under 50 acres and about 81 per cent. on holdings under 100 acres. In this connection it may be pointed out that farms on which the entire work is carried out by the family are in reality working in unfair competition with those on which outside labour has to be employed, since the wages item, one of the most serious in the cost of production, is practically eliminated.

8. *Increased Demand for Milk.*—Associated with the change in agricultural conditions arising from the war and the question of labour in dairy farming in particular, there have been indications of an increased demand for milk as a human food. The rise in the price of foods and the awakening of popular interest in food values has directed attention towards the cheapness of milk as compared with other animal foods; there has also been a greater realisation of its unique value as a food for children. The increased demand is also attributable to the ability on the part of many consumers to purchase larger amounts than formerly. From the national point of view this higher appreciation of, and greater demand for milk are most hopeful signs, but this demand can only be met if dairy farmers have an adequate supply of labour. Further, compliance with the demand on the part of the health authorities and the public for a cleaner milk supply will require, under the conditions of production which obtain on most farms, the employment of extra labour.

To obtain this supply the dairy farmer must enter into keener competition with industry than has been necessary in the past. This competition will be rendered all the more intense, and the farmer's difficulty in securing the additional labour necessary to produce the requisite increase in the milk supply will be aggravated by the experience of social life which many thousands of rural workers have had in the army or in different kinds of war work. By some means or other the attractions of town and city life must be counterbalanced if the country is to obtain and keep its due share of labour.

9. *Difficulties common to all branches of agriculture.*—In surveying the field to be covered by their enquiries, the Sub-Committee considered it desirable to adopt the guiding principle that those subjects which, though of great interest and importance, were common to all branches of farming, should be interpreted as being outside the scope of their work. On this basis such subjects as:—

- (a) the actual rate of wages to be paid;
- (b) rural housing conditions, including the question of the "tied" cottage;
- (c) social conditions in the country in general

would not arise for detailed consideration.

The first of these is in the hands of the Wages Board which has been created for the specific purpose of fixing minimum rates of wages suitable to the conditions in the different counties. The second, though of prime importance in dairying and indeed in all branches of agriculture, cannot be adequately considered except as part of a national scheme of housing associated with other problems of local government and reconstruction. There is no doubt that at the present time there is a very great need for additional cottages, and that in numerous districts large numbers of existing cottages are far below modern standards. The third subject is also one of national interest and is an essential part of any scheme for increasing the numbers of the rural population. It has been dealt with in the report of the Agricultural Policy Sub-Committee of the Reconstruction Committee (Cd. 9070, pages 118-122, Appendix 11. Village Industries and Social Life). Also one aspect of this subject, namely, that of Women's Institutes, is now directly associated with the Women's Branch of the Board of Agriculture and Fisheries and with the Board of Agriculture for Scotland.

In addition to subjects such as those just mentioned, there are others which, although common to other branches of agriculture, have a direct relationship to the future of labour in dairying and, therefore, require special reference. Of these the most important would seem to be:—

- (a) improved educational facilities;
- (b) improvement in the relations between employer and employed.

10. *Education in Dairying.*—The Sub-Committee are aware that the subject of education in dairying has been referred to another Sub-Committee, and therefore refrain from making any detailed recommendations upon it. They welcome the opportunities which will be provided under the Education Acts, 1918, for the general development of education and, in particular, for the provision of country continuation schools.

They trust that the courses of study and instruction which it is proposed shall be provided for pupils during their latest years at such schools will be the means of securing a higher standard of education and efficiency in rural workers. They also wish to emphasise the desirability of some instruction being given in rural subjects at all continuation schools so that pupils in industrial districts may have an opportunity of acquiring some knowledge of, and interest in rural life.

As regards the provision of increased educational facilities for those at present engaged in farm work the Sub-Committee believe that much could be done by the County Agricultural Education Staff and other bodies, and that lectures, short courses of instruction, and demonstrations on appropriate subjects at suitable hours would be appreciated by cowmen and other farm workers as well as by farmers themselves. In this connection, the Sub-Committee would draw attention to the valuable educational work at present being carried out by the National Clean Milk Society by means of demonstrations of the possibility of producing clean milk under the most unfavourable farm conditions. If satisfactory attendance at such courses and the attainment of a certain degree of practical efficiency were followed by the awarding of certificates, and the possession of such certificates were recognised by employers as meriting the payment of a higher wage the results could hardly fail to be to the benefit of all concerned.

11. *Relations between employers and employees.*—The Sub-Committee realise that in the course of time the relations between employees and their employers will become the subject of frequent discussion between the various representative organisations. They are of the opinion, however, that no official conferences between branch unions or with official representatives can take the place of personal contact and sympathy between the farmer and his men. Conditions of labour and rates of wages should be the subject of more frequent discussion between the individual farmer and his men, in order that each may understand and be able to sympathise with the other's point of view. By such personal contact and understanding it should be possible to develop mutual confidence between employers and employees, and to increase the interest of the workers in the management and output of the individual farm. The working hours and conditions under which dairying has been carried on in the past must be improved in the future, and employers will be well advised to give their workers an opportunity of stating their views as to what alterations they consider necessary and satisfactory, and in what way these may best be made effective.

The Sub-Committee have given considerable thought to the part which may be played in the improvement of the relationship between employer and employed by schemes of co-partnership, profit-sharing and bonuses, but they are of the opinion that it is well-nigh impossible to devise any scheme which could be made the subject of a general recommendation. They have given particulars of a few such schemes in Appendix A, but they are principally concerned to emphasise the importance of employers—by whatever means local conditions may make most suitable—endeavouring to give their employees an interest in the conduct and prosperity of the business in which they are engaged.

The organisation of farmers and farm and other rural workers into their respective unions has extended with varying rapidity in different parts of the country. In nearly all parts of Great Britain there are organisations representative of the interests of farmers, and as regards farm workers, the Agricultural Labourers' and Rural Workers' Union and the Workers' Union in England, and the Scottish Farm Servants' Union in Scotland all have a considerable membership. In districts where employers and employees are

well organised, meetings between representatives to discuss labour problems have had beneficial results and there is much to be gained by the development of such opportunities for free discussion. One notable instance is the arrangement which has been come to between the Edinburgh and Leith Dairymen's Association and the Scottish Farm Servant's Union in respect of the hours and holidays of byremen and vanmen, dairymaids and women milkers. The general terms of this arrangement are given in Appendix B.

In English counties where the Agricultural Labourers and Rural Workers' Union and the Workers' Union have branches it is to the advantage of the farmers' organisation to recognise and confer with both of the former as an agreement with the representatives of one Union cannot be binding on the members of the others. During the next few years an increase in the membership of all unions mentioned above is both certain, and, in the opinion of the Sub-Committee, desirable, inasmuch as upon the development of a more complete organisation for farmers and farm workers alike, the representative character of any such joint and permanent body as an Agricultural Whitley Council or a National Council for Agriculture must depend.

12. *Hours of Labour.*—The definition of a week's work as a stated number of hours with a corresponding wage and a specified rate for overtime, or the adoption of the alternative method of fixing an inclusive wage for "customary hours" and no overtime are questions which fall definitely within the scope of the Agricultural Wages Board. The Sub-Committee, therefore, do not wish to make recommendations on these points, but having in mind the early and late hours at which much dairy work must be performed, they desire to emphasise the importance of making the conditions as to hours and wages for dairy workers at least as favourable as for other agricultural workers. They have had evidence to the effect that at present in counties where the system of customary hours is in practice, the position of cowmen and others engaged in the production of milk compares unfavourably with that of horsemen. The former often have a longer working week and much more Sunday labour for the same weekly wage.

13. *Holidays.*—On the subject of holidays, the Sub-Committee are unanimous that a definite holiday period should be provided, but that the actual method by which holidays are allotted to employees must be left to agreement between the employer and the employee. On this point much will depend on the situation of the farm with reference to towns or cities. Experience has shown that in the case of farms close to towns, an arrangement permitting one half day per week works satisfactorily, whereas in the case of farms at a considerable distance from a town, preference has been shown for a holiday of several days' duration in a given period of months. Whatever system may be adopted, it is evident that the means whereby the work of the farm may be carried on efficiently must receive careful consideration.

On some farms it may be possible to make arrangements by a re-organisation of the working hours of the labourers at present employed, but, generally speaking, and especially on the larger farms, it will be found necessary to engage additional employees either for whole or part time. In many districts one of the great difficulties in the way of engaging additional whole time workers is the lack of cottages. Although the farmer may be willing to engage the extra labour he cannot do so, because there is no housing accommodation available in the district, and in order to make the amount of work on his farm fit in with the number of workers and hours of labour, he may be forced to reduce the number of milking cows in his herd.

In the course of their enquiries, several instances of arrangements whereby workers were enabled to get a half or a whole day holiday have been brought to the notice of the Sub-Committee and particulars of these are given in Appendix B.

14. *Employment Exchanges.*—The attention of the Committee has been drawn to the fact that very little use is made of the Labour Exchanges as a means of bringing farmers and labourers into touch with each other. They believe this to be largely due to the failure to appoint persons with agricultural experience to the staffs of Labour Exchanges in country districts. They believe it to be essential that in such areas, where agriculture is the most important employing industry, at least one member of the staff of each Employment Exchange should be thoroughly conversant with farming conditions and the various types of labour required. Only in this way can the Exchanges inspire the confidence needed to supply the necessary link between the demand for and the supply of labour.

15. *Part time work.*—In some parts of Great Britain the engagement of part time workers on dairy farms is a general practice, the wives and daughters of the farm labourers being employed for the work of milking morning and evening. While this system has enabled many labour difficulties to be overcome in the past, it is doubtful if it can be relied on to the same extent in the future. There is the outstanding objection that if the farm labourer's wife and daughters are engaged in the early morning work of milking, it is sometimes difficult for the labourer himself to obtain a substantial morning meal. There are also indications that as the wages of the men increase the women and girls become less inclined to undertake work outside the home. The Sub-Committee, nevertheless, believe that an increase in the number of part time workers, especially for the hand milking of cows, would afford a supply of labour which would enable many dairy farmers to overcome some of the labour difficulties arising from the institution of shorter hours and regular holidays.

The increase of small holdings in dairying districts may in some cases have the effect of providing a rural population who might be willing to add to their income by undertaking part time work in connection with dairying, and the Committee consider it desirable that this point should receive the careful attention of the authorities responsible for the establishment of small holdings.

16. *Conditions under which work is carried out.*—In respect of the conditions under which the work on dairy farms is usually carried out, the attention of the Sub-Committee was directed chiefly to the waste of labour entailed by the lack of system in the arrangement of the farm buildings as a whole and by the inconvenient internal equipment, such as bad floors without adequate drainage arrangements and improperly constructed stalls. Where the cows are housed in a number of sheds, and where much of the food has to be conveyed to those sheds through open yards, the labour in feeding is considerably increased, and during the winter the workers are much more exposed to weather conditions. Where the internal equipment is poor, it is well-nigh impossible to maintain any reasonable degree of cleanliness.

As regards labour-saving equipment, the milking machine has been largely tried throughout the country and results are, generally speaking, somewhat conflicting. On some farms where a mechanical milker has been in use for years good results have been obtained, and in other districts the majority of machines installed are now disused. The Sub-Committee have had before them a Report* on an enquiry

into the use of milking machines in England which was prepared for and is being fully considered by the Agricultural Sub-Committee. A summary of the information contained in this Report in so far as labour is concerned, would lead to the conclusions that where reliable hand milkers can be obtained, it is not desirable to instal a milking machine, but that where milkers are unreliable, the installation of a machine should be of considerable benefit, provided that a thoroughly efficient operator is in charge. Further, with well arranged buildings, the installation of a mechanical milker should lead to a reduction in the amount of labour required, but where the buildings are badly arranged, the milking machine does not save labour on the whole, as the labour required for the feeding of the cows and the cleaning of the sheds is also capable of carrying on milking. Other mechanical labour-saving devices such as a ground level system of rails with waggons or an overhead system of one rail with trolleys are not common on farms in Britain, and the chief reason is the lack of systematic arrangement of farm buildings.

The Sub-Committee believe that much could be done towards a solution of labour difficulties by the rearrangement and reconstruction of dairy farm buildings and their equipment with suitable mechanical labour-saving machinery, but they realise that improvements are needed on a very large scale, and that the cost would in many cases be prohibitive. In order that more information may become available to demonstrate the advantages of well-arranged buildings, &c., and to guide those who contemplate alterations and improvements the Sub-Committee recommend that in the general investigations to be conducted by the Agricultural Costings Committee an analytical study be made of the cost of labour and the amount required on farms representing respectively good and bad arrangements and equipment.

It cannot be doubted that in the future those farms on which the work in connection with milk production can be carried on in the most convenient, efficient, healthy, and comfortable manner will, other things being equal, have least difficulty in attracting and keeping an adequate supply of labour.

A memorandum outlining the means contributing to labour-saving on dairy farms is given in Appendix C.

17. *Women labour on dairy farms.*—The Sub-Committee have had before them a memorandum on Women Labour on Dairy Farms, prepared by one of their members, in which the type of women to be employed, the kind of work which can be undertaken by women, the size of farms which might employ women and the conditions of employment are fully discussed. This memorandum is given as Appendix D. They realise that experience has proved that women can undertake a considerable amount of the work on dairy farms, particularly that which can be carried on at the homestead.

In future, in view of the somewhat larger supply of men which will be available for farm work, it appears probable that women will be employed chiefly as whole-time workers on large farms, or as part-time workers on small farms. It is exceedingly difficult at the present time to forecast in any detail the conditions under which women will be employed. In those districts where it is customary for women to undertake farm work and to live in the farmhouse, very long hours are often worked, and it is desirable that some reduction should take place. Any such reduction, however, will necessitate, as in the case of men, reorganisation of the farm labour or the employment of additional workers, and the difficulties of obtaining satisfactory solutions to the problem along these lines have already been mentioned. Evidence was brought before the Sub-Committee to the effect that in certain districts the introduction of Land Army workers, with their regular hours of employment and wages, created considerable discontent amongst the local women workers living in. It is evident that some means will have to be found of bringing into line the conditions under which the local women who combine farm and domestic work are employed with those now obtaining in the case of "imported" and other female farm workers. As regards the general conditions as to hours of labour, holidays, and wages for women employed in the manner referred to above, the Sub-Committee consider it desirable that these should be dealt with by the Wages Board as in the case of other female farm labour.

18. *Co-operation amongst Farmers.*—Reference has been made to the dairy farms of 100 acres or less where the work can be almost entirely carried out by the farmer and his family, and the view has been laid before the Sub-Committee that such farms must be the mainstay of the national milk supply in the future. There should also be associated with this class of farm those holdings where it is the custom to engage a dairyman to take charge of a herd of cows, and where the cows are sublet according to local custom. In such instances the work is often carried out entirely by the dairyman and his family. It is undoubtedly true that the new conditions of labour as to wages, hours, and holidays have not the same application to such farms as to those of greater size or where other labour customs are the rule, but the new conditions must sooner or later affect even such farms, and it will be necessary for such changes to be made as will prevent the junior members of the farmer's or dairyman's family acquiring such a distaste for dairy work that they will take the first opportunity of departing to more congenial employment. An approximation to the statutory conditions as to wages and hours of labour would tend to have this effect, and the Sub-Committee also believe that a considerable improvement could be effected by the spread of co-operation. The labour of milk delivery and haulage of manure and feeding-stuffs could be reduced, and where cheesemaking is largely practised, the organisation of milk collection and the erection of depôts where milk could be adequately treated for transit to consuming centres and the surplus made into cheese would materially lessen the amount of work to be undertaken by the family. Evidence from districts in Scotland is strongly in favour of the development of co-operation with this end in view.

Further, it was pointed out that, previous to the control of milk and in the absence of co-operation, farmers were unable to get such a price for their milk as would have enabled them to work reasonable hours and pay a proper wage. In the event of all regulation of milk prices being removed, co-operation amongst the producers would appear to be the only means whereby they could avoid the re-occurrence of the unfortunate conditions under which they previously carried on their work.

SUMMARY.

Bearing in mind the general considerations in para. 6, the Sub-Committee are of opinion that:—

I. EDUCATION.

In addition to the opportunities for education provided under the Education Act, 1918, it is most desirable that, wherever possible, lectures, demonstrations and short courses should be given on appropriate subjects

at hours convenient to farmers and their employees. The granting of certificates to farm hands attending such courses who attain a certain standard of efficiency, and their recognition by higher pay would greatly increase the value of such a method of instruction.

II. RELATIONS BETWEEN EMPLOYERS AND EMPLOYED.

Discussion and consultation, not only on such subjects as the conditions of labour, but also on the actual working of the farm, will, by giving each individual labourer a personal interest in his work, do more to encourage friendly relations between farmers and their workers than formal conferences between organisations of employers and employed, although, of course, the Sub-Committee fully recognise the necessity of this also and the beneficial results which, as mentioned in their Report, they know to have accrued.

III. HOURS.

Without making definite recommendations on the subject of hours and wages, which they recognise as falling within the province of the Agricultural Wages Board, the Sub-Committee desire to emphasise the importance of making the conditions in this respect at least as favourable as for other agricultural workers.

IV. HOLIDAYS.

In view of the varying conditions on different farms, their distance from towns and so forth, the Sub-Committee feel that the method of arranging holidays must be left to agreement between employers and employed. They are, however, unanimously of the opinion that definite holiday periods should be given to dairy workers.

V. EMPLOYMENT EXCHANGES.

In order to increase the value of the Employment Exchanges in rural districts, the Sub-Committee strongly urge that in each case at least one member of the staff should possess expert agricultural knowledge, such as will enable him to be of adequate assistance in the supply and allotment of agricultural labour.

VI. PART-TIME WORK.

The employment of part-time labour, especially in the hand-milking of cows, would assist many farmers in overcoming some of the difficulties with which they are faced owing to the institution of shorter hours and regular holidays. They urge that this point should be borne in mind by the authorities responsible for the establishment of small holdings, for they believe that many of the owners of such holdings might be glad to increase their income by undertaking part-time work in dairying.

VII. LABOUR-SAVING MACHINERY.

Where difficulty is found in obtaining good hand-milkers, milking machines might be used with advantage, provided that a competent operator can be placed in charge.

The Sub-Committee recommend that, in the general investigations to be conducted by the Agricultural Costings Committee, an analytical study be made of the cost of labour and the amount required on farms representing good and bad arrangement and equipment.

VIII. WOMEN LABOUR.

With regard to the labour of women on farms, some means must be found of bringing the conditions under which the local women who combine farm and domestic work are employed more into line with those now obtaining in the case of "imported" and other female workers. As regards the general conditions as to hours of labour, holidays and wages for women employed in this manner, they consider it desirable that these should be dealt with by the Wages Board, as in the case of other female farm workers.

IX. CO-OPERATION.

There is undoubtedly a future for co-operative methods in dairy-farming, especially in the opportunities they afford of reducing the labour required in cheesemaking and the collection and delivery of milk. Further, in the event of the control of milk prices being removed, an extension of the practice of co-operation is likely to provide the most satisfactory remedy for the evils arising from the former unrestricted competition amongst the milk producers.

The Committee desire to express their thanks to Miss Mackenzie for the valuable assistance which she has given them in the course of their investigations.

(Signed) E. F. L. WOOD (Chairman).

May, 1919.

APPENDIX A.

PARTICULARS OF CO-PARTNERSHIP, PROFIT-SHARING AND BONUS SCHEMES.

1. Mr. T. ———, *Lincolnshire*.—"What I am doing here is this. There are 54 cows at this minute in milk. I pay A. and his wife 1½d. a gallon for the milk. They not only milk but feed the 54 cows. I allow them one milker to whom I pay the current wages. The cake is crushed and brought to the door for them. The root room is kept supplied with roots and the straw is near at hand, so that they have to waste no time in collecting food or fetching it from a distance. A. and his wife are very thrifty. They earn upwards of 75s. per week."

"I forgot to say that, as well as paying A. 1½d. per gallon for the milk, I pay him 2s. 6d. for each calf which reaches one week old. On the other hand, if the calf dies, A. pays me 10s. forfeit. This system is working very well."

2. Mr. K. ———, *Hunts*.—"My herd consists of, say, 46 cows, and in order to make milking more attractive and financially interesting to my workers, the following scheme has been adopted:—

"That for every gallon of milk produced in the year over 20,000, 1d. per gallon be handed over as a bonus

divided between the workers who have served 12 months in the shed."

3. Mr. H. ———, *Oxon.*, "has adopted the practice of allowing his stockmen bonuses on sales in order to keep alive their interest in pedigree stock. The milkers and dairy workers get a weekly bonus in proportion to the agreement which is found between the totals of the daily milk record sheets and the total in the milk sales' account."

"So far Mr. H. has not devised or adopted any system of profit-sharing or co-partnership, or of payment according to output of milk or other means."

4. Mr. S. ———, *Essex*.—"About 20 years ago Mr. S. commenced paying his employees an annual bonus in addition to their wages. This bonus ranges from a payment of £20 to a foreman, £5 to a head cowman, to 40s. to an ordinary hand. The system has been still further elaborated in the case of cowmen, who receive an additional bonus if the amount of milk from their cows exceeds a certain quantity. While certain rough rules of this kind are observed in allocating the

bonuses, the exact amount which each one receives rests with Mr. S., whose aim throughout is to reward any man who has done especially good work. The amount distributed in bonuses has varied in different years, latterly amounting to £1,000, and has averaged during the whole period about £700 per year; but this sum bears no exact relation to the year's profits.

"In the year 1908 it was decided to supplement the bonuses by a regular system of co-partnership. The principal particulars of this scheme are as follows:—Any man working on the estate is allowed to invest his own or his wife's savings in the farm. The money thus invested is used as ordinary farming capital. It is withdrawable at any time on a month's notice being given. It is guaranteed interest at 4 per cent., and it receives in addition a full percentage of any additional dividends that may be declared at the end of the year. Thus, as far as profits are concerned, the men investing money in the farms receive all the privileges of shareholders in an ordinary commercial company. In other respects, however, they are subject to certain important restrictions.

"Men are not allowed to invest money which does not belong to them or to their wives. Any man leaving his employ is required to withdraw his deposit forthwith. No individual depositor may invest a larger sum than £200. Finally, the entire control of the industry rests with Mr. S., who decides the manner in which the man's capital is to be employed and the amount to be put by in any given year for depreciation and reserves before the additional dividends (over and above the guaranteed 4 per cent.) are declared.

"Before declaring dividends the following charges have to be met:—

- (1) Outgoings and current expenses of all kinds, including wages and salaries.
- (2) Rent of about 25s. per acre on all the land farmed.
- (3) The bonuses, amounting to over £700 per year.
- (4) A varying sum for depreciation and reserves.

"Any sum remaining after all these charges have been met is profit and is divided between Mr. S., on the one hand, and the employed depositors, in proportion to the amount of capital invested by each, in equal rates. Up to the present the experiment has been a great success. A large proportion of those employed have invested their savings in the farm, the amounts invested being in many cases very considerable, and it has been found possible to pay on the deposits a considerable dividend over and above the guaranteed 4 per cent."

Elaboration of system mentioned in first paragraph:—

"When the milk yield in a herd of 40-80 cows averaged 650 gallons a year, a bonus was given to the head cowman and to the under-men in proportion.

"This bonus was increased as the average rose to 700, 750, and 800 gallons, respectively.

"During the last three years no bonus has been earned.

"Extra money was also given to the head cowman for cows that calved during September and October."

5. *Mr. A.—Kent.*—"I give my milkman an interest by paying him so much in the shilling after he gets above a certain quantity. If the price of milk goes up, the amount he has to realise goes up, too, before his commission starts, as it is not through his efforts that I get more money for my milk, but if he finds fresh customers, then he benefits."

6. *Wiltshire.*—"On milking farms, in practically every district, a system of management is adopted in working the milking herd. On farms of 40-70 cows a family is engaged, with cottage and garden rent free, and allowance of coal to obtain boiling water for cleansing the churns and utensils.

"The man takes the management of the cows at a price per head; this is usually 1s. 6d., and excepting that all foodstuffs are drawn to the sheds, the man, with his family, does all the necessary work of milking, cooling, feeding, &c. In the haymaking and harvest, opportunity is given to earn extra money by helping between milking hours.

"This system works very satisfactorily and, certainly, relieves the farmer from a great deal of the worrying detail connected with the working of the herd."

7. *Cornwall.*—"A custom, called the leasing of dairies, which exists in Cornwall, affords a means of advancement by which the labourer may rise to become the tenant and, even, the owner of a fair-sized farm. The system is prevalent in the dairy districts of Cornwall, especially the west country, and is usually in the form of a yearly arrangement which provides, that, for a rent per cow for a year, an established farmer hands over a farm or holding with its complement of cows to a competent man with a capable wife. The lessee takes all responsibility off the hands of the lessor and is entitled to all he can make over and above the rental he has paid the lessor. I am told that the usual price paid per cow to the lessor was, and perhaps still is, £9 to £10 per annum. There are provisions as to the maintenance of the herd at the original number taken over.

"The chief feature which tends to success is that from the moment the lessee takes over there is an immediate return. As a safeguard to himself, and as an aid to the lessee, the lessor retains a right to supervise. The lessee usually combines the production of pork with his dairy work and from that branch a very satisfactory return is usually forthcoming. The success or failure of these leases depends very largely on the lessee

having a capable and hard-working woman for a wife, on the terms on which he enters into the arrangement, and on the nature of cows handed over."

8. *Bucks.—Farm.*

Details of a Scheme in Operation.

1. ————— (hereinafter called "the Employer") will (subject to Clause 14) provide the necessary Capital of the Undertaking. Such Capital will consist of Working and Fixed Capital.

Working Capital.—The Working Capital will be of such an amount as the Employer may from time to time think necessary. It will consist partly of cash and partly of the value of such live and dead stock, produce, tillages, unexhausted manures, feeding stuffs, plant, utensils, machinery (other than fixed), and such other matters as in the opinion of the Employer are properly including as Working Capital. The Employer will be entitled in respect thereof (as hereinafter provided) and so far as he has provided such capital to interest on the Working Capital for the time being at the rate of — per cent. per annum.

Fixed Capital.—The Fixed Capital will be the land hereinafter described with the farm-buildings, fences, gates, permanent structures or works and fixed machinery at present thereon, and such new fixed machinery, buildings, fences, gates, permanent structures or works, and future additions thereto or substantial alterations thereof, as the Employer may think necessary.

The land will be such as is specified and valued in Schedule "B" hereto, with such additional land as the Employer may in his discretion from time to time by written notice direct to be included, but omitting nevertheless such parcels or plots of land as he may in the like discretion by written notice direct to be excluded (all which land and additional land subject to such exclusions as aforesaid is hereinafter called "the Farm"). All land so added to or taken away from the Farm will be valued by the Employer, and such value will (as the case may be) be added to or deducted from the value of the Fixed Capital as given in the said Schedule.

Rent.—The Fixed Capital will as on the day hereinafter fixed for the commencement of the Profit Sharing Scheme, be valued at the amounts and in the manner specified in Schedule "A" hereto, which is based on the estimate of the actual agricultural value of the place to an incoming farm tenant which was specially made by a well known firm of valuers, and the employer will be entitled in respect thereof (as provided in Clause 7 hereof) to annual rent calculated at the same rate per cent. as the current bank rate upon the value so ascertained. He will also be entitled annually, by way of further rent, to a sum calculated at the same rate of interest per cent. upon the actual cost of any future additions necessary or intended for the purpose of the undertaking he may make to the Fixed Capital, provided always that in estimating such actual cost there shall be excluded such a sum as in the Employers opinion, reasonably represents the cost of any architectural or artistic ornamentation to such additions.

2. *Management.*—The Management Staff will consist of such Managers, Assistant Managers, Overseers, Foremen and others as the Employer shall from time to time employ and appoint upon such Staff. All such employees will be engaged upon written agreements (to be entered into from time to time with the Employer fixing the terms of their engagement).

3. *Labour.*—The Workmen to be employed will be such as will be from time to time selected by the Employer. In calculating the respective amounts which the Workmen will receive, a Workman who has been employed for twelve consecutive calendar months and upwards preceding the taking of such account, will be paid twice as much as a Workman who has been employed for less than twelve consecutive calendar months. Workmen who have not been employed for a period of six months shall not participate in the profits.

4. *Control.*—The general control and policy of the working and management of the Farm will be kept entirely in the hands of the Employer or of such person or persons as he shall from time to time appoint, but representatives of the employees will be asked to meet the employer or his representative at least once a year, and if possible oftener, to discuss questions of policy.

5. *Valuation.*—All produce from the Farm supplied to the Employer and the Employees will be accounted and paid for as far as possible at the prices quoted for the district in the return of the Board of Agriculture for the week in which such produce was supplied. Land or buildings which may from time to time be used or occupied by or for the purposes of the Employers' Stud Farm shall be accounted for and paid for by the Employer at such rent or prices as he shall consider fair and reasonable. Produce of garden or allotment plots for the time being held by the Employees, or of the private gardens and grounds of the Employer, if such garden or allotment plots, or gardens, or grounds, do not form part of Farm, will not be subject to the provisions hereof. All the valuations that may require to be made, if not expressly made herein, or in the Schedules hereto, will be made by the Employer or someone appointed by him after consultation with the President of the Board of Agriculture or the Head of

University College Agricultural Section. Tillages and unexhausted manures unless otherwise specified will be valued at the current rate in the district, and live stock will be valued and depreciated at the rates set out in Schedule "A" hereto. The basis of valuation and rates of depreciation made herein shall be revised quinquennially by the Head of the Statistical Branch of the Agricultural Department of the University or by some other person nominated by the President of the Board of Agriculture, and there shall also be a quinquennial re-valuation of the Fixed Capital.

6. *Accounts.*—Proper Accounts (and whenever possible separate accounts for each department or section of the Farm) of all receipts and expenditure, will be kept by or on behalf of the Employer, and a yearly Balance Sheet and Trading Account will be made out, audited and certified by a firm of chartered accountants to be selected by the Employer, and when so audited and certified, shall be final and conclusive. Employees will be entitled to see the Balance Sheets and Trading Accounts, but shall not be at liberty individually to enquire further into them.

They will, however, be invited to appoint one of their number as their representative to examine the accounts and to report to them thereon. And such representative will be given access to such accounts, and to all vouchers relating thereto.

7. *Gross Profits and net Profits.*—There will be paid out of the receipts from the Farm the general working expenses of the Farm, including salaries, wages, rates and taxes, insurance premiums, rent (calculated in manner before mentioned), interest on the working capital at the rate aforesaid, renewals of all live stock, repairs, maintenance, depreciation of live and dead stock, the guaranteed interest upon the Deposits hereinafter mentioned, and any other expenditure connected with the business of the Farm and properly payable out of its receipts.

The residue of such receipts as aforesaid will be deemed to be the "gross profits." Out of such gross profits there will be paid annually to the Reserve Fund hereinafter mentioned the sums hereinafter specified and the residue of such gross profits shall be deemed to be the "net profits."

8. The net profits will be divided between Capital, Labour and Management, so that each £1, whether (1) of interest on Working Capital (provided that when any Working Capital is transferred by the Employer to the Employee by means of deposits—Section 12—an equivalent amount of the Fixed Capital will be entitled to share as if it were Working Capital) or (2) of salary, or (3) of wage, shall entitle it to an equal share provided that the Employer may before such deduction set aside not more than — per cent. which he may allocate at his discretion (unless otherwise agreed to in writing) either among Management or Labour, being guided by the comparative profits of departments of the Farm and by the special degree to which any employee has contributed to such profit.

9. The proportion of the net profits allocated to them will be distributed among the permanent Employees in shares proportionate to their weekly remuneration. The weekly remuneration of every Employee will be taken as comprising his weekly wages, exclusive of overtime or bonus, but including the estimated weekly rent of any cottage and garden where these are provided for him free of charge. Provided the total amounted limited in Clause 12, Sub-section D hereof, is not exceeded, the share of net profits payable to each Employee, whether as a member of the Management or of the Labour Staff, will be placed to his deposit account (or to one to be opened for the purpose in his name), and will be paid to him from this deposit account in four equal instalments. The first of such instalments will be paid to him on October 1st or as soon after as the accounts are certified by the Auditors as aforesaid, and one other instalment at the expiration of three successive periods of three calendar months thereafter. Provided nevertheless that any Employee may, if he thinks fit, permit such share of net profits to remain to the credit of his said Deposit Account, and while there it will be subject to all regulations affecting deposits herein contained.

For the purpose of calculating the share of the net profits payable to any Employee weekly remuneration amounting in value to less than 20s. will be treated as 20s., if over 20s. but under 30s., as 30s., if over 30s. but under 40s., as 40s., and so on.

No employee who leaves or is dismissed from the employment of the Employer for any reason whatsoever will participate in any share of the profits for the farming year during which he leaves or is dismissed. This will not apply to any employee leaving or dismissed during the war and six months after the cessation of hostilities. Employees leaving during this period will get a *pro rata* share of profits for every completed period of three months on the farm.

10. *Reserve Fund.*—A Reserve Fund will be created as a provision against losses. Such Reserve Fund will be formed in the following manner:—At the commencement of the Profit Sharing Scheme herein set forth, the Employer will pay the sum of One hundred pounds to the credit of such Reserve Fund, and at the end of every farming year on the taking of the Annual Accounts there shall be paid to the same Fund

out of the gross profits of the preceding year a sum of money calculated as follows:—

- (A) When the gross profits show a return not exceeding 6 per cent. for the farming year, no contribution will be made to Reserve.
- (B) When the gross profits amount to more than 6 per cent. but less than 10 per cent. then an amount equal to 12 per cent. of the net profits will be carried to the Reserve Fund Account.
- (C) When the gross profits amount to more than 10 per cent. but less than 15 per cent., then 15 per cent. will be carried to the Reserve Fund Account.
- (D) When the gross profits amount to 15 per cent. or upwards, then 20 per cent. of the net profits will be carried to the Reserve Fund Account.

The Employer may at any time at his discretion, withdraw such sums from the Reserve Fund as he may think advisable, and out of them may defray losses.

11. The moneys standing to the credit of the Reserve Fund will be invested by the Employer in his name in such stocks, funds, shares or securities quoted on the London Stock Exchange, and in no way connected with the business of the Farm as he may in his discretion think fit. Should the Profit Sharing Scheme herein contained be abandoned, the investments representing the Reserve Fund will be sold by the Employer in such manner as he shall think fit and the proceeds thereof (after payment of the expenses of realization) with any cash standing to the credit of the Fund will be applied in the repayment to the Employer of the amount or amounts contributed by him and the remainder will be distributed among the Employees for the time being and the pension holders in such proportions as the Employer may determine. Provided that no Employee will be entitled to share in such distribution unless he was in the employment of, or pensioned by the Employer at the date of such abandonment. But in the case of an Employee or Pensioner who may have died during such farming year and who had prior to his death been in the employment of or pensioned by the Employer for the 10 consecutive years, immediately preceding such death his widow (if any) or failing her, his personal representatives will be paid all sums which would have been payable under this clause to such deceased Employee or Pensioner if he had not died. Should however such deceased person have been employed or pensioned by the Employer for less than such ten years as aforesaid, but for more than three years, his Widow (if any) or failing her, his personal representatives will receive a proportion to be determined by the Employer of such sums as aforesaid, varying with his length of service.

12. *Deposits.*—Any permanent Employee, whether on the Management or the Labour Staff (subject as hereinafter mentioned) may subscribe towards Working Capital, and will receive a Deposit Book in which will be entered the amount or amounts of the Capital so subscribed. The amount or amounts so subscribed (hereinafter called "the Deposits") will be treated as a loan to the Employer, and will be subject to the following Rules which will be printed in the Deposit Books:—

- (A) Deposits will be received on the first day of any calendar month from any Employee on the farm who has been in the Employer's continuous employment for a period of three calendar months preceding such day, and shall be in sums of not less than £1 or a multiple of £1. The employer personally guarantees their repayment to the Depositor with interest thereon (but not share of profits) as hereinafter mentioned.
- (B) Deposits for the time being standing to the credit of a Depositor will carry interest at the rate of £3½ or such other rate as is current for Post Office Savings per cent. per annum, and the due payment of such interest is hereby guaranteed by the Employer on any Deposit up to a total not exceeding the total annual wage or salary (exclusive of bonus or overtime) of the employee. Employers may increase their Deposits beyond this amount but no interest will be guaranteed on any such excess which will be on the same footing as if it were capital provided by the Employer. Such interest shall be deemed to accrue from day to day, and shall annually, on the taking of the annual accounts hereinafter provided for, be placed to the credit of the Depositor as an addition to his deposit, with any share of profits that he may become entitled to as hereinafter mentioned, and such deposit shall be deemed to be increased and shall carry interest accordingly.
- (C) The Employer reserves the right at any time or times to refuse or to return the whole or part of any deposit.
- (D) Every Employee shall have an equal opportunity of increasing his Deposit proportionately to his wage or salary, i.e., No employee may by increasing his Deposit disproportionately absorb an undue proportion of the working capital available.

(E) If any person is dismissed from or leaves the employment of the Employer for any reason whatever, his deposit shall be returned to him (less any amount that may then stand to his debit) together with 3½ per cent. interest to the end of the last completed week nearest the date of withdrawal, but he shall not be entitled to participate in any further or additional profits of the share allocated to capital or rate of interest for any part of the farming year during which he leaves.

(F) Any Depositor may withdraw the whole or any part, not less than £1 or a multiple of £1, of his deposit at any time upon giving one week's notice to the Employer at his Office at the Farm upon a form provided for that purpose, but if such withdrawal shall be made before the 30th March in any year, he shall only be entitled to the receipt of 4 per cent. interest to the date of such withdrawal, and shall not be entitled to participate in any share of profits for the current farming year in respect of the amount mentioned in such notice.

(G) Unless the Employer shall expressly so permit in any individual case, Depositors shall deposit money belonging to themselves only, and not money belonging to or provided by relatives, friends, or other persons. Any Depositor infringing this rule shall have the whole of his deposit money returned to him immediately, and shall not be entitled to any interest thereon or share of profits.

13. *Military Service.*—The calling out of men for service under the Crown will not be deemed an interruption of continuous service. Employees, however, must apply to the Employer for re-engagement at the earliest possible moment after the date of the termination of their service is known to them, and if they fail to do so the Employer may hold their employment by him to have been voluntarily discontinued.

14. *Method of Termination.*—This Scheme will continue in force until the Employer gives notice to the Employees as a whole, or to any Employee in particular determining it, either generally or in any particular case, but such notice unless given before or during the month of February in any year, will not take effect during the then current Farming year. Notice will be deemed to have been duly given if a written announcement to that effect be displayed in some prominent place on the Farm.

15. *Partnership not to be Created.*—This Scheme being of an experimental character and having been framed for the guidance of the Employer and as an indication to his Employees of the method of the distribution of profits proposed to be adopted by him shall not (except as regards Clause 12) constitute a contract of any kind or create any contractual relationship as between him and his Employees or anyone else. And no Employee except under Clause 12, shall have either in law or in equity any rights or liabilities of any kind whether of partnership or otherwise, nor shall any Employee, except as is herein expressly provided or unless so instructed by the Employer intermeddle with, or be concerned in, or be entitled to enquire into, the management of the business or its book-keeping or accounts.

16. *Bonus, etc.*—No Employee will receive any bonus, present or allowance, which is not specified either in this Scheme, or in the Schedule hereto, or in an Agreement made in writing with the Employer and signed by him.

17. *Alterations.*—Alterations or modifications of this Scheme and the Schedules hereto (or of any Rules made in connection therewith) which experience may suggest are desirable, may from time to time be made by the Employer.

18. The Employer may make such Rules and Regulations as he may think fit for the purpose of carrying out more fully and effectually the Profit Sharing Scheme herein set forth.

19. *Regulations.—Determination of Questions.*—Any question that may arise in the working of this Scheme, or on the interpretation of any of the clauses hereof, or of any Rules or Regulations made in connection therewith, or on the taking of the said accounts will be referred to the decision of the head of the Agricultural Section of ——— University College for the time being, or failing him, to some person nominated by the President of the Board of Agriculture, or failing either of them will be decided by the Employer himself.

20. *Interpretation.*—The expression "Farming Year," as herein made use of shall mean the year commencing on the 1st day of April and ending on the 31st day of March following.

In this Scheme words importing the masculine sex also include females, and those importing the feminine sex also include the masculine.

21. *Date of Commencement.*—The Scheme will commence as from the first day of ——— and will continue as long as the Employer thinks fit, subject to Clause 14.

The following Schedules will be Schedules kept:—

SCHEDULE A.—Containing the detailed principles and basis of valuation and depreciation adopted herein.

[This Schedule will be printed with and attached to this scheme.]

SCHEDULE B.—Containing a detailed statement of the fixed and working capital.

SCHEDULE C.—Containing such additions to and such alterations to and interpretations of this scheme as may be made.

[Schedule B and C.—Will be kept up to date and copies will be circulated to the staff as often as may be necessary, or will be available for their inspection but will not be printed in or attached hereto.]

SCHEDULE A.

1. The rates of depreciation shall be:—

(A) —per centum per annum on stone, brick or other permanent building.

(B) —per centum per annum on wooden or iron buildings (not including chicken huts, coops, etc.).

(C) —per centum per annum on fixed machinery.

(D) Carts, wheelbarrows, and moveable machinery, utensils, implements, chicken coops, wire netting, fencing, gates etc., to be taken at the valuation made 30th September, 1916, a "life" to be assigned. The depreciation to be the value divided by the number of years of life.

(E) —per centum on the tubing implements and parts of the milking machine other than the engine.

2. Live stock shall be valued at the following rates:—

(1) Milch cows at £——.

(2) Bulls at £—— each.

(3) Calves at — at birth, with a — increase per head up to a maximum of £——.

(4) Pigs at £—— each, or at — at birth, with a — increase per head per month up to a maximum of £——.

(5) Sheep at market price, less — per cent.

(6) Cattle same as sheep.

(7) Horses. To be valued at Cost and to be depreciated by such annual sum as will leave them on the books at £—— per Horse by the time they reach the age of — years.

(8) Poultry shall be valued at the following rates:—

(A) Pullets of the same year —.

(B) Hens of the preceding year —.

(C) Hens of 2 years preceding —.

(D) Young birds — at birth with a — increase per week.

(9) Purchased feeding stuffs will be valued at the net cost price to which will be added at the beginning of every quarter the same interest as on all other working capital calculated on the total of such feeding stuffs actually then in stock. This interest per cent. will be credited to the respective feeding stuffs account.

Any stock for breeding purposes bought at a higher price than the figures set out in 2 (1), (2) and (3), the amount by which it exceeds those figures will be entered to a "Dairy Pedigree Account." This account will be depreciated at the rate of — per cent. per annum.

3. Home grown feeding stuffs will be valued at the cost of production—interest will be charged as on purchased feeding stuffs.

SCHEDULE B (Summarised).

CAPITAL VALUATION.

	£
Land	£——
Buildings	£——
Fruit Farm	£——
	£——

Working Capital £—— (at date).

SCHEDULE C.

(1) The rent of a cottage on the Estate, occupied by an Employee shall be reckoned at — a week, until otherwise determined. Every cottage shall have the same rent charged. Any person being moved by the employer from one cottage to another shall be paid — by the Estate.

(2) The allowance for a single man or woman lodged with an employee having a cottage on the Farm shall be — per week, which payment shall include use of furnished bedroom and a share in the sitting room and kitchen, but shall not include meals or washing.

(3) Where work is done by the Farm for the Estate including the Stud Farm the actual cost will be charged to the Estate plus — per cent. The same arrangement shall apply for work done for the Farm by any outside department.

(4) The cash value of manurial Residue will be arrived at by taking — of the value of cake fed to stock. No allowance will be made for the value of any other food. The value of such residue will be charged as follows:—

One-half the first year and one quarter to each next succeeding crop.

APPENDIX B.

HOLIDAYS.

1. *Mr. B—Hants.*—"Every dairy worker has one day in seven as a complete holiday. There are from 70 to 75 cows in milk, and seven milkers are employed; they milk on the average 12 cows each daily, as there are six on duty."

2. *Mr. K—Hants.*—"Instead of keeping 4 milkers I keep 5, so that each worker can have the week-end off every fifth week."

3. *Major W—Yorks.*—"For a herd of 20 cows in milk and calves, young stock, and pigs, one cowman and two women are employed. Each gets one full day off in 3 weeks; this is preferred to a half-holiday because of the distance of the farm from a town. This arrangement also gives a practical equality between the hours per week worked by the cowman and the customary hours of the horsemen. Occasionally for the holiday additional assistance is required for calf-feeding."

Northamptonshire.—"It is interesting to draw attention to the case of one very enlightened farmer, who has a large milk business, and who employs all his workers on Sundays so as to get the work done quickly, who gives to each Sunday worker a half-holiday during the week, one man going on Monday, another on Tuesday, and so on. This is a principle which might be applied to the Saturday half-holiday scheme, for it is not necessary for all workers to go on the same day, indeed, it is obviously impossible that they should do so. The enlightened employer referred to above gives this half-holiday quite voluntarily, and he finds no difficulty in the working of the arrangement. It is sometimes argued that all the men in the country village, some miles from a town, would wish to have their half-holiday on the same day, so that they could enjoy games together. The reply may be suggested that it would be the younger men and the youths who would want to play the games, and it is not usually this class of man who is employed in doing the skilled work among the stock. It may be assumed, therefore, that to the older man—the skilled horse and stockman—it would be a matter of indifference which day he had his half-holiday."

5. In the Edinburgh district a claim made for higher wages, shorter hours and half-holidays by the Edinburgh and District

Branch of the Scottish Farm Servants' Union, which is composed entirely of dairy workers, was submitted to arbitration. The award was as follows:—

"Award by the Arbiter in reference between the Edinburgh and Leith Dairymen and their workers."

"Having accepted the Reference, heard parties for their interests, and carefully considered the whole circumstances, I fix the wages of the workers from and after week commencing 10th November last as follows:—

Byremen and Vanmen.—Competent men to be paid £2 17s. 6d. per week and one quart of milk daily.

Men boarded by employers.—Competent men to be paid 30s. per week and board.

"Where men are required by their employers to cut grass on Fridays such men will be paid 2s. 6d. extra, but it will be optional for the employers to arrange the work so as to dispense with grass cutting on Fridays."

"Men to be off work every third Sunday after the morning work is finished."

Women Milkers.—Women milking three times a day to be paid 16s. a week, and one quart of milk daily, the minimum standard to be ten cows. Such women will get one milking off once a week at times to be arranged with the employers.

Women milking twice daily to be paid 12s. 6d. a week and one quart of milk daily, the minimum standard to be ten cows. Such women to get a milking off once a fortnight at such times as can be agreed to by the employers.

Dairymaids (Competent).—To be paid £19 10s. in the half-year and board.

"All dairy workers to have two hours off each day for meals. Other conditions as regards service to remain as formerly."

(Signed) *James J. Davidson.*"

(The Sub-Committee are aware of the very exceptional circumstances under which milk production is carried on in the district in question and the rates of wages are not under their consideration, but they have nevertheless thought it desirable to set out the award in full.)

APPENDIX C.

LABOUR SAVING ON DAIRY FARMS.

In view of the existing and future shortage of labour on dairy farms and the necessity of maintaining the present and attracting an additional supply, it is most important that steps should be taken:—

- (a) To lessen the labour requirements of the farmer.
- (b) To improve the conditions under which the labourer works.

In as far as building and machinery are concerned these ends may be attained by:—

1. Economical arrangement of the farm buildings as a whole.
2. Convenient internal arrangement of individual buildings.
3. Introduction of mechanical equipment.

1. Economical Arrangement of the Farm Buildings as a Whole.

Generally speaking a notorious lack of systematic arrangement is in evidence in the situation of the various buildings on the great majority of dairy farms. Frequently the herd of cows is accommodated in several sheds scattered about the homestead, causing much unnecessary labour in the conveyance of food to cows and in the carrying of milk from the sheds. The only apparent principle of arrangement has been that the sheds should be grouped as closely as possible around a manure-yard. The lack of economical arrangement causes loss of fodder, and the workers are exposed to weather conditions to an undesirable degree. This condition of affairs has arisen partly through the adaptation of existing building to dairy purposes, and partly through the erection of new buildings without considering the relation which should exist between such new buildings and those already in use. Dairy farm buildings should be arranged on a definite plan embodying the following principles:—

- (a) The herd of cows should be housed as far as possible in one shed (with suitable premises for isolation purposes) to economise labour in feeding, cleaning, and removal of milk.

- (b) The food-preparing shed should be so situated in relation to cow-shed, cake and meal store or granary, and root-shed, that the work preparatory to the feeding may be carried out with the minimum of labour, of waste of food, and of exposure to weather. Where possible the cake and meal store should be on an upper floor with shutters leading to the food-preparing and mixing shed.

- (c) The fodder store (hay or straw stack, or Dutch barn) should be as conveniently situated as possible to cow-shed and food-preparing room, for the same reasons as in (b).

- (d) The solid manure should be stored, when storing is necessary at the homestead, in a suitable place at some distance from the cow-shed in order that the yards may be kept clean, the sheds healthy, and the loss of fertilising constituents prevented.

- (e) Liquid manure should be collected from the cowsheds in a properly made tank from which the liquid manure carts can easily be filled. Wherever possible liquid manure should run into the tank and manure cart by gravitation.

- (f) A separate drainage system should be provided to deal with water used for washing out the cowsheds.

2. Convenient Internal Arrangement of Individual Buildings.

When existing buildings have to be altered or new buildings erected, the internal arrangement should be carefully considered with the view to economy of labour and general efficiency.

- (a) Uneven or badly paved or cobbled floors; (b) stalls which are too wide or too long; and (c) gutters which are too narrow or wrongly sloped for the removal of liquid manure by gravitation all increase the labour required in cleaning the floor and in the removal of the manure. Cows kept in at night in such

sheds are usually in a filthy condition in the morning, making such cleaning as may be practised a never-ending labour and the operation of milking exceedingly dirty and disagreeable. Where feeding passages are not provided, the labour involved in feeding the cows is as a rule increased.

3. Introduction of Mechanical Equipment.

Mechanical equipment is desirable as an aid to the work associated with milk production, particularly in relation to those sections of the work which are:—

- Most constant, *e.g.*, milking and removal of manure;
- Most arduous, *e.g.*, removal of manure, preparation of foods and feeding of cows; and
- Most disagreeable, *e.g.*, removal of manure.

(a) *Milking*.—The most constant work in connection with the dairy herd is that of milking. In addition, probably half of this work has to be undertaken at very early hours, and more than half under conditions of artificial light.

Mechanical milkers have been used to a considerable extent to supersede hand-milking.* Where mechanical milkers are not used, the labour and monotony of hand-milking can be relieved by making the conditions under which it is usually carried out more attractive, that is to say, by having well-equipped cowsheds kept reasonably clean, the cows likewise being kept in as clean a condition as possible and ample light provided.

(b) *Removal of Manure*.—The time and energy required for this work is at its maximum in the winter, and the best means of saving labour in addition to the points mentioned in (2) above is by the installation and use of:—

- (a) A ground level system of rails leading from the cowshed to the manure yard with small tip waggons.
- (b) An overhead system of one rail with the necessary trolleys.

In the latter system the trolleys are easier to move and more convenient for the conveyance of manure when full, also more convenient for tipping either in manure heap or wagon or cart.

If the cowshed has gutters of sufficient width and slope and a suitable external drainage system, the liquid manure should be dealt with entirely by gravitation thus leaving only solid manure to be removed by hand labour.

(c) *Preparation of Foods*.—Most farms possess machinery for cutting roots, chaffing fodder, and breaking cake. Where considerable numbers of stock are to be fed, it is desirable that some kind of power unit should be installed to save hand labour. When mechanical power is available, a root cutter with a cleaning attachment and a mill for the grinding of cereals can be used.

It is often advantageous to have the cake breaker, grinding mill and chaff cutter on an upper floor with chutes leading to the mixing floor. By the exercise of some ingenuity in the

arrangement of chutes much time and labour can often be saved in the placing of meal and chaff in different parts of the mixing shed, and by the attachment of suitable hooks sacks can easily be filled when required.

(d) *Feeding of Cows*.—Mechanical equipment in the form of ground rails and waggons or overhead single rails and trolleys is almost as advantageous for lessening the labour in the feeding of cows as in the removal of the manure. Where cowsheds have no feeding passages, one rail system may be made available for both manure waggons and food waggons. Where long hay or straw has to be brought from a stack or Dutch barn some distance from the cowsheds, large iron framework fodder barrows are very useful both in saving labour and lessening waste of fodder on windy days. The wheelbarrow and the bushel basket are out of place on a well equipped farm.

The mechanical equipment referred to above should be supplemented with up-to-date machinery for the economical and rapid handling of crops, for instance, portable engine for use in rickyard or fields, elevator, horse fork, hay sweep, swathe-turner, side rakes, &c., and a silo for ensilage.

Water Supply.—On many farms where the sole source of water is one or two wells, much time and labour has to be spent in the pumping of water and conveying it to stock on different parts of the farm. In many instances the lack of water limits considerably the use which can be made of certain fields. When a suitable well exists, or has been found on any farm, a suitable pump with the requisite power unit and cistern for storage should be installed, and water laid on to such fields and parts of the buildings as may be necessary. An adequate supply should likewise be laid on to the cowshed for washing purposes and to the milk room for cooling the milk and for washing-up. Hand pumps and water carts should not be required on an up-to-date farm.

The arrangement and construction of farm buildings and their equipment with suitable mechanical labour-saving machinery is a subject which requires the co-operation of landlord and tenant, and the alteration of old buildings and erection of new and the installation of mechanical equipment cannot but add to their value to both parties. Also, it cannot be doubted that in the future the farm on which the work in connection with milk production can be carried on in the most convenient, efficient, healthy and comfortable manner will be the farm which will have least difficulty in attracting and keeping an adequate supply of labour.

J. MACKINTOSH.

December, 1918.

APPENDIX D.

WOMAN LABOUR ON DAIRY FARMS.

In dealing with this question, the following points will have to be considered:—

1. The type of woman to be employed.

- (a) Whole-time workers.
- (b) Part-time workers.

The (a) class might be divided into educated and industrial. The educated woman would in the natural course of events endeavour to qualify herself to act as forewoman, and to do such work as keeping of accounts and records, milk-testing, and dairy management. As such workers would probably only be employed on the larger farms, the total number would be small, and it is from the industrial class that the bulk of workers would be drawn.

(b) From many parts of the country expressions of opinion have been heard that part-time workers on the smaller farms would be an invaluable form of labour. These would include not only the village woman who would milk when required, but the farm servant whose work would be partly indoors and partly out.

2. Description of work which could be undertaken by women.

During the war women have proved that they can undertake the following work with efficiency:—

Cleaning sheds, preparation of food, feeding and grooming of stock, care of young stock, milking by hand or machine, cooling and weighing of milk, cleaning of utensils and milking machine, keeping of records, care of milk float and horse, and the delivery of milk, provided that it does not entail the lifting of heavy churns.

Special attention should be paid to the recommendations and suggestions in Appendix C, as they apply more emphatically in the case of women than of men. It is also advisable that all implements used, such as shovels, barrows, etc., should be as light in weight as possible in order to avoid unnecessary strain.

3. Size of farms which might employ women.

From observation, it would appear that it is only the larger dairy farms which can usefully employ whole-time workers, for the following reasons:—

The very small farm usually worked by the farmer himself and one helper is generally unsuitable unless the woman worker happens to be a member of his family.

The medium sized farms also present difficulties. In these cases two or three men and one boy would be usually employed. It is unlikely that the farmer would engage a woman as horseman. Unless she were very skilled, she could not take the place of the cowman, and few women would care to work as "odd man" under the other men. It would be unwise to encourage her to take the boy's place, as only in this way can the future agricultural labourer be trained. Exceptions to the foregoing might be found where the woman was a daughter of one of the labourers or where she was sufficiently skilled to be cowman and have another woman under her. Until women have gained more experience, it is improbable that many will be engaged as head cowmen, and it is generally conceded that only a small proportion of farm labourers' daughters have taken up this form of work. Want of sufficient

* For a Report on the use and efficiency of such machines, see page 54.

accommodation in the cottages as well as the higher wages paid in the towns have been contributing causes.

The great demand on the small and medium sized farms is for the woman who will undertake a certain amount of outdoor work, and work the remainder of the day indoors. Difficulties of housing do not occur in this case, as she lives in the farm-house. The rate of pay also, when the cost of living is considered, is often higher than that given to the whole-time outdoor woman. Conditions in this form of employment do not at present appear to be attractive to the average woman, but as this worker is needed and does fill a very important part in agriculture, it is essential that some steps shall be taken to render the position more congenial to her and to secure greater leisure and freedom.

On large farms, however, where several assistants are necessary in the cowsheds, it would be feasible and advantageous to employ a certain number of women. One large farmer who has a herd of about 400 cows expressed his opinion that it would be practicable to employ women in the proportion of two women to every man. Where labour saving machinery is employed, it would seem possible in very large herds to employ a greater proportion.

Where several women are employed, it would be possible to arrange for a rotation of workers, so that each could have regular time off, and it would be economical to allow one cottage or two, if necessary, for housing the workers.

4. Conditions of Employment.

Wages.—It is difficult to make definite suggestions regarding these in the present state of uncertainty as to what wages will obtain in the future in the industrial world and as to the prices to be paid for dairy produce. The wages, if they are to attract, must bear some proportion to those paid in other industries. At the moment, the amount generally considered satisfactory is about 30s. per week. Other conditions are, however, quite as important if women are to stand the strain of heavy physical labour and exposure to weather. In these may be included:—

Housing.

Hours of work.

Holidays.

Conditions under which the work is done.

Housing.—In the case where one, or perhaps two, women are employed, board and lodging have been frequently given in the farm-house. From the farmer's point of view, this is often a desirable arrangement, as proximity to work ensures greater punctuality. On the worker's side the chief drawback appears to lie in the fact that early hours have to be kept in the evenings, and that sometimes she is expected to give assistance in the house.

Good housing is, however, a question of vital importance, and where good and reasonable billeting cannot be obtained

it is essential that a cottage or bothy should be provided. Such cottage should be within reasonable distance of the farm and be provided with at least the absolutely necessary furniture. One cottage could house several workers, and, from experience, it has been found an advantage if the employer can arrange for a certain amount of assistance to be given in the work of the house, either by employing a woman to do regular cleaning or by employing one woman part-time in the cowsheds (preferably for milking) and allowing her to work the remainder of her time in the cottage, or by allowing each woman one week of part-time in turn. Want of domestic comfort, in addition to being prejudicial to the health of the worker, would quickly drive her to other employment.

Hours of Work.—In this industry the work must of necessity start at an early hour in the morning, but for the convenience of the workers it might be advisable, instead of having long breakfast and dinner intervals, to have a short breakfast with a long dinner interval. This would more especially apply where the workers have to live at some distance from the farm, and considerable time and energy would be expended in the walk to and fro. It would appear, from experience gained through the war, that an average woman can work nine hours per day without injury, provided there is a suitable interval.

Individual cases have been known where these hours have been exceeded without apparent injury, but such cases should be considered the exception rather than the rule. A free Sunday should occur at regular intervals and one free afternoon per week, if the work is to remain attractive.

5. General Conditions.

Another important matter in the case of women who are residing at some distance from their work is the provision of a place in which they can change and dry wet clothes in bad weather, and where breakfast can be warmed up and eaten with some degree of comfort. Social amenities will also bulk largely in the younger women's outlook, and employers should endeavour to bring them into such social life as the village can offer, especially Women's Institutes. Through this latter body they should be able to get any educational facilities they require and help in securing their own allotments should they so wish, or advice about any hobby they wish to undertake.

6. Keeping up supply of labour.

At the present moment a good number of Land Army women could be secured to continue in agriculture. Up to the present date, between five and six thousand of them have expressed their desire to remain in agriculture; these are, however, young women, of whom a large proportion will probably marry, and if the supply is to be kept up it may be necessary at some future date to consider how this can most economically be done.

M. M. MACQUEEN.

January 16th, 1919.

REPORT OF SUB-COMMITTEE ON EDUCATION IN DAIRYING

MEMBERSHIP OF COMMITTEE.

Lieut.-Col. WEIGALL, M.P. (*Chairman*).
 Right Hon. F. D. ACLAND, M.P.
 Major The Hon. E. F. L. WOOD, M.P.
 Dr. C. CROWTHER.
 Mr. C. M. DOUGLAS, C.B., B.Sc.
 Mr. P. A. FRANCIS.
 Principal GOODWIN.
 Mr. J. MACKINTOSH.
 Mr. ERNEST MATHEWS.
 Mr. A. POOLE WILSON.
 Mr. A. TODD.
 Miss YELD.

TERMS OF REFERENCE.

1. The Sub-Committee was asked to report on education and research in dairying and particularly, as stated in a letter received by Major Astor from the President of the Board of Agriculture and Fisheries, "to submit a statement of the matters which they consider require to be dealt with and provided for in the future, outlining the deficiencies which have been shown to exist and the special requirements of the industry which have to be met."

EVIDENCE TAKEN.

2. In the course of their meetings and in order to supplement the knowledge of the different branches of dairy education possessed by the Sub-Committee, they have interviewed the following witnesses:—

Sir T. H. Middleton, Board of Agriculture and Fisheries.
 Mr. J. F. Blackshaw, Board of Agriculture and Fisheries.
 Mr. A. Poole Wilson, Department of Agriculture and Technical Instruction for Ireland.
 Principal Paterson, for Board of Agriculture for Scotland and West of Scotland Agricultural College.

Mr. J. Darlington, Shropshire.
 Mr. Richmond James, Somerset.
 Mr. W. Bown, Somerset.
 Mr. B. Broughton, Somerset.
 Mr. J. H. Mackie, Cheese Inspector, Ministry of Food.

Education in Dairying inseparable from Education in Agriculture.

3. It was evident to the Sub-Committee at the beginning of their work that the facilities for and methods of education and research in dairying could not be satisfactorily considered except as part of the national scheme of agricultural education and research.

Further, in view of the fundamental differences in administration obtaining in England and Wales, Scotland and Ireland, they considered it necessary to deal with and to report on each of these countries individually.

ENGLAND AND WALES.

Scheme of Agricultural Education and Research.

4. The subject of agricultural education has been carefully studied in all its aspects during the last 15 years, and particularly by the Committee presided over by Lord Reay, which presented its report in 1908.

That Committee pointed out clearly the deficiencies which then existed, and made many useful suggestions for improvement and development. Since that date, the passing of the Development and Road Improvement Funds Act, 1909, and the consequent provision of much larger sums of money for agricultural education and research has enabled comprehensive new schemes to be thought out and brought into operation to a greater or lesser extent in almost all the counties of England and Wales. The scope and method of these schemes is best stated by the following extracts from the Report of the Development Commissioners (H.C. 305) for the year ending March 31st, 1912:—

“The schemes for the extension of a system of education fall under two main heads: first, the division of England and Wales into 12 areas, each centred round an agricultural college, and grants to those colleges to enable them to demonstrate the application of known results to local conditions and to provide technical advice to local agriculturists; secondly, grants to county councils to enable them to provide or extend farm institutes or schools—educational centres which will give short winter courses or similar instruction, and also be the headquarters of an increased county staff of itinerant teachers, advisers and organisers.”

As regards research the scheme adopted was based on two main principles.

“First, that what may be called pure research is not a local matter, and the proper division of effort is not by geographical districts; and secondly, in order to be really effective it must be continuous and concentrated. Attempts have therefore been made to divide agricultural science into 11 main branches, and to provide for systematic research into each of these at one or two institutions devoted to that subject.”

“When these schemes are in full operation the Commissioners hope to see an organic system of research, technical advice and education covering the whole of England and Wales. At the head will be the research institutes, each carrying forward the investigation of a particular branch of agricultural science, and with similar Irish and Scotch institutions, covering practically the whole field of that science. Next, there will be the colleges, whose duty it will be to provide the highest form of education in agriculture, to demonstrate by experiment the application to local conditions of the results obtained by the research institute, and to advise farmers within their areas on the more difficult problems of farm practice. Last, there will be the farm institutes, closely connected with the colleges, providing education for classes to whom the long college course is unnecessary or impossible, and finally, by means of itinerant county staffs centred at them, advising the farmers in the simpler and less far reaching difficulties which require for their solution no great scientific knowledge or prolonged scientific training.”

Present Facilities in England and Wales.

5. Education and research in dairying development on the lines indicated in the above scheme have been greatly hindered by the war. The existing facilities consist of three stages of dairy education provided by County Education Authorities. The first stage takes the form of itinerant instruction, including courses in cheesemaking and buttermaking at different centres in the counties, and advisory visits to dairies and farms. The instruction in cheese and butter-making is frequently provided by travelling schools, and such courses were carried out in fully two-thirds of the administrative counties of England and Wales in 1918. The next stage in dairy education is provided by the same authorities at dairy schools attached to the county farm institutes. There are some 13 county centres for this instruction at the present time, and other counties have schemes in hand for the establishment of institutes within their own boundaries. The third and highest existing stage of dairy education is provided at three provincial centres in England and Wales. At the same time, it is very difficult to make any hard and fast distinction between the instruction given at some of the best county schools and that given at the provincial centres. The long courses of instruction provided at these colleges constitute the courses of training for teachers who undertake itinerant instruction in counties and for other dairy experts. These colleges are the best-equipped institutions for such educational work in England.

Facilities for Research.

6. No special facilities for research work were provided at any educational centre prior to 1912, but in that year, in the development of the scheme adopted by the Development Commissioners and referred to above, an Institute for Research in Dairying was established at University College, Reading. Owing to the war, however, progress has been slow, and there has been great difficulty in obtaining the necessary external and internal equipment for the different branches of research work. Grants have also been made to Cambridge and Leeds Universities for the purpose of research in the nutrition of the milk-producing animal.

Administration and Finance of Schemes.

7. The responsibility for the initiation of schemes for agricultural and dairying education in England rests on two groups of authorities. First, education in the administrative counties, of which there are 62 in England and Wales, is in the hands of the county councils; and, second, the schemes for centralised and advanced agricultural and dairying education are administered by certain agricultural colleges and universities.

With regard to the counties, most of the money that was available for educational work was, previous to the date of the Development Act, entirely under the control of the county authority. The Development Act, however, made it possible for the Board of Agriculture and Fisheries to assist counties by grants for new and additional work. The Board had no driving power with regard to the initiation of educational schemes in backward counties.

In respect of the work already in existence in 1912 the Development Fund was held not to be available for assistance. Grants were made available to colleges for the appointment of additional officers to undertake advisory work and investigation of local problems. Only one provincial centre, however, appointed an adviser in dairy farming.

Reference has already been made in paragraph 6 to the establishment of a research institute in 1912.

Deficiencies and Recommendations: Strong Central Authority Necessary.

8. In considering the official scheme of agricultural and dairying education as it was outlined in 1912, it must be remembered that sufficient time had not elapsed before the outbreak of war to permit of any considerable development. Much of the evidence given before the Sub-Committee, however, showed conclusively that in counties which were thought to have well organised schemes there was still a great gulf to be bridged between the agricultural organiser and his staff and the average practical farmer; and that in others any advancement was well-nigh impossible, because of the lack of interest or initiative on the part of the local authorities and the absence of driving power on the part of the Government Department responsible.

The first essential in remedying this defect is to strengthen the position of the Board of Agriculture and Fisheries, and the Sub-Committee, therefore, most cordially welcome the statement made in the House of Commons on March 26th last by the Parliamentary Secretary to the Board of Agriculture, on behalf of the Government, that the necessary measures will be brought forward as soon as possible to re-organise the Board of Agriculture and to accord to the Department the status, staff, and accommodation of a first-grade Ministry.

Lack of Well-trained Teachers.

9. At the present time there is great lack of really well-trained teachers and advisers in dairying subjects. The institutes giving the highest type of education are not in a position either as regards accommodation, equipment, or staff, to give technical instruction up to the standard required, nor are they able to give sufficient attention to training in teaching. In order to obtain teachers and experts of the desired standard of practical and scientific knowledge, the Sub-Committee recommend that longer and better proportioned courses of training be provided. They consider that a course covering not less than two years is necessary, and that the centres providing such courses should have such additional equipment as may be necessary in respect of farms, dairies, and laboratories to enable all aspects of the production and management of milk to be taught in a comprehensive and efficient manner. They wish to emphasise the point that no educational centre, whether for advanced or elementary work in dairying, can be considered adequately equipped unless the students have easy access to a dairy farm, and can obtain practical illustrations of the best methods of dairy stock management and the handling of milk.

Lack of Instruction in Counties.

10. Reports on the facilities for dairy education throughout England and Wales show that in some counties little is done in the way of providing even the first stage of dairy education, i.e., itinerant instruction, and that in others where dairying is an important branch of farming no county farm institute has been established. The Sub-Committee attach great importance to itinerant instruction as the foundation of a complete scheme of dairy education, and they welcome the extension of this work which has recently taken place under the scheme of the Board of Agriculture for the encouragement of cheese-making. They consider, however, that further provision should be made for adequate itinerant instruction in each county and they recommend accordingly. In the case of small counties, or in those where milk production is not an important branch of farming, two or more county authorities might co-operate to provide such instruction. Further, this instruction should not be concentrated so much on butter and cheese-making as has been the case in the past, but should deal fully with the best methods in the production and treatment of milk for direct consumption. It should be remembered that 70 per cent. of the milk produced in this country is sold for this purpose, and not for the manufacture of dairy products.

With regard to dairy schools attached to county farm institutes, the evidence laid before the Sub-Committee has shown that certain counties, which at present limit themselves to itinerant instruction, contemplate the establishment of institutes, and they believe that there is ample scope for such additional county educational centres provided that the school is located on a farm, and that the system of management on the farm exemplifies, according to circumstances, the principles advocated in the school.

Lack of Instruction in Factory Management.

11. At the present time there is not only a deficiency in the facilities for the training of teachers and advisers, but there is a total lack of facility for training in factory management. The most fully equipped dairy schools undoubtedly give great attention to practical instruction in cheese-making, but this instruction, though quite adequate for the manufacture of cheese on individual farms or in private dairies, does not give students experience in dealing with large quantities of mixed milk such as is received at factories. In other respects also, such as the management of machinery, the existing institutions fail to give the training which is essential.

As the number of farmers' co-operative societies and factories will probably be largely increased in the near future, and as there is a lack of managers and cheese-makers with a sound technical training for existing factories, the Sub-Committee are of opinion that special provision should be made for training in this work. Such facilities may be provided either in immediate association with existing teaching

centres or by the establishment of entirely new centres. They recommend that, having regard to the presence of laboratories and staff at existing institutions, and to the advantages of maintaining close touch with technical and scientific work, provision should be made for instruction in factory methods and management at existing institutions in preference to the establishment of new centres.

Research Work.

12. Owing to the neglect of research work in dairying in this country in the past, the itinerant teacher and the college lecturer alike have had to depend for their information with regard to many recent and important discoveries in dairy science and practice on reports received from other countries, and often translated from other languages. One of the results has been that improvements in practice resulting from scientific research have found their way but slowly into this country, and often long after they have been incorporated into daily practice in other countries. All teachers and advisers know that their work is much more convincing and effective when they can support their recommendations by reference to experiments which have been carried out under conditions obtaining in this country, instead of having to quote from reports of work done in other countries, and there can be no doubt that the lack of facilities for research has been a great handicap to dairy education and to dairy practice in the United Kingdom.

The Sub-Committee recommend that the development of research be assisted to the fullest extent, and in view of the importance of considering the breeding and individuality of the cow and the food and method of feeding in relation to the quantity and composition of milk and the quality of produce obtained, they consider it very desirable that the Research Institute should be able to carry out investigations in connection with the breeding, feeding, and management of dairy stock as well as in relation to milk and dairy products.

SCOTLAND.

Scheme of Dairy Education in Scotland.

13. Agricultural and dairy education in Scotland is much more centralised than in England. The country is divided into three areas, each having an Agricultural College as an educative centre. The College authorities are responsible for the initiation of schemes for internal and external agricultural and dairy education. External or itinerant instruction work is carried out in co-operation with county authorities, who act in an advisory capacity. This centralisation of finance and responsibility is considered in Scotland to have given more satisfactory results than would have been obtained by the placing of responsibility in the hands of county authorities.

Facilities for Dairy Education in Scotland.

14. The first stage of dairy education is carried out as in England by county organisers assisted by instructors and instructresses who give instruction in cheese and butter making at various centres and who visit farms where difficulties have arisen and where improvements are desirable. In the cheesemaking districts the advisory work on cheese farms has been very extensive, and has given very good results.

Courses of instruction in dairying are provided at the three Agricultural Colleges, and the practical instruction is concentrated at one centre, namely, the Dairy School for Scotland at Kilmarnock. This school receives students from the whole country and is worked in association with, and administered by the West of Scotland Agricultural College. Research work in cheese-making has been commenced in recent years at Kilmarnock.

Deficiencies and Recommendations: Itinerant Advisory Work and County Education.

15. Although considerable success has attended the work of visiting advisers in the past, it is felt that much better results would be obtained if a sufficient staff were provided to enable the farms in the different dairying counties to be visited more frequently. One-day visits to cheese-making farms are not thoroughly satisfactory, as the adviser cannot follow up the results of his day's work in such a manner as to enable the local cheesemaker to obtain the greatest benefit. It is also desirable that small centres, if possible in association with small demonstration farms, should be established in different districts, where investigation work into local problems could be carried out and advice given to local farmers. The Sub-Committee, therefore, recommend that the necessary steps be taken to obtain additional staff, and to provide and equip county centres in dairying districts where it is found that such centres are desirable.

Equipment of the Existing Centre.

16. The Dairy School for Scotland cannot be said at the present time to be efficiently equipped in respect of plant, and it is unable to provide accommodation for all the pupils who wish to attend. The Sub-Committee recommend that it be extended so as to provide space for such additional machinery and equipment as may be necessary and to enable it to deal with a larger number of students.

Advanced Dairy Education.

17. They also recommend that longer courses going into greater detail and affording better opportunities for the training of experts in different branches of dairy work be provided.

Research.

18. With the assistance of the Development Commissioners, a certain amount of research work in the manufacture of cheese and in other matters relating to the manufacture of dairy products has been carried on through recent years. There are, however, many additional problems requiring attention, and the Sub-Committee recommend the provision of additional facilities in respect of buildings, equipment and staff for research work.

19. There appears to be room in Scotland for an increased number of dairy schools with special reference to the training of smallholders.

Scheme of Dairy Education in Ireland.

20. Provision for Dairy Education in Ireland falls under two headings:—

- (a) that which is administered directly by the Department of Agriculture, *e.g.*, provision of education of creamery managers and itinerant teachers or instructors;
- (b) that which is administered by County Committees of Agriculture, *e.g.*, itinerant instruction in butter-making and soft cheesemaking.

In each county an Agricultural Committee administers funds raised by rates for the particular purpose of instruction in agriculture, including dairying. The funds of these County Committees are contributed to by the Department of Agriculture, the amount so contributed varying in each case with local conditions. The County Committees work in accordance with schemes recommended by the Department, and though the Department has no power to enforce the adoption of these schemes, it is worthy of note that they have been put into operation by every County Committee in Ireland. The itinerant teachers, through whom these schemes are worked, give instruction in butter-making and in soft cheese-making at local classes and on farms.

Present Facilities for Dairy Education.

In addition to the instruction provided through the medium of the local classes referred to above, complete courses in dairying are given at two central dairy schools and at nine schools of Rural Domestic Economy. The terms or sessions at one central dairy school cover a period of about eleven weeks, but the majority of the pupils in attendance remain for either two or three terms, and for those who are being trained as teachers the course covers a period which averages about eighteen months. The terms at the schools of Rural Economy cover about five months, but, as in the case of the central schools, the majority of the pupils remain for a second term.

21. Instruction for managers of creameries, cheese factories, &c., is as follows:—

- (1) A preliminary course of five months' lecture and laboratory work at the Royal College of Science held during the winter months.
- (2) A practical training, under the supervision of the Department, of thirty weeks during the summer months follows, the students being placed at approved creameries where butter and cheese are manufactured. During this stage those undergoing the training are expected to take part in every section of the work of the creamery, &c. A maintenance allowance is paid to the student during this period.
- (3) A final course of five months during the winter at the Royal College of Science, when the student attends an advanced course of lectures and laboratory work. The instruction thus covers a period of eighteen months.

The highest stage of Dairy Education provided for in Ireland consists of a four years' course at the Royal College of Science.

Deficiencies and Recommendations.

22. From the evidence placed before the Sub-Committee it would appear that the facilities for Dairy Education in Ireland meet to a greater degree the requirements of the country than is the case either in Scotland or in England and Wales. They wish to point out, however, that in their opinion teachers in dairying should have the opportunity for obtaining a more comprehensive course of scientific instruction than is at present provided.

In respect of facilities for research, nothing appears to have been done, and the Sub-Committee recommend most strongly the giving of all necessary assistance for carrying out research work into the problems which have arisen and which require to be solved in order that further progress may be made in the dairy industry of Ireland.

(Signed) W. E. G. A. WEIGALL (Chairman).

January, 1919.

REPORT OF AN ENQUIRY INTO THE USE OF MILKING MACHINES.

At the early meetings of the Committee the value of milking machines as labour aiding appliances on dairy farms was discussed, and in view of the present and prospective difficulties of obtaining a sufficient supply of labour for milking and the differences of opinion expressed as to the utility of the types of machines at present available, the Secretary was asked to obtain further information and report to the Committee.

SCOPE OF REPORT.

In 1917 an investigation into the use of milking machines in Scotland was carried out by the Highland and Agricultural Society, and a Report prepared for the Society by Mr. W. Burkitt, Grange Hill, Bishop Auckland, was issued, giving the results of the enquiry. So far as Scotland was concerned, therefore, it was not considered necessary to undertake another detailed enquiry.

As no recent enquiry covering all the machines now on the market has been carried out in England and Wales,* it was decided to make an effort to get opinions from all parts of the country, both from makers and agents, and from dairy farmers. Names of farmers who had experience of milking machines were received from makers and agents and from the agricultural organisers in the different counties. Information was collected from these sources in the autumn and winter of 1917 and analysed, and the report prepared as time permitted during 1918.

In respect of England and Wales, therefore, the report consists of three parts. Part I deals with the information received from farmers; Part II deals with the information received from makers and agents, and Part III contains general conclusions and suggestions.

* The only reports issued in recent years are:—

- (1) Report on Milking Machine Trials, 1909 and 1911, Midland Agricultural College Bull. 1911-12.
- (2) The Trials of Milking Machines, 1913 (J. R. Agric. Soc.).
- (3) Farm Labour-Saving Machines, etc., 1916 (pages 22-27), by J. R. Bond, B.Sc.

REPORT ON THE USE OF MILKING MACHINES IN ENGLAND AND WALES.

PART I.

INFORMATION RECEIVED FROM FARMERS.

The list of questions given below was drawn up and submitted to 204 farmers in all parts of England and Wales.—

- 1a. What is the name of the milking machine you are using?
- b. How long have you had it in use?
- 2a. What is the daily average number of cows milked by your plant?
- b. What is the number of cows milked for each machine used?
- c. Do you use it all the year round?
- 3a. If your machine works by suction, what pressure, as indicated by the gauge, do you find most suitable?
- 4a. What source of power do you employ?
- b. If an engine, state the kind and horse-power.
- c. Does this engine do other work? If so, what work?
- 5a. What is the average time required to milk the number of cows given above under 2a?
- b. How many persons are required?
- c. Are the cows hand-stripped after the machine?
- d. About what quantity of strippings do you get per cow?
- 6a. Have you found any injury or irritation to the teats or udder of a cow from the use of a machine?
- b. Do cows take readily to its use?
- 7a. Have you had cows that held up their milk, or were so fractious with the machine that they had to be milked by hand?
- b. If so, about what proportion?
- 8a. How soon after calving do you begin to use the machine?
- b. Are the cows dried off by hand?
9. What is your opinion of the difference, if any, between hand milking and machine milking—
- a. In the yield of milk?
- b. In the length of lactation period?
- (If you have any actual records on these points, please forward copies.)
- 10a. Is it easier with the machine to prevent impurities getting into the milk?
- b. Does the milk keep sweet longer?
- c. What is your experience of taints arising through the use of the machine?
- 11a. What is your method of cleaning the machine?
- b. What time does the cleaning require daily?
- c. Do certain parts of the machine require more perfect cleaning periodically?
- d. How is this effected and what time is required?
- 12a. What was the total cost of your installation?
- b. Please divide total cost as follows:
 1. Cost of providing power.
 2. Cost of milking machine plant.
 3. Any other costs.
- c. Were there special circumstances in your case affecting this cost—such as situation or construction of cowsheds, or extra power of engine for other uses?
- 13a. Can you state approximately the average total annual cost of running your installation, apart from labour, but including oil, &c., for engine, replacement of rubber parts and other parts and repairs generally?
- b. What is the smallest herd for which you would instal a machine?
14. What do you estimate to be the saving through the use of your machine—
- a. In labour?
- b. In cost of production?
- c. If sufficient reliable hand milkers were available, would you continue to use a milking machine?
15. In what particulars do you consider that there is room for improvement in your machine, especially in regard to:—
- a. Simplicity in mechanism, ease in working and cleaning?
- b. Saving in wear of parts?
- c. Easy adaptation to any size of teat and for comfort of cows?
- d. Obtaining milk as free from impurity as possible under practical conditions?
- 16a. If you were installing a milking plant now, what changes would you make in your engine, make of machine, or fittings?
- b. Should the engine do other work than that required for milking machines?
- 17a. If you have had experience of more than one type of milking machine; please compare their merits.
- 18a. Does the success of your machine depend on continuous personal supervision?
- b. Do you consider that an average cowman, after a few lessons, can be trusted to operate your machine with success and clean it satisfactorily, or is any special training and knowledge desirable or necessary?
- c. Are there recurring difficulties or occasional breakdowns which cannot be overcome by a cowman of average intelligence?
19. Any additional remarks about milking machines that would further this enquiry.

The replies obtained to these questions are summarised below:—

NUMBER OF REPLIES RECEIVED AND NAMES OF PLANTS USED.

In respect of the 204 forms sent out, 142 replies were received. These replies covered 8 different machines as follows:—

"Lister"	...	...	...	...	...	...	...	...	38
"Amo"	...	...	...	...	...	...	...	...	21
"Vaccar"	...	...	...	...	...	...	...	...	20
"Hinman"	...	...	...	...	...	...	...	...	17
"Gane"	...	...	...	...	...	...	...	...	15
"Wallace"	...	...	...	...	...	...	...	...	12
"Manus"	...	...	...	...	...	...	...	...	10
"Lawrence-Kennedy"	...	...	...	...	...	...	...	...	9

All the above machines are of the *suction* type, and it may be assumed that only machines of this type are making any headway in England at the present time. Some years ago machines operating on the cow's teats by *pressure* only were in use here and there, but these met with little success. It may also be safely assumed that no types of suction machines other than the above are used in any numbers in England.

DESCRIPTION OF SUCTION MILKING PLANT.

All mechanical milking plants of the suction type in use in this country are constructed on the same general lines. They consist of the following essential parts:—

1. A power generating unit for driving the vacuum pump.
2. A vacuum pump for creating the necessary suction, and a tank and gauge for steadying and registering the pressure.
3. A system of iron piping leading from the pump to the cowshed, and usually fixed above the cow-stalls.
4. A pulsator, pulsators, or other mechanical device, for converting continuous into intermittent suction.
5. One or more rubber tubes connecting the overhead vacuum pipes to the pulsator and the teat cups.
6. A milk receiver or receivers.
7. Teat-cups and tubes for conveying the milk from the teats to the milk receiver.

In the different types of plant reported on variations were found to exist in all the above parts, and the following general description is given in preference to an attempt to describe each plant in detail.

The Power Unit is the most variable item in the plant, and may consist of petrol, oil, steam, or gas engine, an electric motor, or any other means of driving a pump. A list of the sources of power reported on is given on page 57.

The Pumps used vary according to the make of the machine, the action is similar, and is somewhat as follows:—

The pump consists of a cylinder (or cylinders, according to the size, capacity, and make of the pump), fitted with a rod and piston actuated by means of either a crankshaft and flywheel or coupled direct to the engine, the cylinder being fitted with both intake and exhaust valves, which are automatically worked. On the upward stroke of the piston, the intake valve opens and the air is drawn through the valve from the vacuum pipe by the sucking action of the piston; at the top of the stroke the intake valve closes and the exhaust valve opens, releasing the air on the downward stroke; as the exhaust valve closes at the bottom of the stroke, the intake valve again opens and thus a continual sucking action is maintained.

At a short distance from the pump and connected to the vacuum pipes a small *tank* is generally placed to assist in maintaining a uniform vacuum; to this tank is fixed a *safety valve* for the regulation of the suction and a *gauge* to register the pressure.

A gauge is often attached to the vacuum piping in the cowshed, where it is visible to the person in charge of the milking operations.

The Overhead Piping is usually of iron, with a diameter of from $\frac{3}{4}$ " to $1\frac{1}{2}$ ". Where the cowsheds are badly arranged, the amount of piping and the cost of installation is considerably increased, particularly if part of the piping has to be carried underground.

The Pulsator varies in construction according to the patents of the different manufacturers, and is placed in different positions between the pump and the cow's teats. Thus in the Gane and Hinman one pulsator only is required for each plant and it is placed at any convenient point in the piping system, either inside or outside the cowshed. In the Lister, Vaccar, and Lawrence-Kennedy, the pulsator is attached to the lid, and in the Amo and Manus to the body of the milk receiver, one being required for each receiver and set of teat cups; in the Wallace, one very small pulsator is fixed to each teat cup, four being required for each receiver and set of cups.

The vacuum is continued from the overhead piping to the pulsator or receiver by means of *rubber tubes*. These are connected to the piping by T-pieces, and at each junction an airtap is inserted to shut off the vacuum from the pulsator and teat cups when necessary.

The Milk Receivers vary according to the make of the machines. In the Amo and Manus they are slung under the belly of the cow by means of a suspender over the back. Each receiver is round in shape, and has a capacity of $2\frac{1}{2}$ –3 gallons. In the other plants the receivers rest on the ground between the cows, and are of two types; (a) a large receiver with two compartments designed to take the milk of two cows at once, but to keep the milk separate to facilitate milk recording. Receivers of this type are used in the Lawrence-Kennedy, Vaccar, and Lister plants; (b) a receiver of one compartment only, designed to take the milk of one cow at a time, and used by the Wallace, Lister, and Gane plants.

It should also be mentioned that in the Gane and Lister plants an "automatic receiver" can be installed in place of the types just described. By this method the milk is drawn straight from the teat cups through bronze or tinned copper piping with rubber joints into a receiver or twin receivers placed immediately above the cooling apparatus or elsewhere; this receiver is fitted with an automatic device which causes it to empty when a certain weight of milk has been collected, the milk falling into the reservoir of the cooler or other vessel. The advantages to be gained from this system are a saving of labour and time in milking, and in carrying the milk to the milk room; the disadvantages are the impossibility of keeping milk records and the increased amount of tubing to be washed after each milking. No installations of automatic receivers were reported on in this investigation.

The Teat Cups are of several different patterns according to the make of the machine, but the principle of construction is practically the same in all. A metal cup made of aluminium, gunmetal, or brass, often nickel-plated to facilitate cleaning, is fitted with a rubber lining or moulding in such a manner that a space is left between the lining and the outer shell. The suction of the pump, regulated by the intermittent action of the pulsator, withdraws the air from and refills this space, thus causing the rubber lining alternately to grip and release the teat; the lining is so constructed with thick and thin parts that a downward pressure from two or more sides is applied to the teat and the milk is forced into the conveying tubes by a combination of pressure and suction.

One make of pulsator is fitted with a filter so that no dust from the air of the cowshed can be drawn through the inlet.

The teat cups are in most cases connected together at the base by means of a "claw," and from this claw rubber or celluloid tubes connect with the milk receiver. In the Gane, Lister, and Vaccar, one air and one milk tube lead from the receiver to the teat cups, so that no air is drawn through the tube through which the milk passes; in the Hinman, Lawrence Kennedy and Wallace machines only one tube leads from the teat cups to the receiver, and this is used for both milk and air. In the Manus machine there is one short celluloid tube for the conveyance of the milk from the claw to the receiver and four separate rubber tubes connecting the pulsator and the four teat cups. In the Amo machine there is a celluloid milk conveyor and rubber air tube to each cup. The celluloid tubes have the advantage of being short, straight, transparent and easy to clean, and they are not so perishable as rubber.

PERIOD OF TIME USED.

The period of time during which milking machines have been used in the various herds ranged from a few days up to 11 years, the average time for the various machines being as follows:—

"Lawrence Kennedy"	...	...	...	...	...	4.8 years.
"Vaccar"	...	...	...	...	...	4.2 "
"Gane"	...	...	...	...	...	2.4 "
"Wallace"	...	...	...	...	...	2.4 "
"Lister"	...	...	...	...	...	2.3 "
"Amo"	...	...	...	...	...	2.1 "
"Hinman"	...	...	...	...	...	1.2 "

(Introduced into this country in 1915.)

"Manus"	...	...	...	...	...	1.0 years.
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(Introduced into this country in 1916.)

Both the "Lawrence Kennedy" and the "Vaccar" machines had been in use on farms for 11 successive years; the "Wallace" and "Gane" for 5 years continuously; the "Lister" for fully 4 years and the others for shorter periods due to the more recent date of introduction into this country. Many of the farmers who had had machines in operation for periods of years reported very satisfactorily, and said that they were quite satisfied with the type of machine which they were using. One reporter stated that throughout 5½ years' usage, he never had to milk his herd of 60 cows by hand, while another with 8½ years' experience, stated that he found machine milking equal to the average good and bad hand milking. On the other hand, one user of a machine stated that he had discontinued it after 9 days as the milk yield fell off so rapidly, while, another, who had his machine installed early in 1916 used it throughout that summer only and stated that 5 out of 7 machines erected in his district at the same time as his own are not being used now. In numerous instances farmers reported that they had had to discontinue or reduce the work done by their machines during 1917, owing to the shortage of petrol and the inadequate amounts allowed to them.

On the whole the replies received to the questions sent out are sufficiently numerous for each make of machine, and cover a sufficiently long period of time to make them a reliable basis on which to form an opinion as to the efficiency and value of mechanical milkers.

AVERAGE NUMBER OF COWS MILKED PER DAY.

The herds in which machines were used ranged from 10 to 140 cows, the average herd numbering 48. Where double receivers were in use, the average number of cows milked per machine was 10, and with single receivers the average was 8.6. In reply to the question as to whether machines were used during the complete 12 months, 93 out of 130 stated that the machine was used continuously, while 37 stated that it was not continuously in use. Amongst the latter were a considerable proportion of cheese makers, who so arranged the management of their herds that they had a maximum number of cows in milk during the summer and a very large proportion dry during the winter, and who considered the use of the machine uneconomical during the latter period. In other instances, the lack of petrol contributed to the stoppage of the machines for varying periods.

AMOUNT OF PRESSURE AND SOURCES OF POWER USED.

The pressure used varied according to the make of the machine, and ranged from 12 to 20 lbs. per square inch. On this point definite instructions are usually given to the operators by the firms installing the machines. The sources of power used for driving the plants were as follows:—

Petrol Engine	...	...	...	...	...	77
Oil	...	...	...	...	...	31
Gas	...	...	...	...	...	3
Electric Motor	...	...	...	...	...	7
Water Power	...	...	...	...	...	1
Oil and Electric Motor	...	...	...	...	...	1
Steam Engine	...	...	...	...	...	2

In a number of instances 2 sources of power were available, one for emergency use.

Many of the farmers had utilised as sources of power for the milking plant such engines as they had previously had installed in their farm buildings for other indoor work, and the majority considered that the power unit installed for driving a milking machine should be available for other work. The horsepower of the various power units ranged from 2 to 4 h.p. in 83 replies out of 129 received, the remainder

using power units of from 4 h.p. upwards. In many replies emphasis was laid on the necessity for having reliable power units, and in many instances the installation of an emergency power unit was advised, particularly in the case of large herds of cows, since in the event of a breakdown of the engine, it would be difficult to obtain the necessary number of hand-milkers to carry through the milking of the herd in a reasonable time.

TIME AND NUMBER OF PERSONS REQUIRED FOR MECHANICAL MILKING.

The average time required to milk the average herd of cows worked out at 82 minutes. The averages for the individual machines ranged from 69 to 94 minutes. The number of persons required to milk the average herd worked out at 2.7 persons.

NECESSITY FOR HAND STRIPPING AFTER MECHANICAL MILKING.

Out of 136 replies received, 130 stated that it was their custom to strip by hand afterwards. The remaining 6 stated either that it was not necessary, or that only a few cows needed hand stripping. The quantity of strippings obtained varied from 0.12 to 2.65 pints, the average being 83 pints. The point involved in the hand stripping of cows is not merely one of the efficiency of the machine; most, if not all, of the machines would strip out the majority of cows effectively but at the expense of time. Further, it is desirable that the teats and udders should be examined closely every day by the cowman in order to note in due time any sore teat or any defect in any of the quarters. This daily inspection can be most reliably carried out if it is the custom to strip the cows by hand.

INJURY OR IRRITATION RESULTING FROM THE USE OF THE MACHINE.

On this point 131 replies were received, and in 110 instances the reply was to the effect that no bad results were caused by the use of the milking machine. The remaining replies stated that various troubles had followed its introduction, such as the teats becoming very tender, and quarters swollen if the cups were left on too long.

In respect of the adaptability of the cows to mechanical milking, 75 per cent. of the replies stated that cows took readily to the machine. Nearly all reporters agreed that heifers took more readily to machine milking than older cows. With cows, the majority became accustomed to it in a few days, but there were a few exceptional animals which it was almost impossible to milk by mechanical means. The general opinion was to the effect that cows and heifers are much quieter under mechanical milking than with hand milking once they get used to the noise and action of the machines.

USE AT BEGINNING AND END OF LACTATION PERIOD.

The time of bringing machines into use in the case of newly-calved cows varied greatly. A few replied that they used the machine "at once," but it is difficult to take this as meaning that the machine was used within 24 hours after calving. Others stated that they used the machine 2, 3, 4, 6, 7, 8, 9, 10, 14 days up to 3 weeks after calving.

In respect of cows drying off, out of 127 replies received, 84 stated that the cows were dried off by hand and 33 stated that during this period the cows were milked partly by hand and partly by machine.

EFFECT OF MECHANICAL MILKING ON YIELD AND LACTATION PERIOD.

In respect of the effect of mechanical milking on yield, out of 116 replies, 75 (or 65 per cent.) stated that there was no difference as compared with hand milking, 28 per cent. stated that the yield was less, while 7 per cent. expressed the opinion that the yield was slightly increased.

As regards the lactation period, 70 per cent. of the replies agreed in stating that there was again no difference, while 28 per cent. gave the period as slightly shorter, and 2 per cent. as slightly longer. The replies as to the amount of the reduction in the lactation period were very variable. Some stated that the milking period was shortened by one month, while another ventured the statement that it was shortened by 3 months.

Actual records of the effect of mechanical milking on milk yield or on length of lactation period were asked for, but it is a matter of regret that none were forthcoming. Undoubtedly some of the replies were based on the records in the possession of the farmers, but in many cases the replies were expressions of opinion unsupported by any actual records.

EFFECT OF MECHANICAL MILKING ON CLEANLINESS OF MILK.

Ninety-two per cent. of the replies stated emphatically that it is easier to prevent impurities getting into the milk by using a milking machine.

In reply to the question "Does the milk keep sweet longer?" 47 out of 99 replies received were in the affirmative, 35 stated there was no difference, while 17 were in the negative. It is remarkable that 10 replies out of the 17 were from users of the same make of machine. It is difficult to understand exactly what is implied in the answers to this question, because of the lack of information as to the length of time during which the milk remained sweet under former methods of milking, but it is impossible to avoid the general conclusion that milk obtained by a mechanical milker kept in proper order should be cleaner, and should keep sweet for a longer time than milk obtained under the average conditions of hand milking.

In respect of taints, 89 replies out of 123 stated that they had had no experience of taints arising through the use of their machine; 27 replied that there were no taints if the parts through which the milk passed were kept clean; 7 instances of taints were recorded, and these were attributed to the following causes:—

1. Dirty rubber tubes.
2. Old " "
3. New " "
4. Faulty rubber teat-cup linings.
5. Pulsator leakage leading to oil taints in the milk.
6. Water which had collected in vacuum pipes obtaining access to and tainting the milk.

With efficient management and adequate renewals of worn out parts, no taints need have arisen from any of the above causes.

METHOD OF CLEANING MECHANICAL MILKERS.

The usual method of cleaning resorted to consisted of passing by suction first cold water and then hot water through the teat-cups and milk-conveying tubes into the milk receiver. In some instances the hot water contained a disinfecting agent, in others the teat-cups were regularly brushed out, but it was obvious from the general tenor of the replies that the cleaning was, as a rule, not sufficiently thorough or systematic. The time given to the daily cleaning appeared to be about 5 minutes per receiver and associated parts, and it was added that the rubber parts required more perfect cleaning periodically. In most cases the machine was taken to pieces and thoroughly cleaned weekly, fortnightly, or monthly. Again, it was obvious that on many farms there was no definite procedure laid down for the dismantling and careful examination of the working parts and the parts which come into contact with the milk. At no stage in the management of a mechanical milker is there greater need for attention to detail than in the daily cleansing. The other work of a cowman is by no means of a cleanly nature, and it is not to be expected that the average cowman will carry out this work satisfactorily unless the necessity for thorough cleansing of the milking machine is understood or regular supervision is given by the farmer or bailiff.

The following are several of the most complete replies to questions relating to cleansing, and show the work undertaken and the time required where satisfactory results were obtained from the machines:—

Machines conveying Milk in Rubber Tubes.

- (1) Used 2 years in a herd of 100 cows:—
“A reliable man with no stint of brushes, soap, soda and time to use it takes at least 4 hours taking to pieces two machines daily.”
- (2) Used 3 years in a herd of 80 cows:—
“After milking each time rinse with water and steep the pipes and fittings in cold water and formalin. Once a week machine is taken to pieces and thoroughly cleaned by hand. Takes 10 minutes daily and 3 hours once a week.”
- (3) Used 4½ years in a herd of 34 cows:—
“First rinsed with cold water, then thoroughly swilled with water at about 100° Fahrenheit, using brushes at the same time and soda. Takes 30 minutes daily. Dismantling and re-assembling takes one man one hour once a month.”
- (4) Used 8 years in a herd of 38 cows:—
“Draw cold water through milk tubes first, then boiling water, then use long tube brushes. Takes 20 minutes daily.”
- (5) Used 10 years in a herd of 45 cows:—
“First draw cold water through cups and rubber tubes. Take to pieces and wash in a tub containing warm water, washing powder and soda. Fix together again and draw boiling water through, then hang them up on hooks to drain and dry. Takes ½ hour in the morning and ¼ hour in the evening. Pulsators require cleaning once in 3 months; takes one hour each pulsator.”
- (6) Used 11 years in a herd of 60 cows:—
“Strong soda water sucked through cups and tubes by power, then scalding clean water. Then brush outside; re-rinsed and hung up. Takes 5 or 10 minutes. Twice a week all rubbers boiled for 5 or 10 minutes. Pulsators are occasionally taken to pieces and cleaned; takes an hour once a month.”

Machines conveying Milk in Straight Celluloid Tubes.

(Amo and Manus.)

- (7) Used 2½ years in a herd of 40 cows:—
“Wash with cold water first, then scrub them with hot; takes one hour. Tubes take ½ hour to clean well.”
- (8) Used 2 years in herd of 60 cows:—
“Washing thoroughly with warm water once a day and all parts taken to pieces. After using in the evenings the machines are simply rinsed out; takes about 15 minutes for each machine.”
- (9) Used 2 years in a herd of 28 cows:—
“Cold and then hot water drawn through teat cups, and milk tubes and milk containers are steamed. Time required, 10 minutes daily. Taken apart and thoroughly cleaned once weekly in summer and once fortnightly in winter. Time required, 2 hours.”

In addition to the methods described above, it was customary on a number of farms to keep the teat cups and rubber tubes in cold water from the time of cleansing after milking until required for the next milking. In a few instances a brine solution, sometimes with a disinfectant, was used instead of cold water.

COST OF INSTALLATION ON FARMS.

Satisfactory replies on the whole were received to this question, but it is not considered desirable owing to the great rise in the price of material and labour to take up space and time giving details. In quite a number of replies it was stated that the unsystematic arrangement of the milking sheds made it necessary either to have the sheds altered, or to instal engines of greater power; in several other instances, the cost of installation was increased by the uneconomical arrangement of the buildings.

COST OF MAINTENANCE.

The figures supplied under this head were very variable, and for this reason, in addition to the increases in the price of material, petrol and labour, it is impossible to give any reliable average figure.

MINIMUM HERD FOR MECHANICAL MILKING.

In reply to the question “What is the smallest herd for which you would instal a machine?” replies giving a minimum of from 10 to 50 were received, but generally speaking, the replies ranged between 20 and 30 cows. It was, however, noticeable in the replies where a low minimum was given, that very good

results had been obtained. This may indicate that the management in these small herds was more thorough, and that more attention was given by the farmer himself than was usually the case with large herds. In the latter, the success or non-success of the plant often depends on the cowman in charge.

ESTIMATES OF SAVING IN LABOUR AND COST BY MECHANICAL MILKING.

There was great variation in the replies given to the questions on these points. In many instances it was stated that there was no saving in labour or in the cost of production, indeed, in a few instances, it was definitely stated that the cost of production was increased. Others again, pointed out that although the actual labour in milking might be reduced in the use of the machine, the same amount of labour was required for the cleaning of the cowsheds and the feeding of the stock. On the other hand, numerous replies were received giving definite instances as to reduction in the labour required, and figures as to saving in the cost of production. The following are typical replies on these points, together with expressions of opinion on the continued use of the milking machines if sufficient reliable hand milkers were available:—

No.	Size of Herd.	Period in Use.	Saving in Labour.	Saving in Cost of Production.	Continued Use if Reliable Hand-milkers Available.
1	35 cows...	3 years ...	One man	None, but it enables me to keep on milking, which I should not be able to do without it.	No, as there is such a lot of work to do when the cows are lying in.
2	34 " ...	4½ " ...	Three milkers		Yes, decidedly.
3	38 " ...	8 " ...	One man	Present day pay of one man £75 per annum.	No.
4	90 " ...	5½ " ...	50 per cent.	½d. per gallon	Yes.
5	42 " ...	7 " ...	50 per cent.	Pays greater percentage on capital than any other machine on farm, as it is used more constantly.	Certainly.
6	34 " ...	8½ " ...	Two men	Very little	Yes, a great advantage in harvest time.
7	25 " ...	1½ " ...	None, but skilled men not required. It enables me to carry on with very indifferent labour.	None	No.
8	45 " ...	3 " ...	I had six milkers when war commenced, four joined and I at once put in machine. Have done it since with two men and a boy.	I should say at present cost of labour, machine would be a little cheaper, petrol costs so much.	I think I should. * Several men milkers always quarrel.
9	60 " ...	2 " ...	3 good men milk 60 cows in about 1½ hours; a little longer when cows are in full milk thus save three milkers.	It does not save much in cost of production.	No.
10	100 " ...	5 " ...	In my case 8-10 milkers		Yes, certainly.
11	43 " ...	2½ " ...	None; the only reason I continue to use the machine is the great difficulty in getting milkers.	None	Certainly not.
12	40 " ...	11 " ...	One man... ..		Yes.*
13	140 " ...	? " ...	None	I found my machine a dead loss, and before I would put in another I would sell my herd.	No, if each milker had to milk 14 at a meal.

The answers (several of which have been given above) to the question "If sufficient reliable hand milkers were available would you continue to use a milking machine?" were generally to the effect that *reliable* hand milkers were preferable to the machine, but the fact that a number of users, with years of experience, stated that they would continue the use of the machine makes it evident that under reliable management the mechanical milker is an efficient substitute for hand milking.

SUGGESTIONS FOR IMPROVEMENTS IN MACHINES.

Many of the suggestions received dealt with small points which apparently had been brought to the operator's notice in the management of his own machine. It is possible that more careful management in some cases would have obviated the necessity for improvement, for instance, one user said that the pressure on the teat and udder was too severe, which was probably due to his having worked the machine at an unnecessarily high pressure. Another asked for teat-cups adaptable for any size of teat, while a third was more reasonable in asking for different sizes of teat-cups. On this latter point, it is worth noting that some of the earlier machines put on the market supplied teat-cups in 4 or 5 sizes, but later use has apparently shown that so great a variety is unnecessary. The suggestions which appeared to have most force were those which asked for pulsators of simple yet strong construction, and for greater simplification in the construction of the machine so as to facilitate cleansing. One farmer stated that in his opinion stripping by hand should not be necessary, but as it has already been pointed out, many machines will effectively strip the cow at the expense of time and with greater risk of too late detection of udder trouble. A number of users mentioned as a defect that the machines they had in use were too costly.

CHANGES IF ANOTHER PLANT WERE TO BE INSTALLED.

The majority of the replies on this point were to the effect that the users would prefer the plant which they already had in operation. Several stated that they would use a different type of engine, either smaller for the use of the milking machine only, or larger to enable them to have sufficient power for other work in the farm buildings. Several who had plant with vacuum pipes of ¾" diameter stated they would

prefer to have pipes of the diameter of 1" to 1½" in order to have less variation in the pressure, and one stated that he would prefer single milk receivers to double receivers taking the milk from two cows at a time.

In reply to the question "Should the engine do other work than that required for the milking plant?" the general opinion was that the engine should be available for other work. Most of the replies were from farmers who had had no experience of other plants than that in use on their farms at the time of making the Report, and in cases where the users had experience of several machines the replies were of a very variable and conflicting nature.

IS PERSONAL SUPERVISION ESSENTIAL FOR SUCCESS?

With very few exceptions the owners stated definitely that they considered the success of a milking machine to be absolutely dependent on personal supervision. Also, there was general agreement that the average cowman could not be relied upon to operate and clean the machine satisfactorily. Much, of course, depends on how the words "average cowman" were interpreted in the opinions given on this point, but there would probably be general agreement that a man capable of looking after a herd of cows satisfactorily and also able to clean and operate a milking machine with success over a prolonged period, was distinctly above the average. Several replies were to the effect that if the farmer provided the personal supervision necessary to ensure the cleanliness and smooth working of the plant, the actual operation of milking could be carried on by men or women of comparatively little experience. A few of the replies as to the necessity for personal supervision and the need for training of the operator are given below:—

	Can the average Cowman become a successful Operator?	Is Personal supervision essential?
(1) Herd of 50 cows. Plant used 3 years.	"Of course, there are exceptions, but it requires a man with a mechanical turn of mind for the case of both engine and milking plant."	"Emphatically, yes."
(2) Herd of 80 cows. Plant used 5 years.	"A boy that can milk is quite capable after a few lessons."	"I think so."
(3) Herd of 70 cows. Plant used 5 years.	"No special training required, only must use common sense, not to tire cows by keeping machine on too long and injuring them."	"Yes, wholly so."
(4) Herd of 36 cows. Plant used 4 years.	"An average cowman can operate and clean the machine satisfactorily if he takes an interest in it and is really anxious to learn and work it. Boys learn much quicker."	"No."
(5) Herd of 100 cows. Plant used 5 years.	"Yes, anyone can learn it in a day or two. I have taught 20 or 30 women at different times."	"Early success of my machine did depend on personal supervision but not now, the girls all know it."
(5) Herd of 34 cows. Plant used 8½ years.	"It is impossible to find a cowman who can manage the machine satisfactorily; they very rarely give the attention to details which counts so much towards success."	"Yes, certainly."
(7) Herd of 60 cows. Plant used 11 years.	"Yes, a cowman may be satisfactory if he has the above qualities" (conscientiousness and observation).	"Yes, much depends on the operator's conscientiousness and observation."
(8) Herd of 45 cows. Plant used 10 years.	"A fortnight's training is necessary."	"Yes, we think all milking machines require personal supervision."
(9) Herd of 35 cows. Plant used 3 years.	"No special knowledge necessary; it is easily managed."	"No."
(10) Herd of 34 cows. Plant used 4½ years.	"Any cowman with intelligence would adapt himself to the machine and become an expert in three months."	"No, but it must be kept in good working order."
(11) Herd of 34 cows. Plant used 3 years.	"Special training is very desirable. The ideal milker for a machine must be a good hand-milker and must have a liking for and a gift for mechanics and be firm, quiet, and thoroughly used to cows."	"No."

Several owners referred to the desirability of having a young active man as operator, and pointed out that such a man could make much more rapid progress in the actual milking by changing the machines from cow to cow more quickly.

PART II.

INFORMATION RECEIVED FROM MAKERS AND AGENTS.

The list of questions given below was drawn up and submitted to the following firms:—

1. R. & A. Lister & Co., Ltd., Dursley, England, makers of the "Lister" Milking Machine.
2. Dairy Supply Co., London, England, agents for the "Amo" Milking Machine. (Swedish.)
3. Associated Manufacturers' Co., London, England, agents for the "Hinman" Milking Machine. (American.)
4. Boving & Co., Ltd., London, E., agents for the "Manus." (Swedish.)
5. Worthington Simpson, London, E., agents for the "Gane." (New Zealand.)
6. Lawrence Kennedy, Ltd., Glasgow, Scotland, makers of the "Lawrence Kennedy" and L.K.G. Milking Machine.
7. J. & R. Wallace, Castle Douglas, Scotland, makers of the "Wallace."
8. Vaccar, Ltd., London, England, makers of the "Vaccar" Milking Machine.

List of questions.

1. What is your estimate of the number of herds in England and Wales milked by your milking machines at the present time?
2. What is the minimum size of herd for which you recommend the installation of a milking machine?

3. What is the cost and horse-power of an engine suitable for:—
 - (a) 40 cows?
 - (b) 80 „
 - (c) 120 „
4. What is the approximate cost of an installation, excluding engine, and with an average amount of piping, for:—
 - (a) 40 cows?
 - (b) 80 „
 - (c) 120 „
5. Has there been an increased demand for milking machines on the part of farmers since 1914?
6. Have you had difficulty in turning out sufficient machines to meet orders? Is this difficulty increasing?
7. Do you consider that an average cowman after a few lessons can be trusted to operate your machine with success and clean it satisfactorily, or is any special training and knowledge desirable or necessary?
8. In your opinion, what are the chief factors contributing to the lack of success occasionally experienced in the use of milking machines?
9. Will you kindly supply me with a list of 10 farmers who have used your machine for a period of years, and who would give me first-hand information of their own experience?
10. Have you had any complaints of taints arising in the milk when your machine has been used?
11. In what direction do you think there is room for great improvement in the types and operation of milking machines?

The replies obtained to these questions are summarised below:—

(1) *Number of herds milked by milking machines in England and Wales.*

Up to the autumn of 1917 the total number of herds milked by milking machines was apparently between 1,400 and 1,500. This total was made up as follows:—

- “Lister” Machine, fully 350 herds.
- “Amo” Machine, approximately 130 herds.
- “Hinman” or “Hinman Amanco” Machine, approximately 200 herds.
- “Manus” (type 3) Machine, 14 herds.
- “Gane” Milking Machine, 50 herds.
- “Lawrence Kennedy” Machine, approximately 120 herds.
- “Wallace” Machine, 46 herds.
- “Vaccar” Machine, approximately 500 herds.

The number of installations of the above machines are not necessarily an index to the popularity or efficiency of the machine, as some of them have been on the market for a much longer time than others, for instance, the “Manus” (type 3) is the most recent introduction into this country—1916; also machines such as the “Vaccar” and “Lister,” which are manufactured in all their parts in this country, have an advantage over others, such as the “Manus,” “Hinman,” “Gane” or “Amo,” where at least some of the parts have to be imported from the countries of origin. The “Wallace” and “Lawrence Kennedy” machines being manufactured in Scotland, are stated to have the largest number of plants in that country.

(2) *Size of minimum herd.*

The minimum herd for which the installation of plant is advised ranges from 12 to 30 cows. Seven firms give from 12 to 20 as the minimum number, and one firm states that the minimum herd should contain 30 cows.

(3) *Cost and horse-power of engine.*

The replies received showed the following ranges:—

- For herds of 40 cows, from £25 to £54, and from $1\frac{1}{2}$ to $2\frac{1}{2}$ h.p., according to type of machine.
- For herds of 80 cows, from £25 to £65, and from 2 to $2\frac{1}{2}$ h.p., according to type of machine.
- For herds of 120 cows, from £35 to £85, and from 3 to 6 h.p., according to type of machine.

The size and cost of the engine are not necessarily directly in proportion to the requirements of the milking machine, as occasionally farmers have more powerful engines already installed for general farm work, or where no engine is already in use, one of sufficient power for additional work is often preferred.

(4) *Cost of installation of plant, excluding engine.*

- For 40 cows, from £85 to £130.
- For 80 cows, from £150 to £240.
- For 120 cows, from £200 to £330.

The above figures were supplied in the Autumn of 1917, and the cost has undoubtedly risen since that time. On the figures supplied the “Manus” and “Hinman” can apparently be installed at the lowest costs, whereas the “Amo” and the “Lister” appear to be the most costly. In the present circumstances, however, it is unwise to attach too much importance to estimates of costs.

(5) *Increase in demand since 1914.*

All firms report that there has been an increased demand since the outbreak of war owing to the difficulties experienced by farmers in obtaining reliable hand-milkers.

(6) *Difficulty in meeting orders.*

Up to 1917 several makers found no difficulty in supplying plants, but others were in some cases unable to obtain certain material. In the case of the “Manus” machine, it has, of course, been necessary to obtain permits to import parts from Sweden; such permits have usually been granted without difficulty.

(7) *Can the average cowman operate machine successfully and clean it satisfactorily, or is special training desirable and necessary?*

(8) *What are the chief factors attributed to the lack of success?*

In considering the replies received to question 7, some difficulty arose in the definition of an "average cowman" and of what constituted "special training," hence the actual replies are quoted below. Also, as in replies to question 8, lack of success was usually said to be due to the operator rather than to the machine, it has been considered advisable to quote the actual replies side by side with those given to question 7.

Machine.	Replies to Question 7.	Replies to Question 8.
Lister" ...	An average cowman, if he will take an interest, should, after a little tuition, operate it successfully.	Lack of interest and inattention to certain points, such as cleaning; personal element, is important.
Amo" ...	A cowman or cowwoman can operate quite well after our operator has installed and instructed in the use of machines.	Lack of interest and perseverance on part of operator.
Hinman" ...	2-3 days at most for average cowman; boys and girls can do it. Experienced milker essential afterwards to see that cows are properly stripped.	Lack of interest and proper supervision of owners. Opposition on part of cowman.
Manus" ...	6-10 days ample time to instruct attendant thoroughly, depending on interest displayed.	Absence of supervision of farmer. Attendant not encouraged to attain success.
Gane" ...	No special knowledge necessary. Girls and women can work it.	Installed by merchant salesmen with little knowledge of engineering.
Lawrence Kennedy" ...	Average cowman or dairymaid is generally quite able to operate satisfactorily after instruction by us.	Less trouble when some member of family supervises than when left entirely to hired labour.
Wallace" ...	A few lessons to cowman when machine is started and again a month later are all that is necessary with an average man.	Machines not working on correct principle. All should imitate calf sucking.
Vaccar" ...	We consider the average cowman requires a week's instruction from an expert. Advise and practise making visits 1-2 months after installation.	Too little interest is taken and too much left to cowman. Want of attention on part of user to cleaning and upkeep. Faulty power units.

While it was to be expected that makers and agents would find the chief reason for the non-success of their machines to be lack of proper attention on the part of the farmer or his assistant, it is a question worthy of consideration whether this lack of attention to detail is not attributable in part at least, to the insufficient training given by the representatives of the firms installing the machine. Those responsible for the sale of milking machines in order to effect sales, naturally emphasise the ease with which their machine can be operated by the average cowman after a few days' instruction and minimise the difficulties which are bound to arise sooner or later; it follows naturally that the cowman, continually hearing the management of the machine spoken of as a simple matter, does not give the attention to it which it requires, and in due course complaints are received by the makers and agents. The amount and quality of instruction given by the firm installing the machine must contribute largely to the results obtained by the farmer or the cowman. This point will be dealt with more fully at a later stage in the report. (See page 64.)

One firm attributes non-success in some cases to a faulty and unreliable source of power on the farms, and points out that the power unit for a milking machine plant must start and operate efficiently twice a day, seven days a week. Attention to this detail is most important.

(10) *Complaints of taints in the milk.*

Four firms report that they have had complaints, but that these were due to inefficient washing out after milking. None should occur when the machines are properly cleaned.

(11) *Where the greatest improvement is possible.*

Several firms report that they are unable to foresee any material improvements which will render their machine more perfect. Others state that they are continually experimenting, and that everything that is discovered to be of value in increasing the efficiency of the machine is incorporated in it. One firm says that the improvement most necessary is the simplification of the machine so that as little labour as possible may be required for milking, and that stripping may be reduced to a minimum. Another firm reports that milking machines have been most successful in those countries where attention has been given to the production of clean milk under sanitary conditions, while another complains of the bad arrangements of cowsheds in the south of England, and the long ranges of piping and the numerous bends and joints thus necessitated.

One firm summarises the chief points that require attention in future improvements as follows:—

- (1) Construction should be as simple as possible.
- (2) There should be no rubber tubes required.
- (3) Machine should be easily cleaned and handled.
- (4) There should be the minimum number of perishable parts, and these should be easily and cheaply replaceable.

CONCLUSIONS AND SUGGESTIONS.

CONCLUSIONS.

The answers given in the preceding pages cover in detail a large number of points, and a brief statement of the more important conclusions which can be drawn from the investigation as a whole may be of general assistance.

1. The experience of many farmers, several of whom have had mechanical milking plants in use continuously for ten to eleven years, shows that mechanical milkers can, under proper management, do the work expected of them in a satisfactory manner.

2. Since 1914 there has been a notable increase in the demand for mechanical milkers because of the increasing difficulty in obtaining hand milkers.

The installation of machines has enabled herds to be maintained which would otherwise have been dispersed.

3. Opinions differ as to the saving in labour resulting from the use of a mechanical milker, but there are sufficient instances of a definite reduction in labour to warrant the inference that with herds of over 30

cows housed in well-planned and equipped cowsheds the installation of a mechanical milker should lessen the labour required.

4. Opinions also differ as to the effect of mechanical milkers on the cost of production. Where plants have been successfully operated and a saving in labour has been effected, the cost of production has most probably been lessened. Much, however, depends on the cost of renewals, petrol, &c.

5. The greatest economy through the use of a milking plant will be possible where cows are concentrated in large herds.

6. The success of a mechanical milking plant depends almost entirely on the operator. With a capable man or woman in charge, excellent results can be obtained from all the makes of machines reported on.

7. Good results cannot be expected unless the parts of the machine which come in contact with the milk are thoroughly cleansed after each milking. There is evidence of a lack of system in the methods of cleansing in general use.

8. Manufacturers and agents emphasise the short period of instruction required to make the average cowman a successful operator. The replies from farmers lead to the conclusion that a successful operator is considerably above the average cowman in intelligence. It appears probable that failure is often due to a lack of realisation on the part of the farmer of the attention to detail which is necessary in order to attain success. He has installed the plant because he has been told it is easy to manage and will save labour. He does not understand that the more complex the machine the higher the intelligence required in its operator.

9. Although all the plants here reported on are successful when they receive proper attention, there are undoubtedly differences in respect of simplicity in management, efficiency in milking, ease in cleaning and cost of upkeep. At the present time in this country there is no definition, based on experiment and practice, of "proper attention," and no facilities exist whereby the differences between the various machines on the above-mentioned points and others may be accurately measured.

If reliable information were obtainable on the above points the installation of milking plants could be carried out on sounder principles, and there should be a considerable decrease in the number of failures.

SUGGESTIONS.

The chief drawbacks to greater usefulness and popularity are:—

- (i) In the event of a breakdown hand milking has to be resorted to, and sufficient milkers may not be available.
- (ii) The difficulty of obtaining sufficiently well trained and reliable operators.
- (iii) Although labour may be saved in the actual work of milking, it is necessary to maintain the same staff as before, because of the amount of work involved in feeding the cows, cleaning the cowsheds, &c.
- (iv) With herds of under 30 cows it is doubtful if an adequate return would be obtained on the capital expenditure necessary.

Suggestions as to how these drawbacks may be lessened or removed.

I.—*In the event of a breakdown hand milking has to be resorted to, and sufficient milkers may not be available.*

Suggestion.—Lessen the possibility of a complete breakdown by (a) having someone on the farm with sufficient knowledge to keep the mechanical parts in good working order; (b) duplicating those parts most likely to get out of order and cause a stoppage.

These parts are:—

- (a) *The power unit.* An emergency power unit could be maintained in working order on most farms without any material increase in the cost. In large herds, where the result of a complete stoppage would be most serious, the cost of an emergency power unit could most easily be met.
- (b) *The pulsators.*—In the "Hinman" and "Gane" plants, where only one pulsator is required, emergency pulsators could be kept and placed in position when necessary. In the "Lawrence Kennedy," "Vaccar," "Lister," "Manus" and "Amo" plants reserve pulsators and associated parts, and in the case of the "Wallace" reserve pulsators and teat-cups could be kept. It should be part of the ordinary maintenance of a milking plant to keep a reserve supply of such rubber parts as require occasional renewal.

II.—*The difficulty of obtaining sufficiently well trained and reliable operators.*

The operator should possess:—

- (a) Knowledge of the management and milking of cows.
- (b) Knowledge of the mechanism and mode of operation of the plant in question.
- (c) The will to make mechanical milking a success.

Suggestions.—(1) An essential to the obtaining of an efficient operator is that the management of a milking machine should be recognised as highly skilled work, and paid accordingly.

Most dairy farmers know and appreciate the value of a good cowman—a man who will study the temperament and habits of each individual cow and treat each one accordingly, both in feeding and in milking. The installation of a milking plant does not make such a man unnecessary. In spite of its highly specialised mechanism it is still but a machine, and the best results can only be obtained when it is under the care of a man who knows how and when to modify the action to suit cows of different milking habits at different stages of lactation, with udders and teats of unequal size, and, in addition, knows how to keep all parts in thorough working order. In the preceding pages it is emphasised that the average cowman cannot be expected to get the best results.

In the case of comparatively small herds the farmer himself or his son usually acts as operator, and very good results are frequently obtained. With herds of 40 cows or more the responsibility for the plant is usually placed on the cowman, and in such cases an adequate training may be considered as essential to success. Where a dairy farmer has sufficient mechanical equipment on his farm as a whole to warrant the employment of an engineer, the latter could see to the mechanical parts of the plant, leaving the responsibility of milking and cleaning to the cowman.

(2) The difficulty of obtaining well-trained operators may be overcome in one or other of the following ways:—

(a) By the provision of adequate training by the firm installing the plant.

This would necessitate the firm's expert remaining on the farm for a longer period of time, and would add to the cost of installation. Also, after a few days, there would be comparatively little for the expert to do on the farm in the intervals between milking.

(b) By the appointment of a milking machine supervisor by firms installing plants.

The supervisor would pay periodical visits to the farms, examine all parts of the plant and report thereon, supervise cleaning, and give all possible assistance and advice for successful management. This method would add to the cost of upkeep to the extent of the charge made by the firm to each individual farmer; further, as the plants installed by one firm are rarely on adjacent farms, or even numerous in any one district, the travelling expenses of the supervisor would be considerable.

(c) By the appointment by a group of farmers, a dairy farmers' society or a milk recording society of a supervisor for the plants used by the members.

The supervisor would do the same work as in (b) above and would require to be familiar with the details of the different types of plants in use. It might be possible to combine the duties of milk recorder and milking machine supervisor and thus lessen the cost.

(d) By the provision of short courses of training for operators and supervisors at a suitably equipped centre.

A large farm with suitable buildings and equipped with two or more of the commonest plants under the charge of an expert would make a suitable centre, or the farms of some of the dairy educational institutions could be equipped for this purpose. Short courses at the latter centre could also include instruction in the feeding of cows, the structure of the udder, the secretion of milk, and the necessity for cleanliness in the management of milk.

III.—*Although labour may be saved in the actual work of milking it is necessary to maintain the same staff as before because of the amount of work involved in feeding the cows, cleaning the cowshed, &c.*

This drawback can only exist on farms where the buildings are scattered, and an unnecessary amount of time must be devoted to the feeding of the stock, &c. In any well-arranged homestead the number of hands required for the feeding of the herd and associated work should never equal the number required for milking; for instance, a herd of 40 cows in milk would require 4 milkers, but two men should undertake all the labour necessary.

Suggestion.—Mechanical milking plants should be associated with all possible means of economising labour, such as (a) arrangement of buildings to lessen labour in the carrying of fodder, roots, cake and meals, and litter to the cowshed; (b) the provision of adequate power and equipment for the preparation of food; (c) the provision of carriers on ground rails or an overhead system for conveying food to cows and for removal of manure.

IV.—*With herds of under 30 cows it is doubtful if an adequate return would be obtained on the capital expenditure.*

On small dairy farms, in addition to the drawback of the high initial cost, the total labour employed is often so small that even though a milking machine be installed it may not be possible to reduce the number of employees. This is particularly the case when most of the work is carried through by the farmer and his family. There appears to be little hope of the common use of mechanical milkers on small farms until it has been found possible to reduce the first cost very considerably. In the case of herds under 30 cows maintained on larger farms carrying on other branches of farming in addition to milk production, the difficulty as regards capital should be more easily overcome, and greater saving in labour should be possible.

Possibilities of improvement.—The improvement of mechanical milkers appears to be possible in the following directions:—

A. In general as to (1) ease of cleansing.

(2) method of cleansing.

(3) reduction in cost.

B. In general as to (1) reliability of pulsators.

(2) construction of teat-cups and linings.

(3) means of preventing teat-cups from falling off teats.

(4) means of conveying milk from teat-cups to milk receivers.

(5) relative positions of pulsator to other parts of the plant.

(6) construction of milk receiver for greater ease in handling.

Experiments with a view to improvements on the above-mentioned points can be carried out by:—

(1) Individual firms experimenting with their own plant.

(a) Independently of farms.

(b) At farms.

(2) Agricultural Colleges.

(3) Dairy Research Institutions.

Up to the present almost the only means of improvement available in this country has been the carrying out of experiments by firms manufacturing and installing plants, but as such firms often lack practical knowledge of dairy stock and technical knowledge of milk and its management, rapid development cannot be anticipated. Farmers cannot be expected to co-operate with firms in this work; they instal plants to get work done and not to experiment, and if a machine is unsatisfactory it is usually discarded.

As regards the Agricultural and Dairy Colleges of this country, those with the necessary facilities in the form of technical staff, farm, and herd of cows have not been sufficiently well supported financially to enable them to undertake experimental work. While several have had plants installed only one, *i.e.*, the Midland Agricultural and Dairy College, has carried out trials, these being confined to one milking machine of the suction type. The main object in these trials was to ascertain how machine milking compared with hand milking under ordinary farming conditions.

The first Research Institute in Dairying to be established in Great Britain was created as recently as 1913. Circumstances have not yet permitted the carrying out of either comparative trials or experiments under the direct control of the Institute, but the staff carried through the technical work in connection with the milking machine trials held under the auspices of the Royal Agricultural Society of England in 1913.

Suggestions.—(1) Detailed information as to a thoroughly satisfactory method or methods of cleansing suitable for any type of plant to be collected, published, and circulated amongst farmers.

(2) The Dairy Research Institute or one of the Dairy Colleges should be assisted financially or otherwise to such an extent as to enable it to instal and maintain all the equipment and to obtain any additional staff necessary in order to carry out an extensive series of experiments on mechanical milkers.

The existence of such a centre for trials of different kinds of milking machines and for experimental work on improvements of the various parts, and on the effect of the above on the bacterial content and flavour of the milk would aid greatly in the development of mechanical milking; much reliable advice to users and prospective purchasers would soon become available and, further, such a centre could provide at suitable times short courses of instruction for operators, as are suggested on page 65.

J. MACKINTOSH.

24th December, 1918.

REPORT ON THE METHODS AND EXTENT OF THE PASTEURISATION OF MILK IN SCOTLAND.

(1) METHOD OF ENQUIRY.

The information in this Memorandum is compiled from that given to me by the Medical Officers of Health of the largest burghs in Scotland and the principal milk-producing counties.

(2) BURGHs WHICH DO NOT PASTEURISE ANY MILK.

Name of Burgh.	Population.	Name of Burgh.	Population.
Motherwell	40,380	Musselburgh	15,938
Ayr	32,986	Port Glasgow	17,749
Hamilton	38,644	Renfrew	12,565
Perth	35,854	Dumbarton	21,989
Kilmarnock	34,728	Fraserburgh	10,574
Dunfermline	28,103	Galashiels	14,531
Falkirk	33,574	Bo'ness	10,862
Peterhead	13,613	Johnstone	12,045
Irvine	10,179	Forfar	10,849
Arbroath	20,647	Stirling	21,200
Montrose	10,974	Rutherglen	34,319
Cowdenbeath	14,029		

(3) BURGHs WHICH PASTEURISE MILK.

Glasgow (Population 1,008,487).—From 85 per cent. to 90 per cent. of the milk is pasteurised.

The milk so treated is sold as sweet milk and not by any other name.

The process is, generally speaking, as follows:—The milk is raised to a temperature of about 165° F., at which it is maintained for about 1½ minutes, after which it is cooled to ordinary water temperature. In summer time it is further cooled to a temperature of about 40° F. In one large establishment dealing with from 4,000 to 5,000 gallons per day, the milk is raised to a temperature of 165° F. and retained at that for about 20 minutes before passing it through the cooling plant. In another similar establishment the milk is raised to 152° F., at which it is maintained for about 30 minutes before being cooled down.

The age of the milk so pasteurised varies from 8 to 20 hours; so that when it reaches the consumer from 12 to 36 hours will have elapsed from the time of milking.

Mr. Fyfe, Chief Sanitary Inspector of Glasgow, adds:—“The primary object of the dairyman is to lengthen the life of sweet milk by destroying as far as possible, or at all events reducing the number of putrefactive organisms, and, of course, incidentally those of pathogenic origin which may be present. There is no doubt that a good effect has followed this system of pasteurisation—so far, at all events, as the incidence of infectious disease in this city is concerned. There has been quite a remarkable decline in milk-borne epidemic diseases since this system was introduced, and such cases as arise have been traceable to milk which has not been dealt with in this way.” Mr. Fyfe also encloses some tables prepared by the Corporation chemists and city bacteriologist, showing the result of analysis of samples of pasteurised milk and untreated milk, together with the comments of the Corporation chemist. I append these for the information of the Committee.

Leith (Population 80,488).—The Medical Officer of Health, Dr. Robertson, writes:—“The only pasteurised milk in the burgh of Leith is from one firm, who pasteurise the whole of their milk, amounting to about 12,000 gallons per day. The milk is not sold as pasteurised, but their customers understand that nothing but pasteurised milk is sent out from this depôt. I was entirely dissatisfied with the original plant installed. In fact, the method first pursued simply meant the heating of the milk for a few minutes with subsequent chilling and bottling. I undertook a series of tests, and proved that the pasteurised milk sold was richer in micro-organisms than the milk as it came from the farm. After a good deal of delay the present plant was put down. While the machinery is a great improvement upon the original plant, one is forced to the conclusion that pasteurisation has not yet been accomplished, because continuous heat from an outside agent, such as steam or hot water, is not being applied to the milk. Until this continuous heating for at least 20 minutes at a temperature of between 165° F. to 170° F. can be maintained, one is safe to assume that such pathogenic micro-organisms as apply to diphtheria, typhoid fever, tuberculosis, and presumably scarlet fever, are left more or less unharmed. I had complaints last summer that the milk said to be pasteurised was turning sour, when milk drawn under unfavourable conditions at our dairies was keeping quite well. When one knows that the lactic acid bacilli may be comparatively easily killed by heat,

the assumption that "pasteurisation" is merely a name, is assured. It is quite clear to me that more scientific methods will have to be employed if we are to secure a supply of milk that is actually pasteurised."

The process in this burgh is as follows:—The milk is passed into a pasteurising machine (upright cylinder) and heated to between 165° F. and 170° F. It is then passed on to a large tank, in which it is kept for 20 minutes. It then passes through a strainer to take out the dirt. It then passes over the cooling apparatus, where the temperature is first brought down to that of ordinary water, and then further cooled to nearly 32° F. It is then bottled while cold, and placed in a cold storage room until sent out for delivery. The manager states that the milk so treated keeps fresh for 36 hours after leaving the premises, and that the milk when pasteurised is about 5 hours old. He estimates the cost of pasteurising at about one penny per gallon, and complains that the Milk Order fixing prices hits them hard, because they cannot charge any more than milk vendors who do not pasteurise their milk.

Aberdeen (Population 163,891).—The Medical Officer of Health, Dr. Matthew Hay, has been good enough to send me in tabular form replies to the information asked for, showing that eight firms in Aberdeen pasteurise their milk. I append the entire table, which shows the proportion of the milk pasteurised in winter and summer, the temperature to which the milk is raised, the temperature to which it is subsequently cooled, the method of pasteurisation, and the fact that in every case the milk so pasteurised is sold as fresh milk. Dr. Matthew Hay makes the following remarks upon the results so tabulated:—"Although certain temperatures are stated by the various dairymen in pasteurising their milk, I am very doubtful if such temperatures are always being taken. The system in use here is the usual Flash system, by which the milk is kept at the stated temperature for not more than a minute or two minutes, if so much. We made some tests last year of one of the supplies, and found that the results were rather better than we expected. The present pasteurising methods certainly require carefully overhauling. There are some Medical Officers, like Dr. Kerr, of Newcastle, who think that, owing to the want of cleanliness in the Flash pasteurising apparatus, the milk is more polluted than purified; and he has published the results of some experiments in favour of this opinion. Of course, all of us are out for the milk being obtained from the cow under the best possible conditions for securing freedom from contamination, but most of us have come to recognise from experience that it will take a long time to secure that these conditions will be such that some process of sterilisation or pasteurisation, especially in the case of milk for children, will not be necessary. I am of opinion that while we should do our best to have improved conditions in the production of milk, we should at the same time endeavour to see provision made for the pasteurisation or sterilisation of milk until the time is reached when guaranteed pure natural milk is purchaseable."

Dundee (Population 176,300).—The then Medical Officer of Health for Dundee, the late Dr. Templeman, informed me that only one company pasteurised milk in Dundee city. "They employ a pasteurising and separating (Swedish) mechanical plant, and treat 300 gallons daily. The temperature is raised to not less than 150° F., and not more than 160° F. It is impossible to say how long it is kept at that temperature as the process is a continuous one. The milk is put into a tank and passed through a condenser at the temperature mentioned, and from there it is passed into a cooler, and then into bottles or cans. I do not think that the milk is kept at the temperature sufficiently long really to pasteurise it, but the manager of the company says that the process is simply to make the milk keep. During the winter months the milk may be anything up to 36 hours old, and during the summer not more than 24 hours."

Paisley (Population 84,455).—About 20 per cent. of the milk supply of this burgh is pasteurised. It is not sold as pasteurised milk, but as ordinary sweet or fresh milk. The process, however, is not carried out within the burgh at all, so that the Local Authorities have no first-hand knowledge of the processes employed.

Kirkcaldy (Population 39,601).—The only place in the burgh where milk is pasteurised is the model dairy belonging to the Co-operative Society, with a daily average for the week ending December 6th, 1917, of 567 gallons. All the milk received is pasteurised and all sold as sweet milk. The process is that the milk as received from the various farmers is emptied into the receiving tank. Hence it passes through the pasteuriser, and in winter is heated to 170° F., while in summer to 180° F. It is then pumped up into the primary cooler, in which water is circulated, and then over the secondary cooler, where brine is being circulated, the effect of these two operations being to reduce the temperature of the milk to 40° F. The age of the milk pasteurised is from 14 to 16 hours in the case of the milk of the night before, and from 2 to 6 hours in the case of the morning milk.

Hawick (Population 16,877).—The Medical Officer of Health, Dr. McKellar, informs me that probably from one-half to two-thirds of the milk in the burgh of Hawick is supplied by the Teviotdale Dairy Company and the Co-operative Store. The former pasteurise five-sevenths of their milk, and they sell both pasteurised and ordinary milk. The former is heated to 160° F. for from 10 to 15 minutes, and then cooled to the temperature of 58° F. in summer and 34° F. in winter. One half of the milk is 12 hours old, the other half is from 1 to 3 hours old. In the case of this particular burgh the milk is also cooled upon being drawn from the cow.

The Hawick Co-operative Society, Ltd., pasteurise the whole of their milk in the summer time, and about 50 per cent. in the winter time. It is sold as pasteurised milk, except in the case of the early morning delivery (6 a.m.), when it is sold as morning milk. The milk when received is first cleansed, then heated to 150° F. in winter and cooled to 38° F. In summer it is heated to 165° F. and cooled to 48° F. The Society state that "momentary exposure to the above heats is best, as it reduces to a minimum the pasteurised flavour, which a large percentage of people object to." The milk varies in age from 14 to 20 hours old. The morning milk is from 2 to 6 hours old.

Greenock (Population 75,140).—The Medical Officer of Health, Dr. Cook, informs me that the only milk pasteurised in Greenock is that of the Central Co-operative Society, who distribute about one-third of the milk of the burgh. The amount for the week ending December 15th, 1917, was 7,844 gallons. It is sold as pasteurised milk, not fresh.

The milk is heated, after being strained, to a maximum temperature of 170° F., probably remaining at that figure for the matter of a minute at most. It is subsequently cooled to 42° F. The age of the milk is not more than 12 hours old, and may be 4 hours. The Medical Officer of Health doubts if the period of high temperature is long enough to kill dangerous organisms.

Clydebank (Population 37,548).—The Medical Officer of Health, Dr. Strang, informs me that from one-third to one-half of the milk is pasteurised. In June last, when the total daily supply averaged 2,961 gallons,

three of the largest dealers pasteurised. Two of them, however, ceased doing so in the winter months, but one continues to pasteurise 1,000 gallons per day. The milk is sold as fresh. It is heated from 160° F. to 180° F., and then cooled to 40° F. The age of the milk is from 6 to 8 hours.

Kirkintilloch (Population 11,932).—The Medical Officer of Health, Dr. Miller, informs me that more than three-quarters of the milk is pasteurised. It is sold as "Pure Sweet Milk," but is generally known, however, to be pasteurised. It is heated to a temperature of 170° F. for a few minutes, cooled to 40° F. and pumped to a large container, where it is bottled by syphon action, and then stored in a refrigerator. The night and morning milk are pasteurised together in the morning.

Barrhead (Population 11,387).—The Medical Officer of Health, Dr. Corbett, informs me that rather more than three-fourths of the milk is pasteurised and is sold as such, being in most cases put up in small sealed bottles. The milk is poured into a raised chamber, from which it passes by gravitation through a chamber heated by steam to a temperature of about 120° F. It is kept at this temperature for from 3 to 5 minutes, after which it is cleaned of all dirt by centrifugal action. It is then cooled down to between 32° F. and 40° F., and bottled by machinery. The age of the milk so treated is from a few hours to 12 hours.

Wishaw (Population 25,263).—The Medical Officer of Health, Dr. Duff, informs me that 50 per cent. (400 gallons) is pasteurised at two different premises. It is sold as fresh milk. In the one place the plant is the modern Flash apparatus, in which the milk is heated to 160° F. for 1½ minutes, then cooled to between 32° F. and 40° F. On the second premises it is treated by a simplified retainer apparatus, heated to 160° F. for 20 minutes, then cooled to the temperature of running water. None of the milk so pasteurised is more than 12 hours old.

Buckhaven (Population 15,149).—The Medical Officer of Health, Dr. Maxwell Dawson, tells me that about half the milk supply of the burgh is pasteurised. It is sold as fresh milk. It is heated to 160° F., passed through a cleanser and cooler, reducing the temperature to 40° F., and then bottled in paper-capped bottles. 25 per cent. is 12 hours old (brought from a distance), and 75 per cent. 2 hours old (local farms).

Coatbridge (Population 43,286).—The Medical Officer of Health, Dr. Hamilton, informs me that about one-third of the milk of the burgh is pasteurised. A few of the buyers ask for pasteurised milk; the majority, who do not ask for it, are aware that they get it.

The milk is raised to a temperature of 160° F., and immediately cooled to a temperature of about 50° F. The age of the milk is from 10 to 22 hours.

Lockerbie.—One firm pasteurises about 900 gallons per day, half of which is 12 hours old, and the other half 1 to 2 hours old. The milk is raised to a temperature of 150° F. to 155° F., and is cooled immediately to approximately 40° F. over a combined water and brine refrigerator. The milk is sold without any declaration. The cost of pasteurising is estimated at about one halfpenny per gallon. The reason given by the firm for their process is that it enhances the keeping qualities of the milk.

County of Ayr.—The Medical Officer of Health, Dr. Macdonald, says that, as far as he can ascertain, no milk is pasteurised by any of the farmers or dairymen in this county, but only at creameries or margarine works. At these he understands that the milk is kept at a temperature of about 75° C. (167° F.) for 15 minutes. Dr. Macdonald adds that he is not inclined to recommend the general adoption of pasteurisation of milk by farmers or other dairymen, as he would have no guarantee that the process would be favourably conducted. He considers that the pasteurisation of milk on any extensive scale should only be carried out in certain centres, under the supervision of Local Authorities or other responsible bodies.

County of Dumfries.—There are about 9,000 cows in registered burghs, producing probably 17,000 gallons daily. The Medical Officer of Health, Dr. Maxwell Ross, informs me that the milk is not pasteurised at any of the farms. There are, however, three creameries in the county, situated at Lockerbie, Dumfries and Gretna, where pasteurisation is carried out.

At Dumfries, 12,000 gallons in summer, and 700 gallons in winter, are pasteurised daily. At Gretna, 486 gallons are pasteurised daily.

At Gretna the milk has been sold either as pasteurised new milk or pasteurised separated milk. At the Dumfries Creamery the milk is raised to a temperature of 180° F., and immediately cooled to approximately 40° F. At Gretna two processes were carried out prior to the Cream Order:—

(a) The greater portion of the milk was raised to a temperature of 180° F. and immediately cooled to between 30° F. and 40° F.

(b) The remainder was raised to a temperature of 110° F., then passed through a separator, the separated milk raised to a temperature of 180° F. and immediately cooled to 40° F. The age of the milk is approximately the same in all creameries, one half being about 12 hours old and the other half 1 to 2 hours old.

County of Lanark.—The Medical Officer of Health, Dr. Wilson, regrets to say that to the best of his knowledge the pasteurisation of milk is not practised in his county area.

Comments.—The foregoing contains the results of my enquiries in every burgh in Scotland having a population of over 10,000, with three exceptions, from which no replies have been received. It may, therefore, be taken as practically covering the whole ground as far as Scotland is concerned.

The enquiry has brought out prominently the following facts. First of all, that a large number of burghs exist in which no milk at all is pasteurised, and these burghs are all, with the single exception of Edinburgh—where the amount treated is very slight—small burghs. Secondly, it shows that in most of the larger burghs from one-third to one-half of the milk is pasteurised. Thirdly, it is quite clear from the description given of the processes employed that the so-called pasteurisation consists in raising the milk to a given temperature for a moment or two and then immediately cooling it. In other words, as usually carried out the process is quite useless from the point of view of killing bacteria, owing to the short period of time the milk is exposed to heat. Fourthly, the enquiry has also elicited the fact that in the majority of cases the night and morning milk is mixed together before being treated. Lastly, it will be found that in almost every case the pasteurised milk is sold as fresh milk, without any declaration at all.

(Signed) GERALD LEIGHTON, M.D.,

Mayor.

[COPY.]

GLASGOW PUBLIC HEALTH LABORATORY.
16th February, 1915.

NOTES ON TABULATED RESULTS.

Acidity.—Determined by titrating 10 cc. milk with $\frac{N}{10}$ caustic soda, using Phenol Phthalein as indicator. The number of cc. of $\frac{N}{10}$ alkali required to render 100 cc. of milk neutral to Phenol Phthalein represents the degree of acidity of the sample. This test was made to determine the relation (if any) of the acidity of fresh milk to its bacterial content. In the non-pasteurised samples the degree of acidity shows some relation to the number of bacteria only in sample No. 12. In the pasteurised samples the degree of acidity affords no definite information on the point.

Cream.—The amount of cream rising to the surface in each glass shows a very notable variation; and while it cannot be regarded as a definite measure of richness, it is noted as a matter of interest. The very thin layer of cream in No. 10b may be taken as an indication that the milk was sterilised rather than pasteurised, and the low bacterial content lends support to this view.

Sediment.—It is understood that these milks have been sieved just before pasteurising. If this is so, it is probable that they have all been twice sieved—at the farm and at the dairy.

The sediment falling in 24 hours was measured in a long tube holding a litre, and gradually narrowed at the lower end for the attachment of a centrifugal tube. The extremity of the centrifugal tube is narrowed and graduated in tenths and hundredths of a cc. to measure the amount of sediment in parts per 100,000. This purely gravimetric result is regarded as the primary reading. But as the sediment does not fall in a compact column in each tube, centrifugal action (4,000 revolutions for one minute) is used to make the depth of the column in the different tubes more definitely comparable. The resulting average compression of the sediment is about 37 per cent.; in other words, the column of sediment is reduced about one-third, and this result may be regarded as the secondary reading. The average for the twelve samples comes out at 0.053 cc. for the primary reading, and 0.033 cc. for the secondary reading.

Nature of Sediment.—The sediment is much alike in all the samples, the various components of it only varying in amount, as indicated by the number of + signs. It would be interesting to know if there were any conditions to account for the large proportion of mineral dust in sediments 3 and 7. In the sediment of sample 10 there were white, glistening, porcelain-like particles which appeared metallic under the microscope.

Those milks showing large quantities of leucocytes indicate the need for veterinary inspection.

Bacterial Content.—The non-pasteurised samples 1, 9 and 12 show large numbers of bacteria—numbers which, except in sample 1, are much too high for fresh milk, especially at this time of the year. The pasteurised milks, it will be seen, vary greatly in their bacterial content. The majority of them—notably, 2, 3, 5, 6, 7, 8 and 11—indicate either that (1) the pasteurising was very inefficient or (2) the after-treatment favoured re-contamination.

There would appear to be little use in going to the expense of pasteurising when this is the result obtained in the milk as it comes from the pasteurising plant. Much better results might be obtained by a more scrupulous regard to the cleanliness of apparatus and utensils—in other words, to the prevention of re-contamination. It is absurd to pasteurise milk, and then find the bacterial content *worse than it ought to be in the fresh untreated milk*.

The anomalous result obtained in sample 1 calls for investigation. This milk has a high acidity and is one of the dirtiest of the series, yet its bacterial content is notably low.

Coliform Bacilli.—These were absent in .001 cc. of non-pasteurised milk and .01 cc. of pasteurised milk.

(Signed) R. M. BUCHANAN.

SAMPLES OF RAW AND PASTEURISED MILK FOR DETERMINATION OF SEDIMENT AND BACTERIAL CONTENT.

(Received, 2nd February, 1915.)

Number.	Pasteurised (P.) or not (N.P.).	Acidity in Degrees.	Cream.			Amount of Sediment.		Nature of Sediment.						Bacterial content per cc.			Coliform Bacilli in .01 cc. (P.), .001 cc. (N.P.).
			Column of Milk.	Surface Layer of Cream.	Percentage.	Gravimetric (per Litre).	Centrifugalsed (per Litre).	Epithm.	Leucocytes.	Mineral Dust.	Lime.	Veget. Fibre.	Hairs.	Gelatine at Room Temperature.		Agar at 37° C.	
														4 days.	6 days.	2 days.	
*1b	N.P.	24	14°	1.1°	7.86	.08 c.m.	.05 c.m.	++	+	++	++	++	+	27,000	52,000	29,500	No growth
2a	P.	21	14°	.9°	6.43	.03	.03	++	+	+++	+++	+++	+++	84,000	153,000	33,200	"
3a	P.	21	16°	1.4°	8.75	.025	.02	++	—	+++	++	++	—	10,600	14,800	4,000	"
4b	P.	20	14.9°	1.2°	8.05	.03	.03	++	—	++	++	++	++	600	1,800	4,000	"
5b	P.†	23	14°	.6°	4.29	.025	.02	++	+++	++	++	++	—	18,600	26,200	15,200	"
6b	P.	21	14.75°	1°	6.78	.03	.02	++	+	—	++	++	—	56,200	63,200	19,400	"
7b	P.	20	15.2°	.45°	2.96	.05	.03	++	—	+++	++	++	—	600	4,800	126,000	"
8b	P.	22	15.2°	.9°	5.92	.1	.07	++	+++	++	++	++	+	15,400	41,000	7,000	"
*9b	N.P.	21	14.75°	.9°	6.11	.04	.03	++	++	++	++	++	+	306,500	370,000	191,500	"
10b	P.	20	15°	.15°	1.00	.15	.05	+++	++	++	—	++	—	1,000	1,200	800	"
11b	P.	20	14.4°	1°	6.1	.025	.02	++	++	++	+++	++	+	17,800	30,400	97,800	"
*12b	N.P.	26	14.5°	.7°	4.82	.05	.03	+++	+	+	—	++	+	525,000	820,000	215,000	"

* From city cowfeeders.

† Evidence of added annatto.

(Signed) R. M. BUCHANAN.

2nd March, 1915.

NOTES ON TABULATED RESULTS.

Acidity.—The average acidity of this series of samples is 21·3°. The average acidity of the previous series (1B-12B) was, for the non-pasteurised samples, 23·7°, and for the pasteurised samples 20·9°.

Cream.—The average amount of cream rising to the surface in each glass calls for no special note, except that it was comparatively low in No. 17B. Estimated by measurement of the column, it is found that the average percentage of 6·59 in previous milks (1B-12B).

Amount of Sediment.—The average for the twelve samples is 0·083 cc. for the primary reading and 0·055 cc. for the secondary reading. This is distinctly higher than for the previous series of samples (1B-12B), which gave an average of 0·053 cc. for the primary reading and 0·033 cc. for the secondary reading, but it is to be remembered that the previous samples were probably sieved twice.

Nature of Sediment.—The sediment presents the same general characters in all the twelve samples. Vegetable fibres and hairs were rather more numerous than in the previous series of samples, probably for the reason already given. It is noteworthy that lime concretions were not detected in six of the samples.

Bacterial Content.—This is stated as the number of organisms per cc., and was estimated by adding 1 cc. of milk to 99 cc. of sterilised water, and taking from this 1 cc. to make gelatine and agar plates and 1 cc. for taurocholate agar plates.

There is some relation between the amount of sediment and the bacterial content, but it is not constant. Samples 13, 20, 23 and 24 must be regarded as having an excessive bacterial content for fresh milk.

Coliform Bacilli.—These organisms were in excessive numbers in sample 23. The same quantity of milk (1 cc. of the dilution 1:100) failed to reveal the presence of coliform bacilli in the majority of the other samples.

Spore-bearing Organisms.—These were present in 10 cc. in all the samples.

(Signed) R. M. BUCHANAN.

DETERMINATION OF INSOLUBLE DIRT, BACTERIAL COUNT, &c., IN MILK SAMPLES 13B-24B.

Received 16th February, 1915.

WARM MILK as received by Wholesale Dairymen in Glasgow from Farmers in the Country. (The samples were taken in the usual way, in course of delivery from the Farmers to the Dairymen.)

No.	Degree of Acidity.	Cream.			Amount of Sediment.		Nature of Sediment.						Bacterial Content per cc.		
		Column of Milk.	Surface Layer of Cream.	Percentage.	Gravimetric.	Centrifuged.	Epithm.	Leucocyte.	Mineral Dust.	Lime.	Vegetable Fibre.	Hairs.	Gelatine, Room T. 6 days	Agar, 37° C. 2 days.	Tauro Agar for Coliform Bacilli, 2 days, 37° C.
13B	21	15·4"	1·2"	7·79	·10 cc.	·05	S+ L+	+	++	+	+++	+	1,104,000*	171,000	900
14B	24	14·5"	·9"	6·20	·07 "	·04	L+	+	+	—	+	+	91,000	19,000	Coliforma
15B	23	15·44	1·0	6·47	·07 "	·05	S+ L+	+	+	—	++	++	42,000	24,000	absent in
16B	20	15·3"	·85"	5·55	·06 "	·05	S+ L+	+	+++	—	+++	++	21,000	15,000	·01 cc.
17B	18	14·1"	·60"	4·25	·08 "	·06	S+ L+	—	+	++	+++	+	110,000	99,000	100
18B	24	15·1"	1·15"	7·61	·07 "	·06	S+ L+	—	—	—	+++	++	106,000	38,000	
19B	19	14·95	·85"	5·68	·06 "	·04	S+++L++	—	+	—	+	+	37,000	56,000	Coliforma
20B	21	14·93	·83"	5·55	·10 "	·09	S+++L++	—	+	++	+++	+	588,000	397,000	absent in
21B	21	14·8"	1·2	8·10	·08 "	·06	S+ L+	+	+	++	++	++	84,000	109,000	·01 cc.
22B	22	14·9"	1·2"	8·05	·075 "	·06	S+ L+	—	++	+++	+++	+	145,000	66,000	
23B	23	14·9"	1·25"	8·39	·16 "	·10	S+++L+	++	+	+	+++	++	242,000*	264,000	22,900
24B	20	15·4"	·9"	5·84	·07 "	·05	S+++	+	+	—	+++	+++	285,000*	109,000	100
Average	21·3			6·62	·083,	·055									

* Counted at four days.

(Signed) R. M. BUCHANAN.

ABERDEEN MILK SUPPLIES.

Pasteurisation and Cooling of Milk.

Present Average Daily Supplies of Milk from Eight Firms.	Proportion of Milk Pasteurised.		Temperature to which Milk is raised.	Is Pasteurised Milk subsequently cooled, and if so, to what temperature?	Is such Milk sold as Pasteurised or as Fresh Milk?	Method of Pasteurisation.
	Present Time.	Summer Time.				
Gallons, 1,540	Per cent. 25	Per cent. 100	160° F.	48° F.	Fresh	Continuous flow.
750	—	50-75	160°-170° F.	40° F.	Do.	Do.
475	—	50-75	170°-175° F.	50° F.	Do.	Do.
400	—	50-100	160° F.	45°-50° F.	Do.	Do.
700	10	100	185° F.	35°-40° F.	Do.	Do.
350	—	25	180° F.	50° F.	Do.	Do.
725	100	100	170°-176° F.	50° F.	Do.	Pasteurising done for separation only.
300	50	100	140°-150° F.	50° F.	Do.	Continuous flow. Do.

Estimated amount of milk consumed in the city is about 10,000 to 12,000 gallons per day.

EXTRACTS FROM REPORT OF THE MAYOR'S COMMITTEE ON MILK

CITY OF NEW YORK.

December, 1917.

VALUE OF MILK AS A FOOD. (Pp. 18-21.)

Concerning the food value of milk, Professor Sherman points out that it is a superior food in three respects, as follows:—

- (1) Its food value in protein, carbohydrates and fats was partly realised a few years ago.
- (2) Its very exceptional value as the means of keeping a proper balance in the mineral constituents in a diet. (This refers to the salts of several kinds contained in milk.)
- (3) That it contains two growth-promoting substances called vitamins.

Concerning the last item of value mentioned above, namely, the vitamins, most important and interesting discoveries have been made in the last three years. The most recent work has been performed by Professor E. V. McCollum, of John Hopkins University, who has followed up the work begun by Professor Osborne, at Yale, and others.

These discoveries show that there are existing in milk and in some other foods two unknown substances which stimulate growth. One of these is found in the fat and the other is found in the water or solution. Their chemical character is unknown, and they have never been separated from the food materials with which they are associated.

Professor McCollum has pointed out that the seeds of plants are good food so far they go, but that they are deficient in these growth-promoting substances, which are found chiefly in the leaves of all trees and plants. They are found in such leaves as cabbage, lettuce, spinach and cauliflower, and above all in milk.

Concerning milk and milk produce, he says it is not generally appreciated that these articles have a dietary value far greater than can be expressed by their protein and energy contents.

In experiments on rats, Osborne, Mendel, and McCollum have shown that the feeding of butter fat and of milk promotes growth in a remarkable way, for the reason that the vitamins or growth-promoting substances are present in milk in an abundance and in a form which is readily available as in none other of our common foods.

Because of its nutritional value and particularly because of its growth-promoting value, milk is the ideal food for infants and children.

In testifying before the Committee, Dr. L. Emmett Holt, one of the leading specialists in children's diseases, stated as follows:—

"For infants during the first year a quart of milk a day is necessary. For the second year, a pint and a half. There is no food as economical at present prices for the nutrition of infants as milk.

"The habit of giving tea and coffee to young children is positively injurious. For children between the ages of two and six years the daily ration of milk should be one pint per day as a minimum.

"Dr. Lucas, of Berlin, found very greatly increased susceptibility to tuberculosis as a result of under-feeding, particularly among children. I should think that after six years of age up to twelve or thirteen years, a pint of milk a day ought to be allowed to all children."

Professor Sherman, in his testimony, said:—

"We cannot expect a good community dietary if that community uses less than one-half quart of milk per capita per day. Unless there was that amount of milk the dietary would be seriously one-sided. The milk has exceptional value as a food for growth due to the so-called vitamins."

"It is the most important single food for adults. It is more economical to produce than meat. A man confined to a bread and meat diet will show deficiencies, while a man confined to a corresponding bread and milk diet will go on indefinitely. A vegetable diet will always be improved by an addition of milk. If it was a question of one or the other, I think it important that a man have milk rather than meat."

Professor Graham Lusk, in his testimony, says:—

"No family of five should buy meat until they have bought at least three quarts of milk. Milk contains not only protein of animal origin, but also a very valuable fat which has specific properties for growth. It also contains in aqueous solution materials which prevent the development of beri-beri and pellagra. Milk is the cheapest form of protein you can get. It is the most complete and sufficient food that can be had. Around the dairy farms centres the proper nutrition of a nation."

How much milk should be used for drinking purposes by New York City?—If we use the quantities recommended by Professors Sherman and Lusk, the city would consume the following amounts daily:—

Age.	Population.	Quarts of Milk which should be used daily.	
		Each.	All
Under 1 year	130,500	1	130,500
1-2 years	126,700	(1½ pt.)½	95,025
2-6, 6-14 years	1,387,900	(1 ")½	693,950
Over 14 years	4,092,332	(1 glass)½	1,023,098
Total	5,737,492		1,942,573

Milk which New York City should drink—1,942,573 quarts daily.

Actual amount used for drinking is probably about 707,486 quarts daily.

The food value of milk has been unappreciated by the public at large. While as a food for babies it is well known, it has been thought that it was not adapted to adults on the supposition that it contained less strength-giving materials than the so-called solid foods. Solidity in food is a mere incident due to the presence of fibre which holds vegetable and animal substances in shape. As a matter of fact, all food must become liquid in form before it can be assimilated. The liquid character of milk simply means that it is entirely free from the presence of any waste material. It is all food and in form which is most easily digested and assimilated by adults as well as infants.

For infants it is not merely a convenient food, but because of the presence of the so-called vitamins or growth-stimulating substances, it is vitally necessary for the development of infants and children. Its value as a food for adults is just beginning to be appreciated. It furnishes to the body those materials which are most necessary for the increase of strength and endurance.

It is believed by those who have investigated the subject that the nations and races of men which have done most in the development of the world, and have shown the greatest physical strength and vigour, are those nations which have depended to the largest extent on dairy products and milk for food.

ECONOMIES IN PRODUCTION.

ECONOMIES IN PRODUCTION. (Pp. 72-77.)

Larger Producing Cows.

For many years dairy farmers have been well aware of the economies in milk production resulting from the keeping of dairy cows which are large producers.

Numerous cow-testing associations have as their primary purpose the testing of cows in local dairy herds, in order to inform the dairymen as to those animals which are low and unprofitable producers and those animals which are high and profitable producers. Numerous statistics have been compiled to show the cost of producing milk as it is modified by the productivity of the individual dairy cow. A good example of this difference is shown in bulletin No. 501—United States Department of Agriculture—entitled "A Study in the Cost of Producing Milk on Four Dairy Farms." These figures are taken from data compiled several years ago on costs much lower than present costs. They show clearly, however, the relation of the productivity of the cow to the cost of milk, for the reason that the same costs were applied alike to all cows at that time:—

Production in Pounds							Cost of 100 lbs. of Milk.		
Per Cow.							\$	s.	d.
2,349	...	...	...	...	...	...	3.57	14	7-81
3,648	...	...	...	...	...	...	2.59	10	7-54
4,596	...	...	...	...	...	...	2.29	9	4-77
5,450	...	...	...	...	...	...	2.10	8	7-41
6,445	...	...	...	...	...	...	1.86	7	8-79
7,513	...	...	...	...	...	...	1.79	7	4-15
9,049	...	...	...	...	...	...	1.70	6	11-71

Another set of figures were presented by Professor W. P. B. Lockwood, of Massachusetts Agricultural College, in his testimony before the Committee. He showed statistics compiled by him indicating the following results:—

Production Per Cow						Cost Per Quart.	
Per Year.						\$	Pence.
Less than 5,501 lbs.	...	...	...	...	...	.0721	3-549
5,501—7,500 lbs.	...	...	...	...	...	.0624	3-073
Over 7,500 lbs.	...	...	...	...	...	.0552	2-718

The third set of figures was presented in the testimony of Professor George C. White, of Connecticut Agricultural College, Storrs, Connecticut. These results have been tabulated in the form of the charts shown on page 74 (reproduced on page 79).

The productivity of the dairy cows supplying milk to New York City market averages not more than 4,500 lbs. per cow per year. In the above tabulation such cows make milk at a cost of about 7 c. per quart, which price corresponds closely with the cost as determined by all of the data compiled on cost of production of the city's supply. There is no doubt that if the city's supply came from cows which were large producers the cost of production would be considerably reduced.

From this it appears that, in herds containing over ten cows, the production per cow and the cost per quart of milk gave the following figures:—

Production Per Cow						Per Quart.	
Per Year.						c.	Pence.
Over 7,500 lbs.	...	...	...	...	...	4.74	2-34
6,500—7,500 lbs.	...	...	...	...	...	5.48	2-70
5,500—6,500 lbs.	...	...	...	...	...	5.60	2-76
4,500—5,500 lbs.	...	...	...	...	...	5.82	2-86
Under 4,500 lbs.	...	...	...	...	...	7.02	3-46

Only a small percentage of the dairymen supplying New York City are members of the cow-testing associations. There is no doubt that there is a large percentage of cows standing in the herds of dairymen producing milk for New York City which are low and unprofitable producers of milk. These animals can be eliminated immediately by fattening and selling for beef. They are actually an expense to the dairyman, and add an item to the cost of milk which is an improper tax on the consumer.

Larger Dairies.

Another factor which has not received the attention it deserves is the size of the dairy herd itself. It makes a great difference how many animals are included in the dairy herd. It is one thing for a farmer to devote his time and attention to the care of one dairy cow, and quite another thing for him to attend to the care of a large herd. The cost of keeping a cow by herself and as a member of a larger herd are very different.

It is clear that a number of the expenses included in the cost of production do not increase as rapidly as the size of the herd. This is well illustrated in a review of the statistics of 178 herds reported in Bulletin No 7 of the Connecticut Agricultural College.

When these herds are arranged in order of size, with the corresponding costs of milk production, it appears that herds of 50 or 60 cows produced milk at a cost of 4.65 cents per quart, while herds of only 7 to 10 cows produced milk at a cost of 6.67 cents per quart. If only these herds are selected which contain cows producing over 6,000 lbs. of milk per cow annually, we find that there are 85 of these, and that the decrease in the cost of production as the size of the herd increases is even more regular.

The results are shown in the chart on page 76 (reproduced on page 79).

The figures in this chart in the form of tabulation show the following:—

Number of Herds.						Number of Cows in Herd.		Cost per Quart.	
								c.	Pence.
6	...	...	...	...	...	30—40		4.65	2.29
21	...	...	...	...	...	20—30		4.97	2.45
45	...	...	...	...	...	10—20		5.45	2.68
13	...	...	...	...	...	7—10		5.92	2.92

Collective Hauling.

Statistics from 11 milk shipping stations show that 453 farmers' wagons are used to haul to the station 1,181 forty-quart cans of milk. This is a little less than three cans to a wagon, the average distance of the dairy farms being under three miles. On a two-horse country truck it is possible for one man to haul 30 forty-quart cans of milk. Through collective hauling by such trucks at these 11 stations it would require only 44 such wagons to haul the same milk that was hauled by the 453 wagons.

If these figures should be applied to the entire milk supply of the city, it would mean that there were now 12,000 farmers' wagons carrying milk from dairy farms to shipping stations, which could be carried by only 1,250 wagons. In other words, there are ten times as many farmers hauling milk to shipping stations as there need be. These figures are probably somewhat exaggerated, as many large shipping stations have instituted a system of collective hauling. It seems certain, however, that the duplication of wagons hauling milk to country shipping stations is much greater than the duplication of wagons delivering milk in the city. It is obvious that the saving through the institution of a proper system of co-operative hauling would be very great, and that this saving would be felt by the consumer who eventually must pay the bills for this service.

Collective Buying of Grain.

The largest single item in the cost of milk is the cost of grain. Little success has resulted from attempts so far made at collective buying. The dairymen shipping milk to New York City use approximately 671 car loads of grain per month, each car carrying 25 tons, amounting to 16,780 tons of grain, at \$55.00 per ton, which is \$923,230.00 per month, or \$11,078,760.00 per year. This makes the dairymen supplying milk to New York City, as a group, the largest single customer of grain in the world. It seems fair to assume that if this grain were purchased through one agent, and the size of the order were guaranteed, some consideration ought to be given to the size of the order. Inquiry of one of the largest grain merchants of the New York Produce Exchange has elicited a reply which is in part as follows:—

"The ordinary dairyman is not usually in a position to buy feed in car load lots, and must therefore buy from a retail dealer, who must charge about 10 per cent. more than he pays for the goods, and not having storage capacity must also buy frequently, preventing him from availing himself of markets when they are lowest. Collective buying through a purchasing agent of immense quantities makes possible purchases whenever the markets warrant, and the buying of enough to tide over what might appear to be a steady rising market. Under these conditions there should be saved at least 10 per cent. on the purchase of feed, as compared with the system under which feed is now purchased.

ECONOMIES IN DISTRIBUTION. (Pp. 79-81.)

Centralising Distribution.

In the report of the Milk Committee appointed by the Food Controller for Canada, published November 24th, 1917, the Committee says that the cost of distribution, or the "distributors' spread," varied, from the evidence submitted, from 2.75c. to 6.50c. per quart, depending on local conditions, and that this excessive spread is chiefly caused by the excessive number of distributors, and varies about in the same ratio as the number of distributors. For example, in Ottawa, where one dairy handles about 75 per cent. of the milk supply, the "spread" is only 3.25c. per quart, while in Toronto, where there are about 90 distributors, it is 5.25c. per quart. The Committee says, further, the effects of the unnecessary duplication are:—

- (a) Excessive capital employed.
- (b) Excessive dairy costs.
- (c) Overlapping in delivery.
- (d) Excessive loss in bottles.
- (e) Diversion of great numbers of men and horses from productive employment.

In addition may be mentioned duplication of administration costs, selling costs, properties (including real estate, buildings, and machinery, both country and city).

On this subject Mr. Weiant, President of the Borden's Farm Products Co., Inc., in his testimony stated, "There are operating expenses in the country that are duplicated and could be removed. It would be possible to have full cars come through instead of part cars. Pasteurising plants could maintain a full flow and at a maximum capacity. Wagons could be filled to capacity and operated in a small area. If the plan were worked out completely, there would be necessarily no duplication. I believe if the dealers are given an opportunity to work on that problem they will solve it.

The data collected by this Committee shows that there is duplication of effort in the country at collecting stations, inefficiency in transportation because of broken car load lots, duplication in hauling from railroad platforms to the city, duplication of bottling and pasteurising in city stations, and, above all, duplication in the delivery wagons on the streets.

Statistics of the delivery system suggest saving that would result from the elimination of competition and the substitution of a single-service delivery. The statistics for the New York City are as follows:—

Bottled Milk Supply	...	...	...	...	...	704,318 quarts.
Milk in Cans	...	...	...	...	...	896,405 "
Retail Wagons	...	...	...	...	...	4,978 "
Wholesale Wagons	...	...	...	...	...	1,522 "
Average Load of Retail Wagons	...	...	...	...	...	142 "
Average Load of Wholesale Wagons	...	...	...	...	...	14.7 cans.

Investigation shows that the minimum load for a retail wagon is 428 quarts, consequently if the total volume of retail milk, amounting to 704,318 quarts, were carried on retail wagons handling only full loads, the bottled milk of New York City would be handled by only 2,243 retail wagons instead of the 4,978 actually in use at the present time. This would mean only 45.3 per cent. on the present number, or a saving of 54.7 per cent. of the total.

In wholesale milk the minimum load for a two-horse wagon operated by one man is 75 cans per day. If all the wholesale milk, amounting to 896,405 quarts, or 22,410 cans, were carried on wagons handling only maximum loads, the number of wagons required would be only 300, as compared with the 1,522 wholesale wagons now operating. This would be a saving of 81.3 per cent.

These estimated savings of 54.7 per cent. on retail wagons and 81.3 per cent. on wholesale wagons are, of course, ideals assuming a perfect delivery system in every section of the city and that every wagon carries only a full load. Under practical conditions this would be impossible, even if delivery were in the hand of a single public service corporation.

For a number of years milk has been retailed in Philadelphia for 2 cents less than in New York City. Philadelphia retail loads have averaged 300 quarts to the wagon, while in New York retail loads have averaged less than 200 quarts to the wagon. This difference in load is chiefly responsible for the difference in retail price.

In the city of Ottawa, Canada, 75 per cent. of the business is in the hands of one distributing firm, which operates at a margin of only 3.25 cents above the cost of production, as compared with the margin of distribution in Philadelphia of 5 cents and in New York of 7 cents.

The Milk Committee appointed by the Food Controller for Canada reported on November 24th, 1917, in favour of the "unification and reorganisation of the milk distributing business," and cited the experience in the adoption of a single delivery system of the City of Regina, Saskatchewan, where a net saving of at least 1½ cents per quart over the previous cost of milk resulted from the adoption of this system.

SUMMARY OF FOREIGN AND COLONIAL LAWS OTHER THAN THOSE OF UNITED STATES RELATING TO MILK.

Classification.—Laws relating to:—

- Milk.
- Certified Milk.
- Pasteurised Milk.
- Sterilised Milk.

MILK.

CANADA. (*November 14th, 1910.*)

Definition.—Fresh, clean, and unaltered product, obtained under proper sanitary conditions, of healthy cows, excluding that obtained within two weeks before, and one week after calving, and contains—
not less than 3.25 per centum of milk fat, and
not less than 8.5 per centum of milk solids other than fat.

COMMONWEALTH OF AUSTRALIA. *Statutory Rules, 1913* 347.

Definition.—Milk shall be the milk of cows, whether mixed or not; it shall contain not less than 3.0 per centum of butter fat, nor less than 8.5 per centum of solids not butter fat.

SOUTH AUSTRALIA. *Sale of Foods and Drugs Act. No. 968, 1908.*

Section 25 gives powers to fix standards.

Section 31 prohibits sale of milk of diseased cows.

VICTORIA. *Standards of Foods and Drugs. 1916.*

Definition.—Milk from udder of healthy cows, excluding that of seven days after parturition. It shall contain:—

- not less than 12.0 per centum of total solids,
- not less than 8.5 per centum of solids not fat,
- not less than 3.5 per centum of milk fat,
- nor more than 0.9 per centum of ash, nor any foreign substance.

Note this excludes any preservatives, but does not exclude milk in month before parturition.

TASMANIA. *Regulations under Food and Drugs Act, 1910.*

Definition.—Milk shall be the normal, clean, and fresh secretion obtained by completely emptying the udder of the healthy cow, properly fed and kept, excluding that got 15 days immediately before and 10 days after parturition.

- It shall contain more than 8.5 per centum solids not fat,
- shall contain 3.5 per centum milk fat,
- shall contain 12.0 per centum total solids.

The freezing point of milk shall be not higher than 0.55° C.

Further regulations prohibit the handling of milk by persons suffering from phthisis, chronic cough, or venereal disease; and also prohibit the exposure of milk to contamination by dust or flies.

These regulations, which came into force on September 1st, 1911, would tend to secure the handling of milk under clean conditions.

WESTERN AUSTRALIA. *Health Act of 1911. (No. 34).*

Section 169. Excludes—Impure and unwholesome milk; or milk from diseased animals; or milk obtained within 30 days before or 5 days after parturition.

Section 172. Prohibits the sale of stale milk.

This prohibition is important as it forbids the sale of milk once sent out for delivery and returned to the retailer, except for industrial purposes. Such a prohibition prevents the sale of milk already stale but treated or pasteurised to prevent its being obviously sour. Such milk contains the products of bacterial activity, and differs chemically from pure sound milk. It frequently curdles when warmed in the house of the consumer owing to these chemical changes although not obviously sour when purchased from the retailer.

WESTERN AUSTRALIA. *Regulations under Health Act (Amendment) of 1918.*

Definition.—It shall contain 8·5 per centum solids not fat; shall contain 3·2 per centum milk fat; shall contain 11·7 per centum total solids.

The remarkable feature of this definition is the low content of milk fat permitted, viz., 3·2 per centum. The next lowest, New Zealand, requires 3·25 per centum, but all the other Australasian colonies stick to 3·5 per centum and this appears sufficiently low to include genuinely sound milk.

NEW ZEALAND. *Regulations under Food and Drugs Act.*

Definition.—Milk shall be the normal, clean, and fresh secretion obtained by completely emptying the udder of the healthy cow, properly fed and kept, excluding that got during seven days immediately following on parturition.

It shall contain not less than 8·5 per centum solids, not fat; shall contain 3·25 per centum milk fat.

It shall not contain any added water nor any foreign substance.

This definition, though allowing a low content of milk fat, expressly excludes the addition of any preservatives.

DENMARK. *Sekretæren, Landburgsministeriet, København. 11/4/19.*

'Just now (11th April, 1919) nothing can be said about the proper fixation in normal times of the lower limits for fatty substances or total solids.' Landburgsministeriet, København.

SWITZERLAND. *Regulations—Berne, 1919. Manuel Suisse des Denrées Alimentaires.*

Definition.—Milk from well-nourished cows; specific gravity, 1·030 to 1·033; fat content, minimum 3 per centum; total solids, minimum 12 per centum; solids other than fat, 8·5 per centum; acidity, maximum 9°; freezing point, between 0·54° and 0·57°; clotting in less than 20 minutes; leucocytes less than 0·05 per centum by volume.

This is a somewhat exhaustive definition.

As regards the freezing point, it is suggested that tuberculosis, and other febrile disorders, will raise the freezing point of the milk from such diseased cows to 0·48° C.

CERTIFIED MILK.

CANADA.

Milk sold as certified milk shall comply with the following requirements:—

- (a) It shall be taken from cows semi-annually subjected to the tuberculin test, and found without reaction.
- (b) It shall contain not more than 10,000 bacteria per cubic centimetre from June to September, and not more than 5,000 bacteria per cubic centimetre from October to May inclusive.
- (c) It shall be free from blood, pus, or disease producing organisms.
- (d) It shall be free from disagreeable odour or taste.
- (e) It shall have undergone no pasteurization or sterilization, and be free from chemical preservatives.
- (f) It shall have been cooled to 45° Fahr. within half an hour after milking, and kept at that temperature until delivered to the consumer.
- (g) It shall contain 12 to 13 per centum of milk solids of which at least 3·5 per centum is fat.
- (h) It shall be from a farm whose herd is inspected monthly by the veterinarian, and whose employees are examined monthly by a physician.

These regulations for certified milk are precise and somewhat exacting. One of the most important is (e) in that it requires the milk to be produced under clean conditions, and does not allow any "doctoring" or "cooking" of dirty milk to pass the requirements of (b). This means that the milk is sold to the consumer without any of the chemical changes produced by either bacteria or heat. The value of fresh milk as an infant's food depends in part at least upon the presence of certain accessory food substances or vitamins, and as these are unstable it is important that the milk is subjected to no treatment that may destroy them.

PASTEURISED MILK.

CANADA. (Ottawa, November 14th, 1910.) *Department of Inland Revenue. Standard of Quality.*

Definition.—Pasteurised milk is milk that has been heated below boiling, but sufficiently to kill most of the active organisms present; and immediately cooled to 45° F. or lower, and kept at a temperature not higher than 45° F. until delivered to the consumer, at which time it shall not contain more than 10,000 bacteria per cubic centimetre.

Note that this is rather a vague definition. It does not prescribe any definite period of heating or temperature to be attained; neither is it specified that the heating must suffice to kill the commoner pathogenic bacteria, *e.g.*, *B. tuberculosis*.

The Dominion Dairy Conference, held at Ottawa, November 25th-28th, 1918, in their report on page 14 change the bacterial content to 100,000 per cubic centimetre, without reason given.

Further on page 57 they record a recommendation for the pasteurisation of milk and cream in the manufacture of all butter made in Canada, and urge its adoption at once.

After discussion, wherein lower temperatures were condemned as ineffectual, the Conference decided that the standard minimum for pasteurisation should be a temperature of 170° Fahr. held for at least ten minutes (page 75).

This recommendation of the Conference on the pasteurisation of milk for butter-making is further supported by a resolution (page 78) that the Dominion Government be requested to make it compulsory to pasteurise or sterilise all dairy factory by-products.

The importance of sterilising dairy factory by-products, *e.g.*, separated milk, was demonstrated by reference to the large proportion of swine affected with tuberculosis, the number for all Canada being 19.04 per centum. Dr. F. Torrence, Veterinary Director-General, points out that this tuberculosis arises by infection conveyed in milk from tuberculous cattle (pages 75 and 76).

If there be a necessity to pasteurise milk and milk by-products to save swine from tuberculosis, it adds another argument to the case for the protection of the human subject from infection by the same means.

PASTEURISED MILK.

COMMONWEALTH OF AUSTRALIA. *Statutory Rules*, 1913. 347.

Pasteurised means subjected to heat in such a manner as to destroy fully developed micro-organisms but not necessarily the spores thereof.

This definition is rather an explanation of what happens to milk subjected to heat than a requirement of any specific process. It depends entirely on what bacteria are at present in the fresh milk.

VICTORIA. *Standards of Foods and Drugs*, 1916.

Definition.—

Pasteurised milk is milk heated to 156° F. (69° C.) for 20 minutes
 " " " " 165° F. (73.9° C.) for 10 minutes
 " " " " 170° F. (76.7° C.) for 5 minutes
 and immediately cooled to 10° C.

It shall not contain any living *Bacillus coli*.

Note that this specification insists that pasteurised milk shall be free from *B. coli*, one of the chief putrefactive organisms found in milk.

DENMARK. *Sekretæren, Landburgsministeriet, København*. 11/4/19.

Pasteurisation is understood to mean the heating of milk to 80° C.

The test, devised by Dr. Sterch for testing whether milk has been heated sufficiently, depends on the fact that the enzyme peroxidase contained in fresh milk, is destroyed at this temperature. Hence heated milk fails to give an indigo blue colour reaction with paraphenylendiamine and hydrogen peroxide.

SWITZERLAND. *Manuel Suisse des Denrées Alimentaires, Berne*, 1919.

Definition.—Pasteurised milk is milk freed of pathogenic organisms by heat at a temperature below boiling point, and whose keeping qualities are a little better than unheated milk in consequence of the destruction of lactic fermentation. The important question as to the freedom of pasteurised milk from *Bacillus tuberculosis* can only be solved by inoculation tests.

This definition of pasteurised milk is vague, but the addition of the rider in the last sentence shows that Swiss authorities accept nothing short of boiling as an efficient means of destroying *B. tuberculosis* in milk.

CANADA. (November 14th, 1910.)

Definition.—Sterilised milk is milk heated to 100° C. or higher, sufficiently to kill all micro-organisms present. It must be delivered sterile; and sold in closed containers marked "should be used within 12 hours after opening."

This definition is precise. But the caution as to use within 12 hours is needless and founded on the erroneous idea that, in the absence of lactic acid fermentation, milk is more liable to putrefactive changes.

DOMINION OF NEW ZEALAND.

New Zealand Government Offices,

415, Strand, W.C.2.

31st July, 1919.

SIR,

FURTHER to your correspondence with the Veterinary Officer in March last, in relation to the public administration and legislation governing the milk supply in New Zealand, I now have pleasure, by direction of the High Commissioner, in stating that, having forwarded your enquiry to his Government, he is now in receipt of a reply over the signature of the Minister of Agriculture. A full copy of this is enclosed herewith, and the information will, it is hoped, be of assistance to your Department.

I am, Sir,

Your obedient Servant,

(Signed) P. OSBORNE,

Secretary to the Department.

G. MONTAGUE HARRIS, Esq.,

Intelligence Department,

Local Government Board.

Whitehall, S.W.1.

Memorandum for the High Commissioner for New Zealand, 413-416, Strand, W.C.2.

The same principle has also been introduced at cheese factories on a modified scale. At a large number of these the milk is pasteurized, but in this case it is not found expedient to raise the temperature much above 160°, owing to the fact that the manufacturing process is interfered with when higher temperatures are used.

No arrangements are in existence for the grading or classifying of milk, as sold to the public, and no restriction is placed thereon apart from the regulations under the Sale of Food and Drugs Act, whereby the milk must be up to the standard required in the case of the percentage of butter fat and milk solids other than fat, together with the control exercised in connection with the registration of dairies from which milk is received for human consumption.

A voluntary system of cream grading has been introduced by a number of the dairy companies, and the cream received is therefore classified according to its flavour and general condition. Two grades have been adopted, and a lower price is paid for that of the second grade. All cream is paid for on the basis of its butter fat content—second grade usually at the rate of 1d. per lb. less than that of first grade.

For the Acting Prime Minister.

No.	Date.	Description of shop.	No. of Bacteria per c.c.	Presence or absence of Bacilli Coli.	Tubercle.
	1916				
1	July 4	Cowkeeper	98,000	Present	No evidence
2	"	Dairy and Post Office	500,000	"	"
3	"	Dairy selling eggs and butter ...	3,300,000	"	"
4	" 11	" " " " " " " "	11,000,000	"	"
5	"	Dairy	860,000	"	"
6	"	"	9,000,000	"	"
7	"	"	700,000	"	"
8	" 18	Dairy selling biscuits and tinned food	1,190,000	"	"
9	"	Dairy selling eggs, butter, bread, etc.	4,800,000	"	Microscopic evidence confirmed by guinea pig test.
10	"	Cowkeeper	65,400,000	"	No evidence
11	"	Dairy selling ham, cheese, butter, etc.	1,070,000	"	"
12	" 25	Dairy	279,000	"	"
13	"	Dairy selling tea, butter and bread	531,000	"	"
14	Aug. 29	Dairy	3,695,000	"	"
15	Sept. 5	"	13,180,000	"	"
16	" 20	Cowkeeper	2,250,000	"	"
17	"	Restaurant	5,780,000	"	"
18	"	Dairy selling eggs and butter ...	1,650,000	"	"
19	"	Dairy	8,590,000	"	"
20	Oct. 9	Cowkeeper	12,590,000	"	"
21	"	Dairy selling ham, eggs, butter, tinned foods.	20,300,000	"	"
22	"	"	5,000,000	"	"
23	"	Dairy	466,000	"	"
24	"	"	1,564,000	"	Microscopic evidence confirmed by guinea pig test.
25	"	"	300,000	"	No evidence
26	" 23	"	6,600,000	"	"
27	Nov. 14	Milk dealer and general provision merchant.	104,300,000	"	"

No.	Date 1916.	No. of Bacteria per c.c.	Coli in dilution.	Tubercle.
28	*April 4	12,500,000	280,000	Guinea pig test confirmed by microscopic evidence.

* Sold by a London dairyman as "Certified Milk, in Glass Bottles. Direct from Farm to Customer."

It will be noticed that every sample contained *Bacillus Coli*, a micro-organism derived from manure.



DECREASE IN COST OF PRODUCING MILK AS AMOUNT OF MILK PER COW INCREASES

Based on data from Bulletin No 7

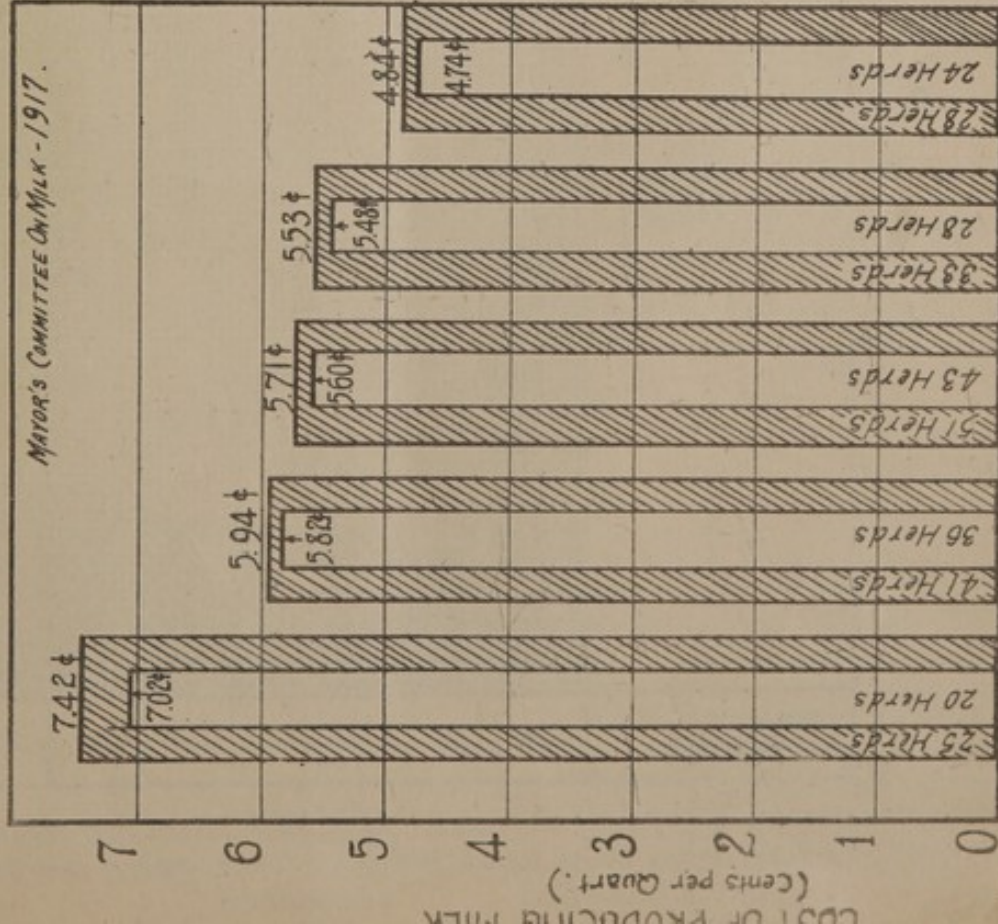
Connecticut Agricultural College

Extension Service

For all 178 herds listed

For 171 herds containing

over 10 cows



DECREASE IN COST OF PRODUCING MILK AS SIZE OF HERD INCREASES.

Based on data from Bulletin No 7

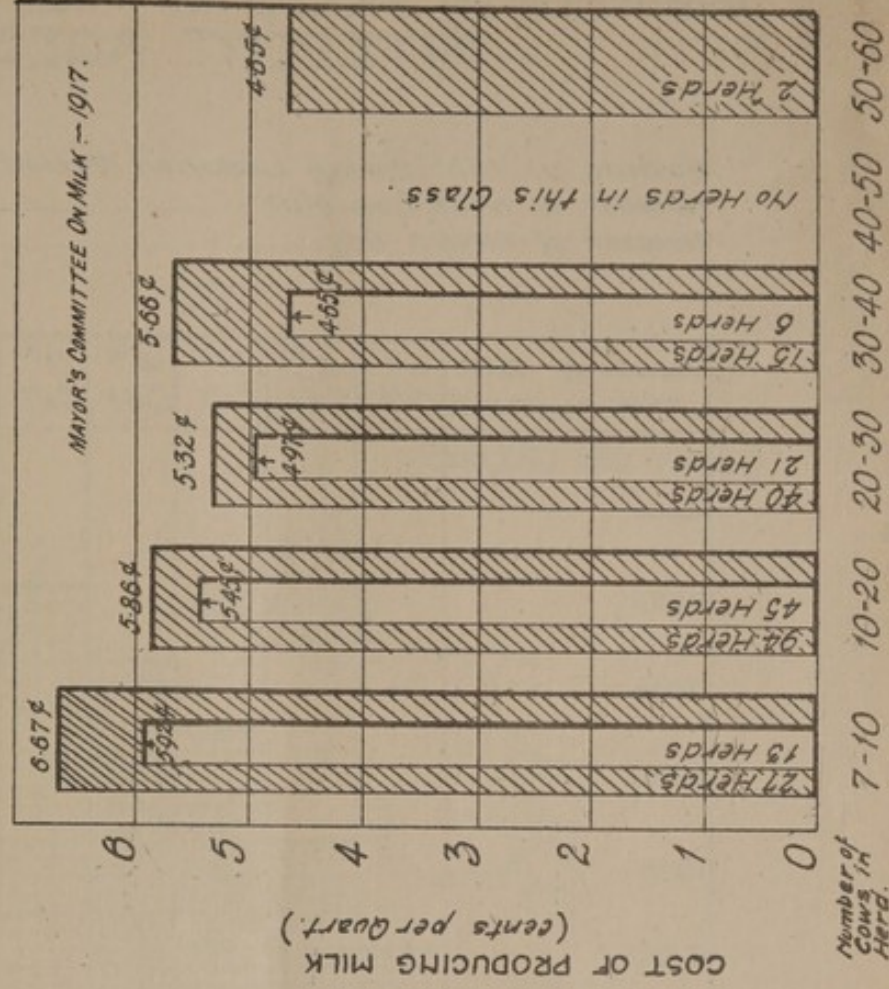
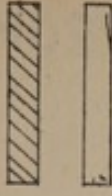
Connecticut Agricultural College

Extension Service

For all 178 herds listed

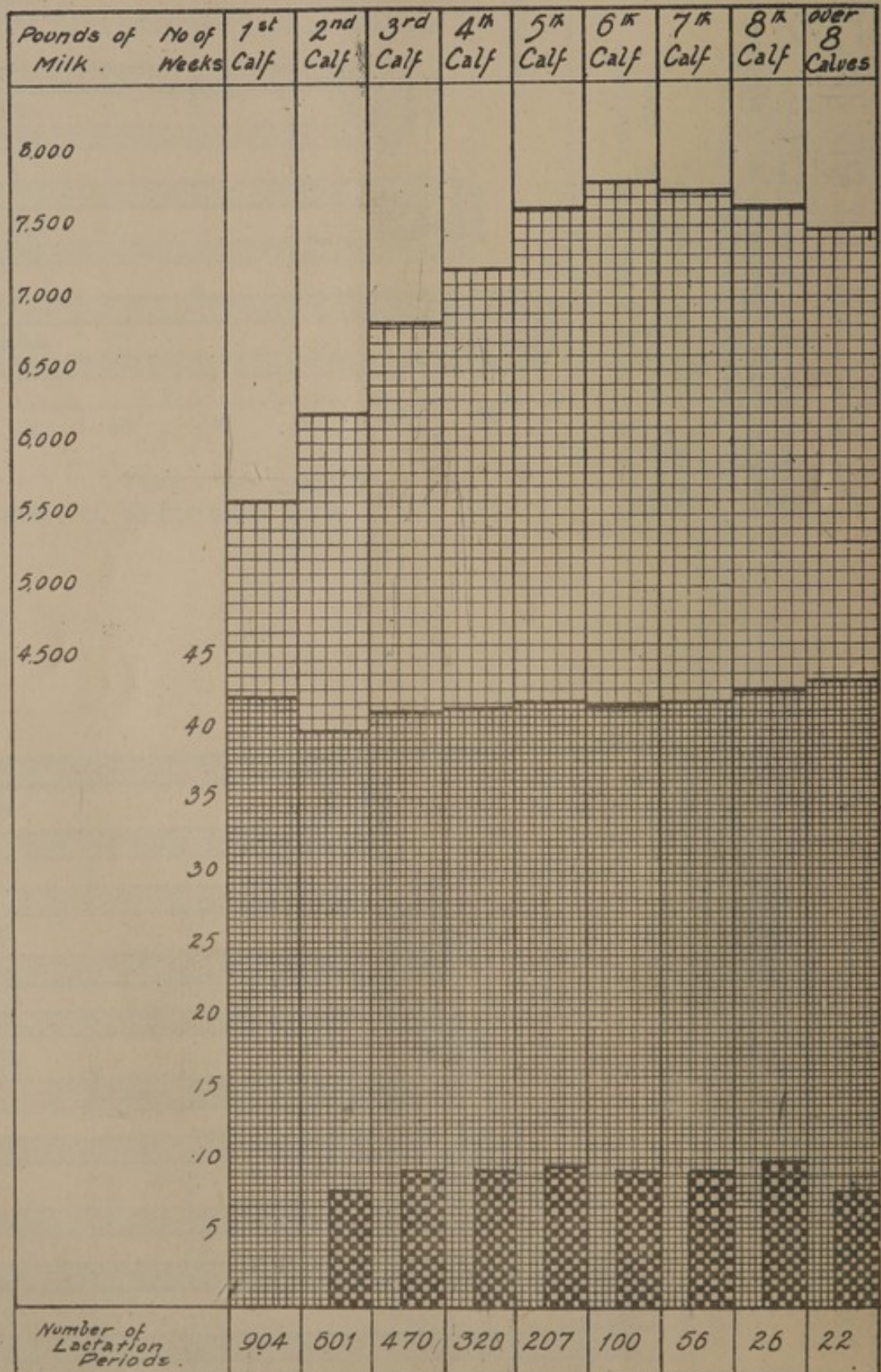
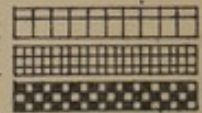
For 85 herds producing over

6000 lbs of Milk per Cow annually



VARIATION IN YIELDS OF MILK FROM COWS OF DIFFERENT AGES.

Pounds of Milk during Lactation Period _____
 Number of Weeks in Milk _____
 Number of Weeks Dry _____

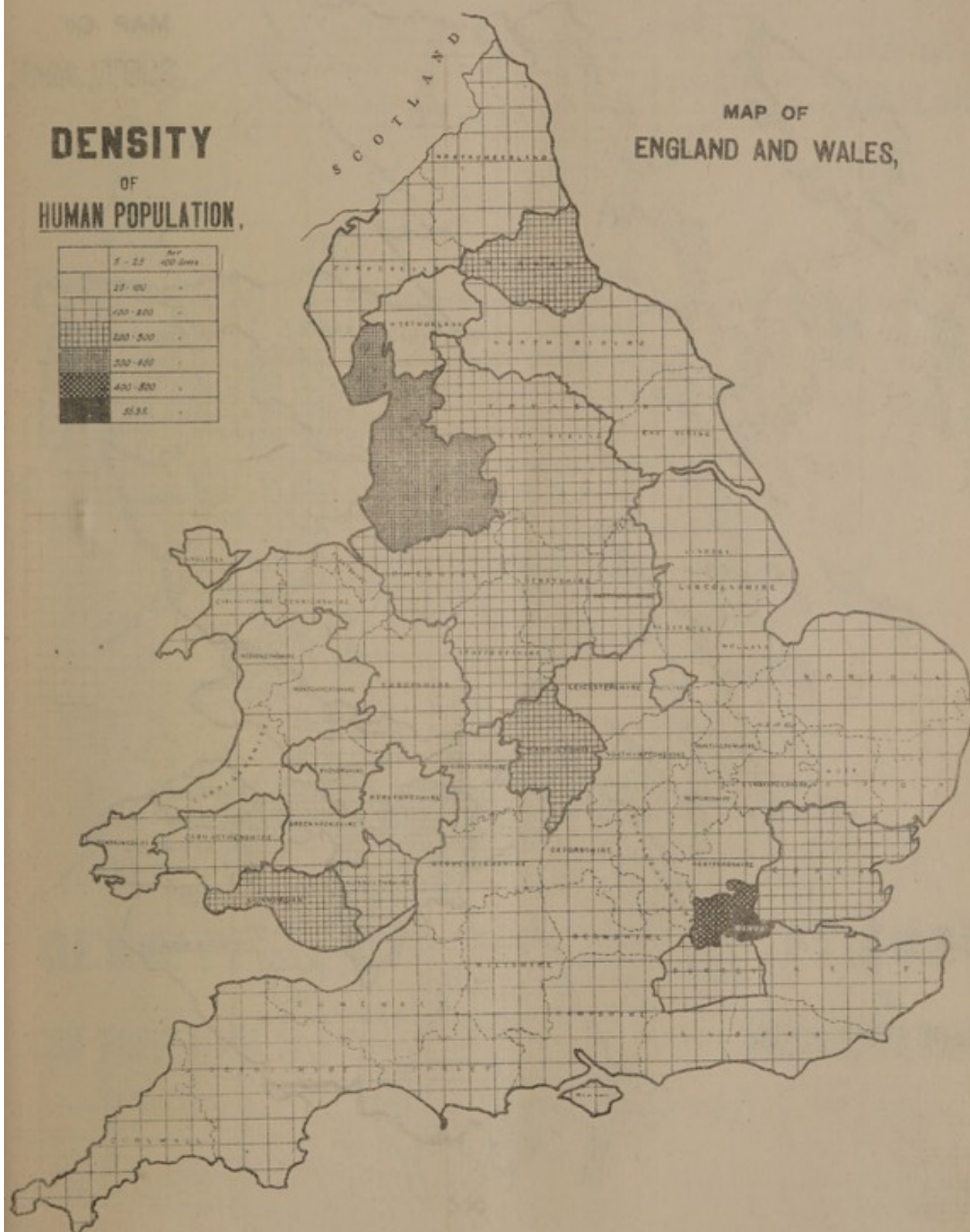


Based on Records covering 2706 Lactation Periods, yields from Cows which did not calve again within 14 Calendar Months (60 weeks) excluded.

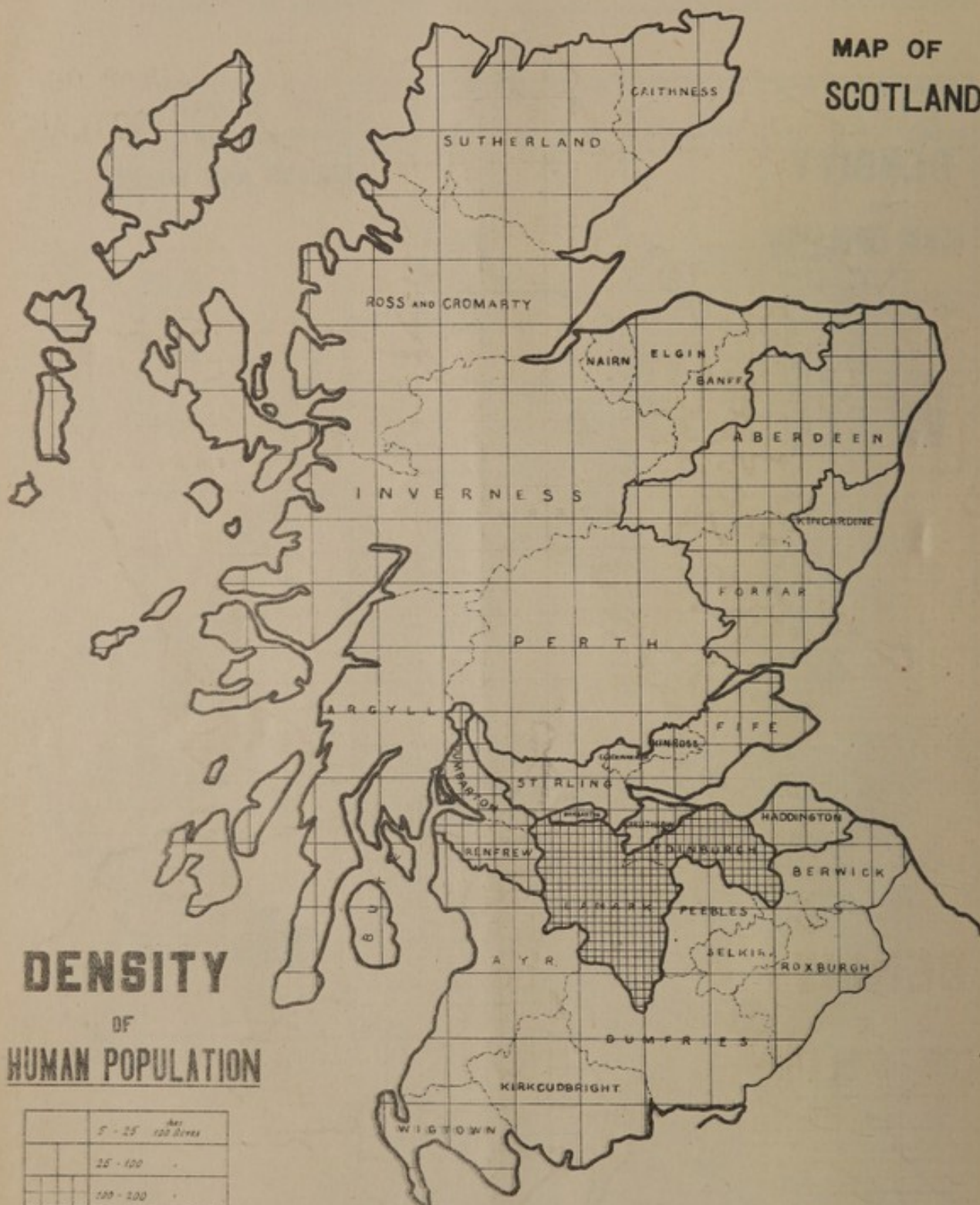
DENSITY OF HUMAN POPULATION.

	1 - 25	per 1000 area
	25 - 100	
	100 - 200	
	200 - 300	
	300 - 400	
	400 - 500	
	500 - 600	

MAP OF ENGLAND AND WALES,



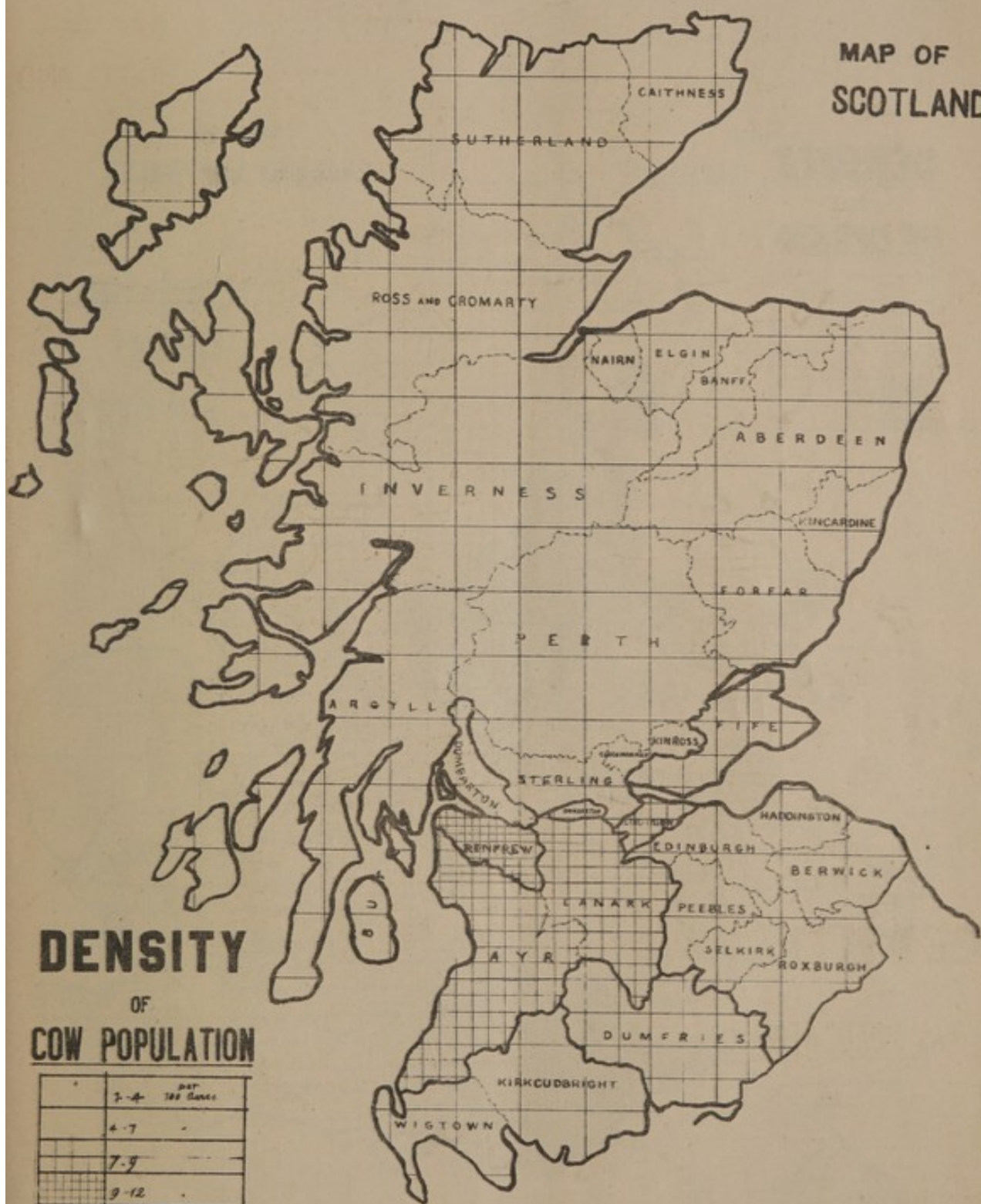
MAP OF SCOTLAND,



DENSITY OF HUMAN POPULATION

	5 - 25	per 100 acres
	25 - 100	
	100 - 200	
	200 - 300	

MAP OF SCOTLAND,



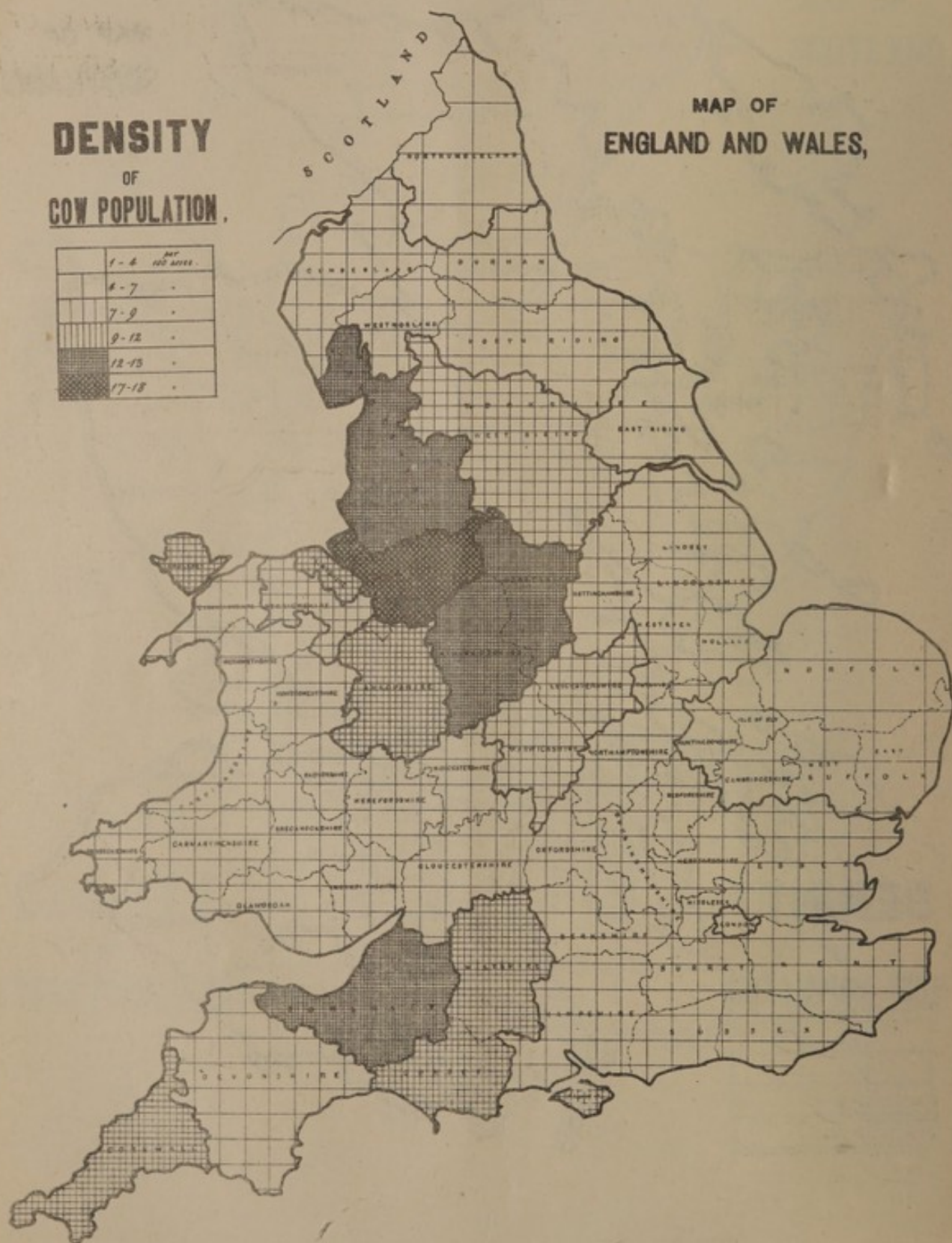
DENSITY OF COW POPULATION

	3-4	per 100 Acres
	4-7	
	7-9	
	9-12	

DENSITY OF COW POPULATION.

	1-6	NOT 100 DIFFER.
	6-7	"
	7-9	"
	9-12	"
	12-15	"
	17-18	"

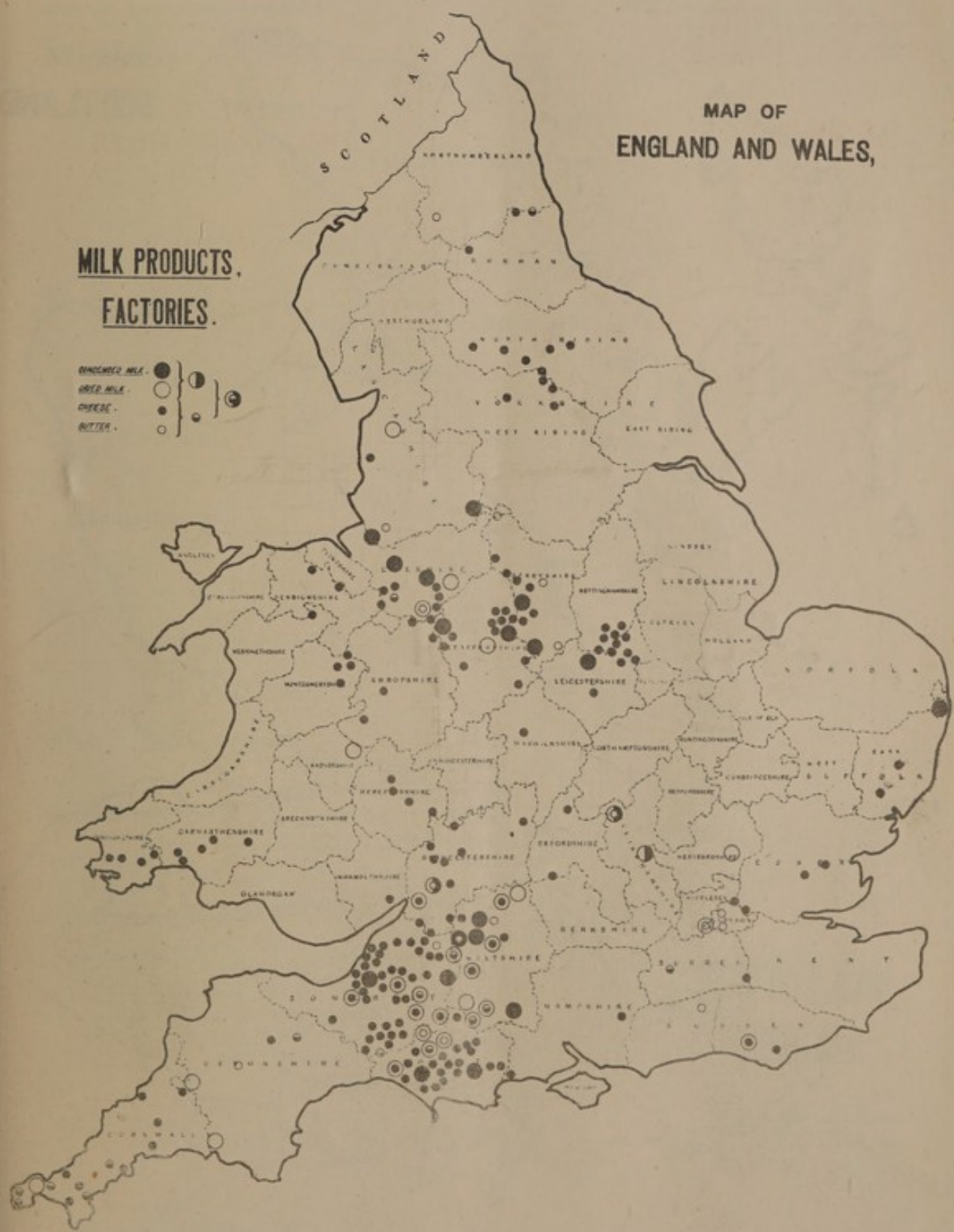
MAP OF
ENGLAND AND WALES,



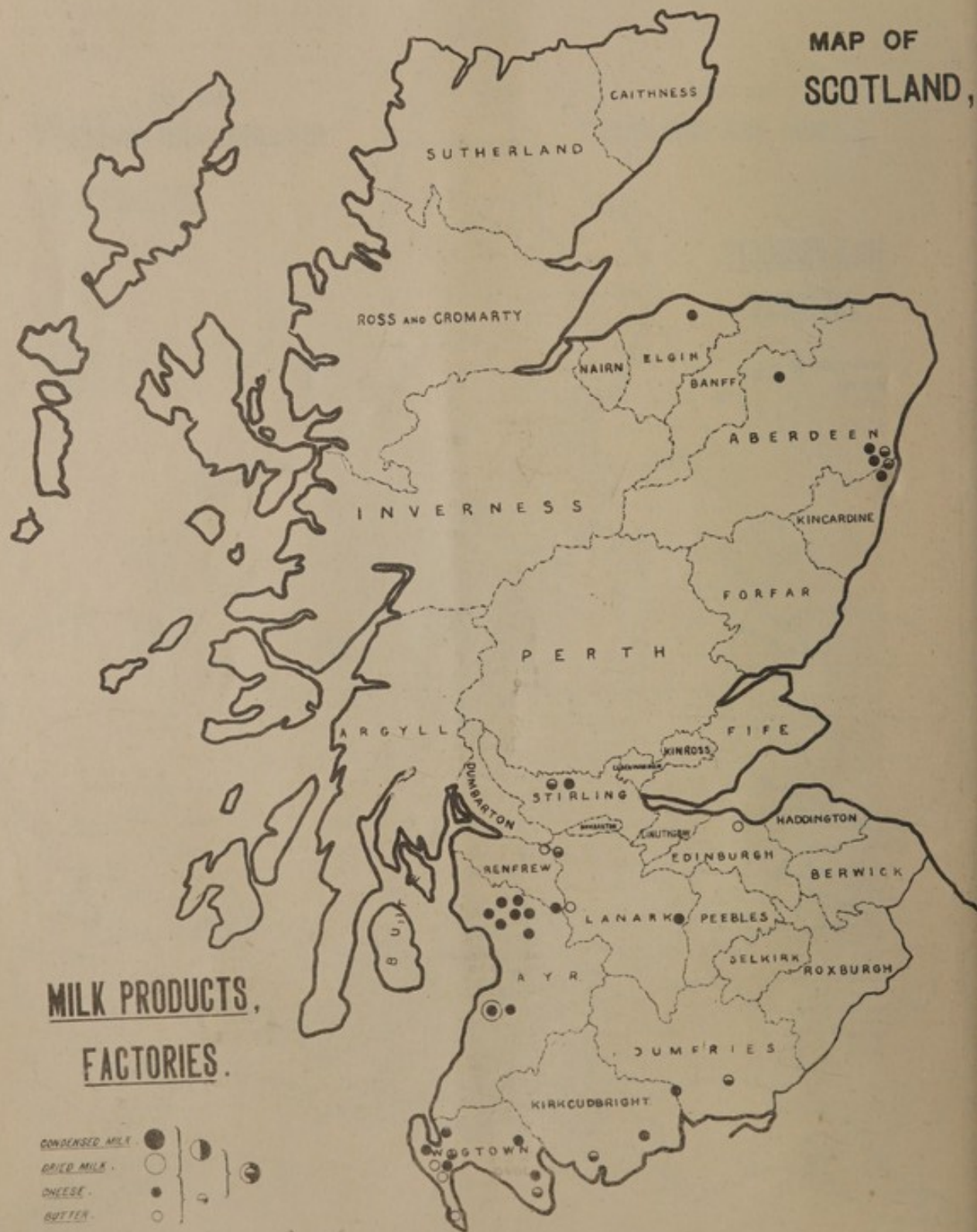
MAP OF
ENGLAND AND WALES,

MILK PRODUCTS,
FACTORIES.

CONDENSED MILK - ●
STERILIZED MILK - ○
CHEESE - ●
BUTTER - ○



MAP OF SCOTLAND,



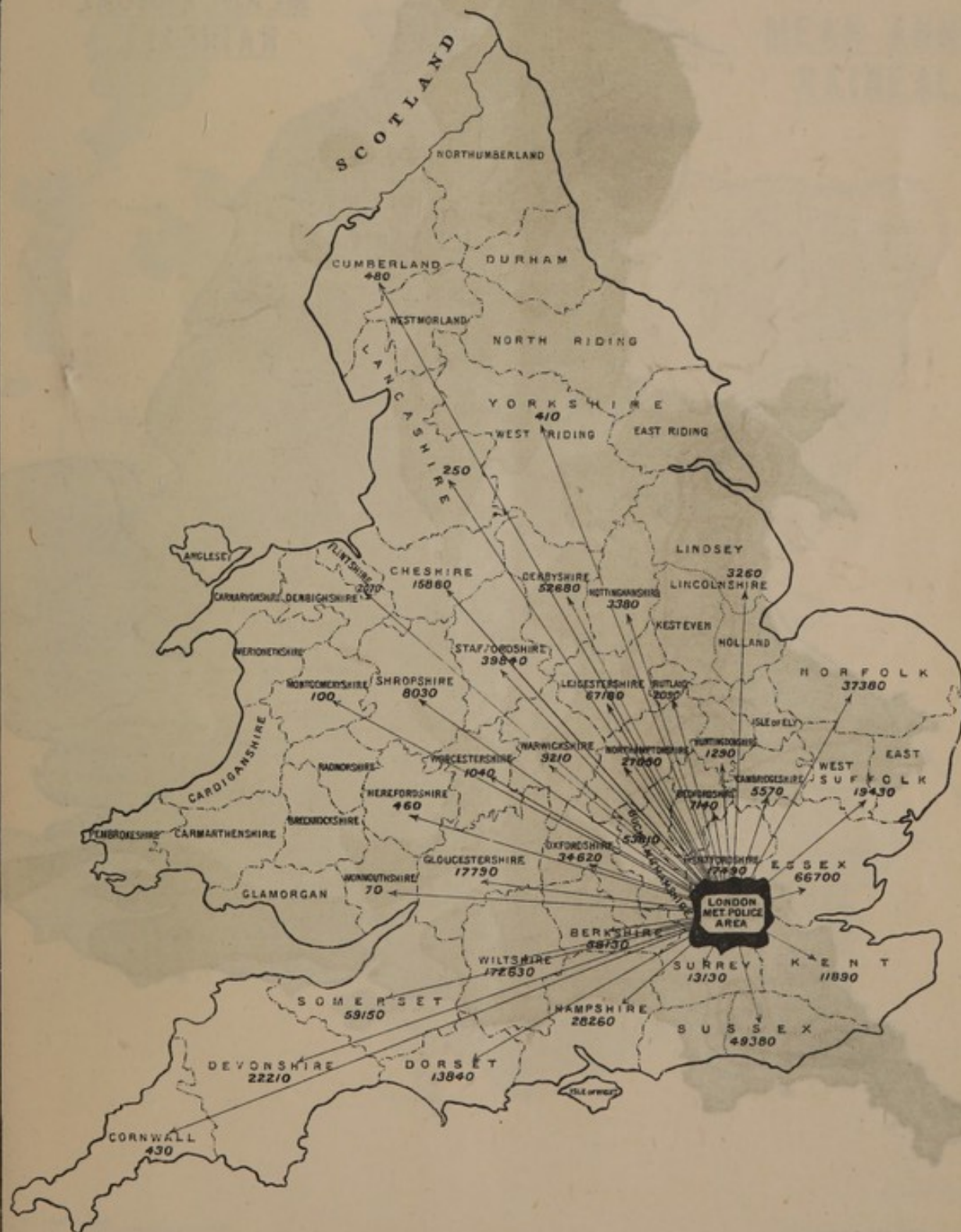
MAP OF ENGLAND AND WALES.

SHOWING

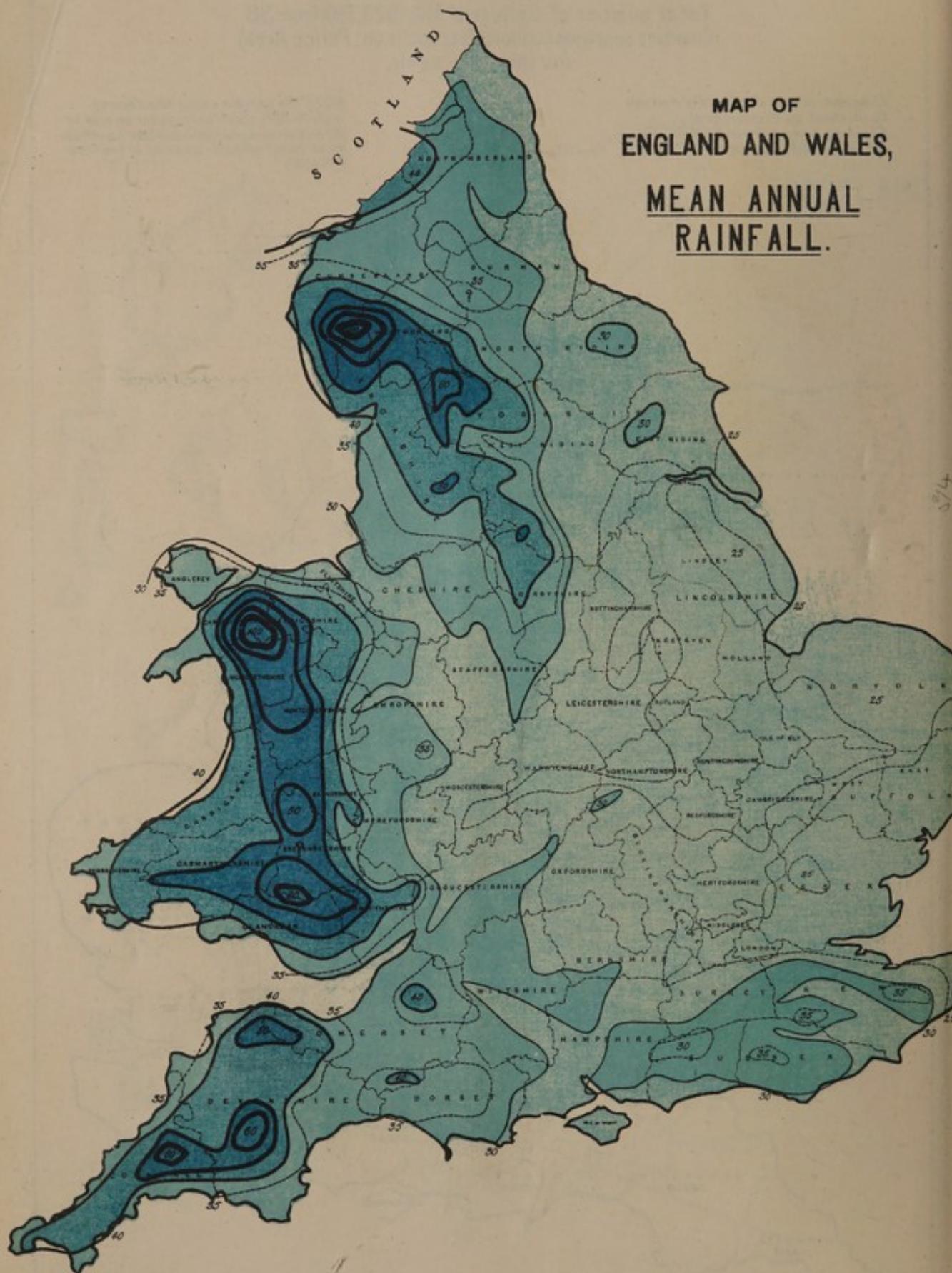
Total number of Gallons of Milk (923,730) from 38
Counties supplying London (Metropolitan Police Area)
during one week.

Diagram drawn from information
furnished by Producers.
Figures taken from CENSUS for
week ended December 7th 1918.

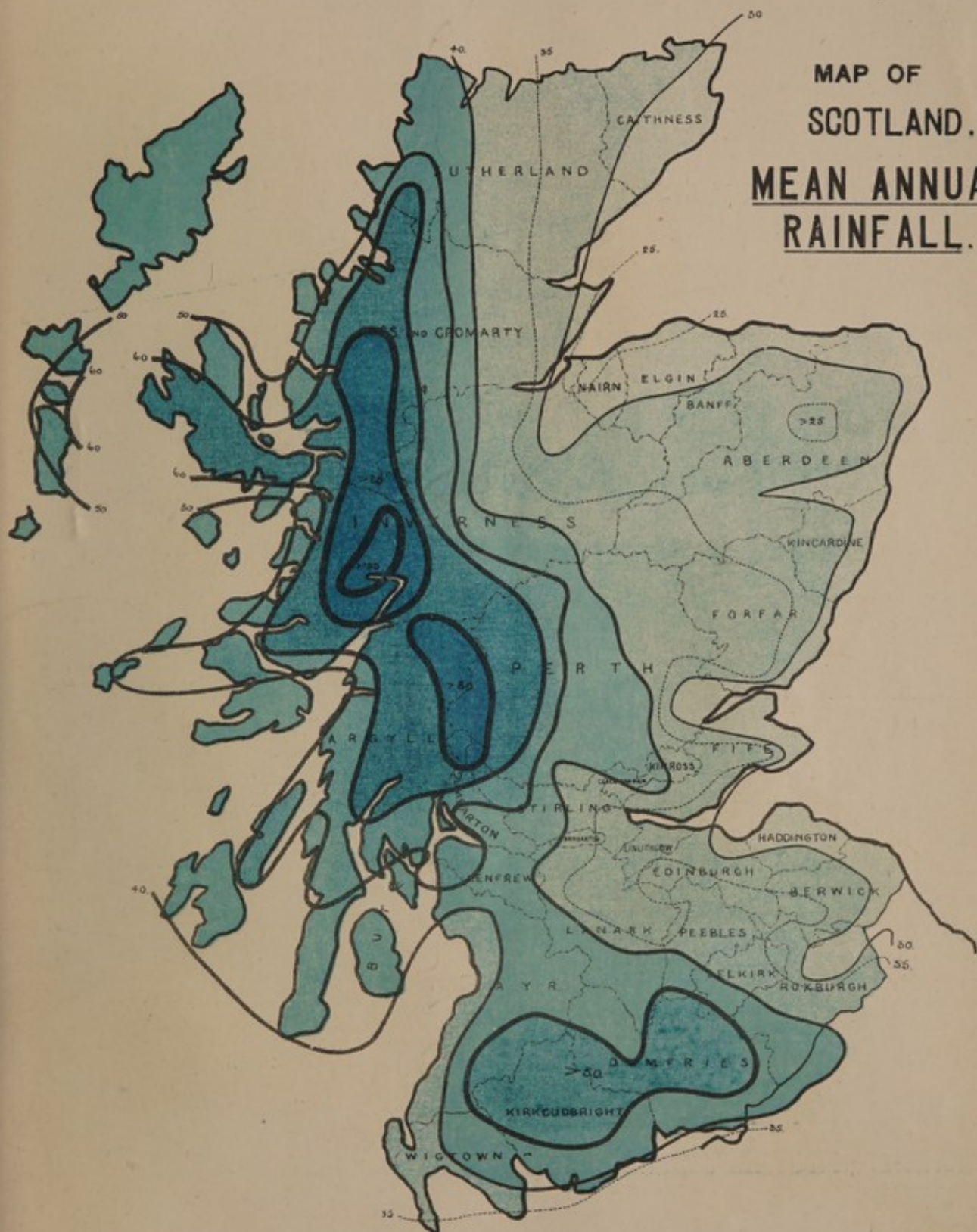
NOTE In certain cases the figures
include Milk shown by Producers as sold in
Distributing Agencies in London: no infor-
mation being available as to its actual des-
tination.



MAP OF
ENGLAND AND WALES,
MEAN ANNUAL
RAINFALL.



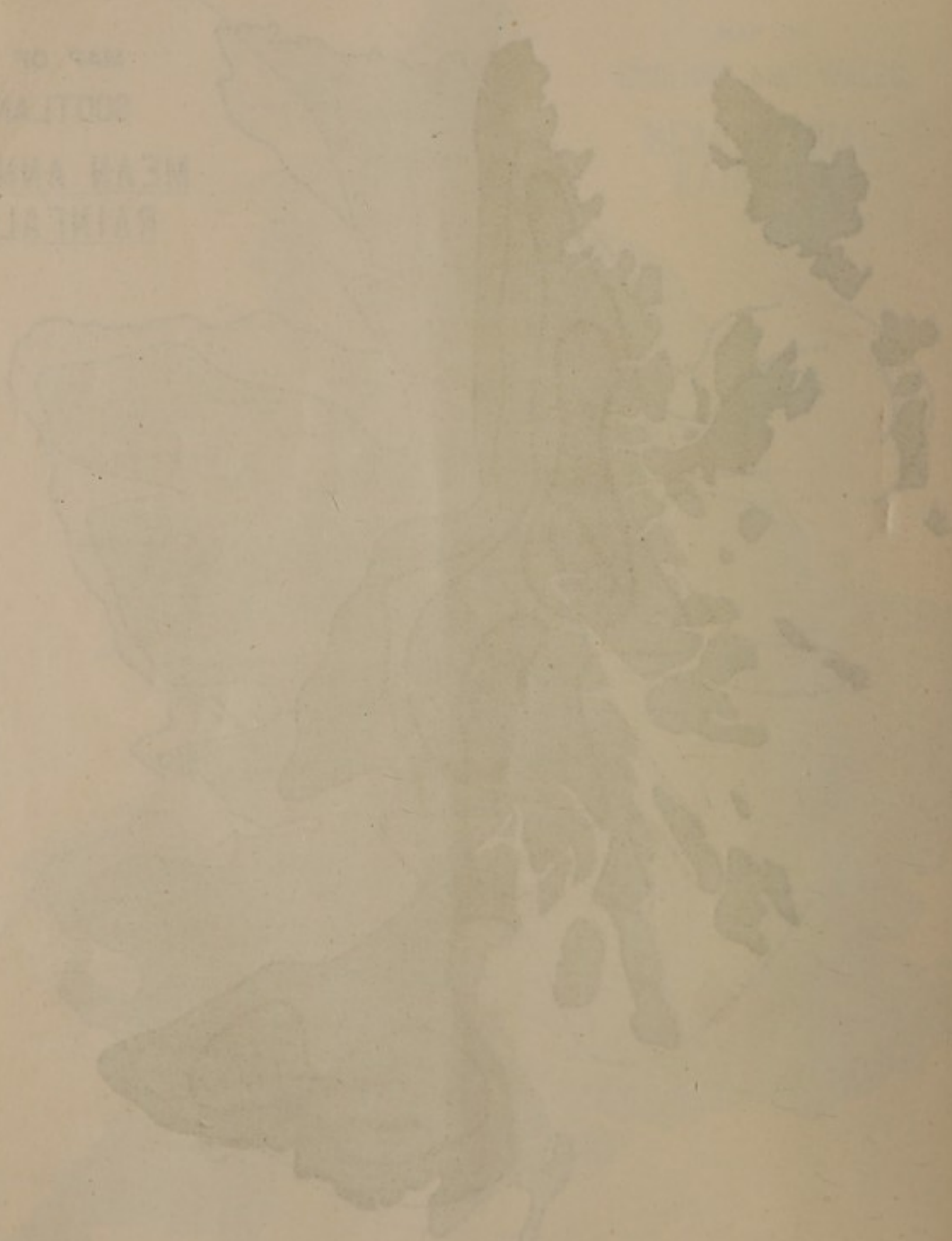
MAP OF
SCOTLAND.
MEAN ANNUAL
RAINFALL.



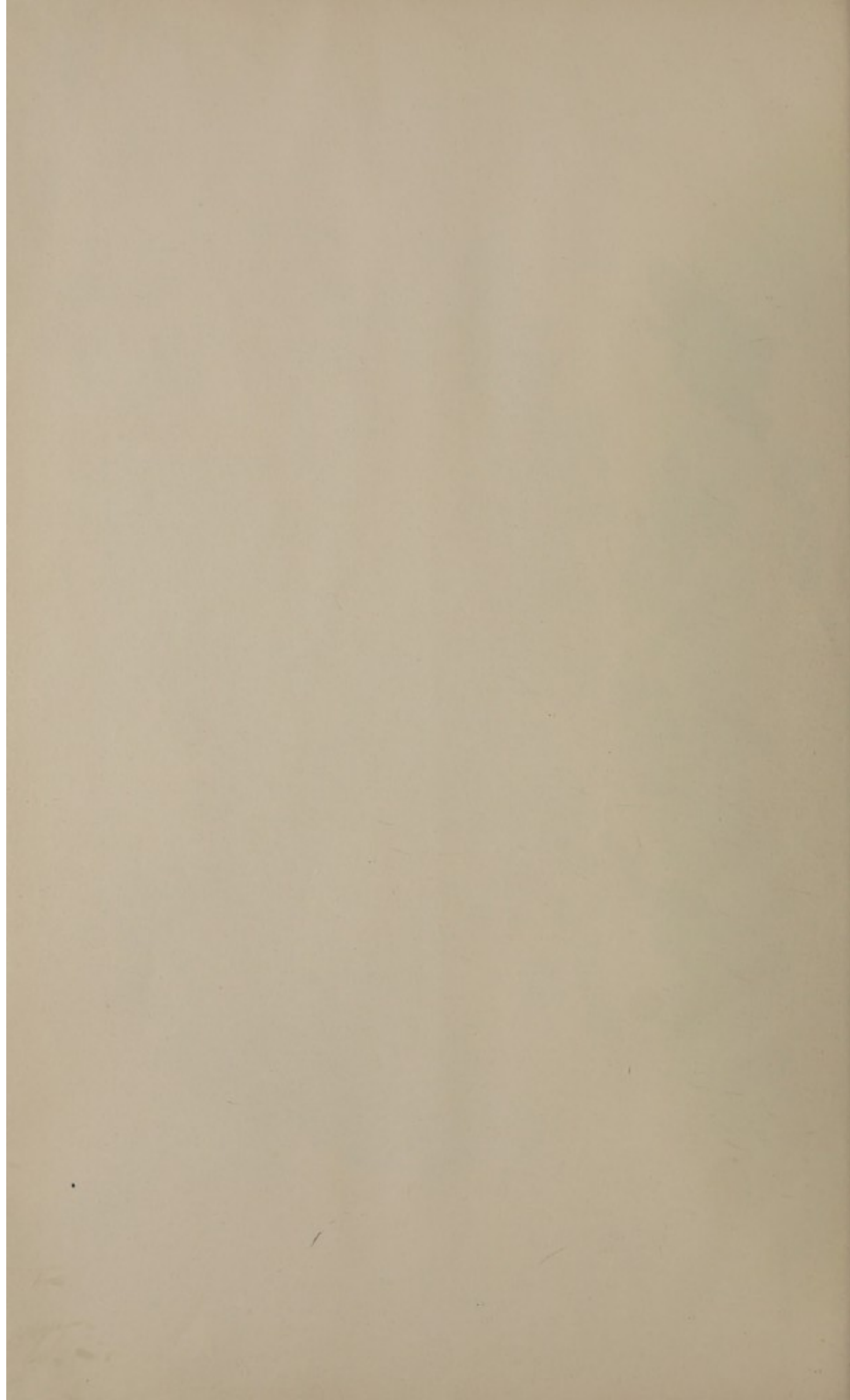
Malby & Sons, Lith.

MAP OF
SCOTLAND

MEAN ANNUAL
RAINFALL









✓



