MODERN DAIRY-FARMING

H. L. PUXLEY

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ONE & ALL OIL CAKES

Modern Dairy-Farming.

Modern Dairy-Farming:

———A Practical Handbook———
on the Management of the Milch Cow
and the Profitable Utilisation of Milk.

By HERBERT L. PUXLEY,

Author of "Dairying that Pays," "Dairy-Farming for Ladies," &c., &c.

ILLUSTRATED.

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PREFACE.

My only excuse for offering this work to those interested in the subject of which it treats is that its origin lay in the repeated experience that many of the small, but none the less important, items connected with the working of a dairy farm appeared to be overlooked by the books with which I was acquainted. It is an unfortunate fact that those who are the highest authorities upon any particular subject very often forget that their hearers or readers are not on the same footing as themselves, and so give them credit for an amount of knowledge which they do not possess. I have tried to keep this fact prominently before me, and have therefore treated of many things which may seem of trivial importance to the old hand, but which my experience has taught me are of much consequence to the beginner.

I have to acknowledge my indebtedness to the "Encyclopædia Britannica" for some of the statistics which I have quoted from the article on Dairy-Farming in the tenth edition; also to Professor Wolff's valuable work on Farm Foods.

H. L. PUXLEY.

July, 1906.

LIST OF PLATES.

Modern Dairy-Farming.

CHAPTER I.

INTRODUCTION.

So great have been the changes and advances in the practice of dairying during the last quarter of a century that few excuses seem to me necessary for presenting this handbook to the notice of dairy-farmers. During the twenty years or so that I was engaged in the business I often felt the want of some condensed and practical manual on the subject, and the present work is the result of mental notes and experiences which I hope may be of use to others.

Quite apart from the naturally increasing demand for milk during the close of last century, the factor which contributed in the greatest degree to revolutionise the dairy business was the invention of the centrifugal cream-separator (Fig. 1). This was the work of Dr. de Laval, and it has since been greatly improved. The result was to render most of the operations of the dairy simpler and speedier, while the practice of butter-making may be said to have been revolutionised. During this same period the

increasing depression in agriculture compelled farmers to pay more attention to profits and losses, with the result that it was soon found that the branch of this business which showed the most certain and steady profit was undoubtedly the dairy. As soon as this was realised, far more attention was paid to this department, while that of corn-growing was allowed to become a thing of the past.

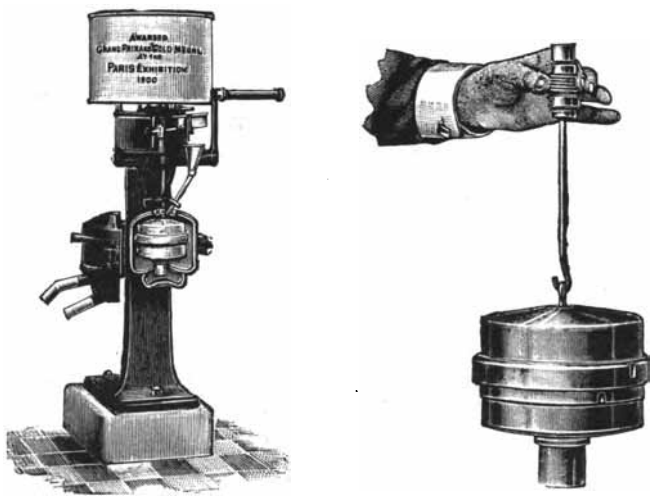


Fig. I. Melotte Separator and Self-Balancing Bowl.

Now we see everywhere corn-fields disappearing, being laid down to grass, whilst dairying has increased by leaps and bounds.

The next result of this new interest in dairying was the formation of the Dairy Farmers' Association in 1876, which was intended to enrol all those connected with it. It was decided to hold a dairy show annually. The first of these took place in London in October, 1876, and has

been followed by others year by year, until the fixture has become a valued institution.

The British Dairy Farmers' Association is under the patronage of the King, and its objects are the improvement of dairy stock and produce by encouraging breeding on proper lines; a larger production of butter, cheese, and eggs; improvement in buildings, machinery, and utensils. It also annually issues a Journal. The advantages of membership are: (1) A free pass to the shows; (2) a copy of the Journal of the Association; (3) analyses, at low fees, of samples of milk, cream, butter, feeding-stuffs, manures, &c.; (4) professional advice on all dairy matters at reduced fees. It may easily be seen what an enormous boon the Association has been.

Simultaneously with the revival of interest in dairy-farming, and thanks, no doubt, to additional light shed on the subject by colleges and by the practical evidences of shows, it came to be felt that the proper handling of milk and butter was not such an easy matter as it had formerly been thought to be. It seems on the surface rather a curious fact that the researches of Dr. Koch, primarily directed to the discovery of some cure for the ravages of the dreaded Phylloxera, should have played an important part in the revival of dairying; yet so it was. The first step taken, the influence of bacteria in almost all departments of living matter was speedily recognised, and just as antidotes were discovered against their effects in disease, so what were called "pure cultures" were brought into use, by which any valuable properties that they might possess, as ferments or otherwise, might be utilised, while they themselves were kept within bounds. To such an extent has this subject been examined and experimented with that nowadays a proper "culture" may

be had that will ensure the right flavour in butter or ripeness in cheese, and that may be employed for many other purposes in the dairy. Not only so, but where improper agents are found to be at work their effects may be checked.

The absolute importance of cleanliness in every operation connected with the handling of milk has also been insisted upon. Formerly, cows were milked in any sort of shed, dirty as they stood, into filthy pails, by a worker whose hands and garments were soiled, and the milk speedily went sour. Not only so, but the infant mortality attributable to unwholesome milk was something prodigious. The number of deaths varied from 25 to 30 per cent. in the large towns in England and France, and was very largely due to dysentery, the immediate result of unwholesome milk, which carried off thousands under one year old. Now the byres are almost spotlessly clean, the milker is taught to cleanse himself and his cow before beginning to milk, and every implement is scalded before and after use.

Fig. 2. Disc-Cover Bottle. Sealed with Disc by hand. Disc punctured to open Bottle.

An improvement is to be noted not only at the source but throughout the whole trade. Little had formerly been done, on proper lines, to enable milk to remain sweet in condition for any length of time. Now, however, it is the invariable custom to scald and cool it before despatch,

and in many cases it is put into special bottles (Fig. 2), hermetically closed, so that neither dirt nor germs can affect it before it reaches its destination. By such means milk can be kept perfectly sweet for almost any length of time, and only need come into contact with the air during the time occupied in its actual consumption.

Before concluding this chapter, I cannot help trying to fix the praise for this happier state of things where it is due. There can be no doubt that we owe the greater part of the advance, if not all, to the British Dairy Farmers' Association and its working members. In season and out they have insisted upon the importance of cleanliness, and, since in course of time their lessons have borne fruit, the result has been the progress I have just described.

One word more. There is a danger in every reaction. Just as there is an ebb and flow in all movement, social or material, just as a great forward wave has its equally great backward ebb, so the foregoing progress may have in it the kernel of an evil. We have become so accustomed to look for germs in every disease, and have so set ourselves upon their extermination, that there is just a possibility that we may carry the business to excess. All bacteria are not malign, and our knowledge—though no doubt great—is yet comparatively so rudimentary that perhaps we may find some day that in our haste to destroy the malignant germs we have also destroyed those which had a useful purpose, and have left nothing behind but the useless husk. This is a matter which requires very much more consideration than it has yet received in connection with the sterilisation of milk. The subject will be treated at some length separately, and therefore I need only suggest here, as food for consideration, whether the time has not come for discarding the process altogether.

CHAPTER II.

A SURVEY OF THE DAIRY TRADE.

STATISTICS.

DURING the first half of the nineteenth century the milk trade was a comparatively small affair. The network of railways which now surrounds the metropolis was non-existent and milk trains were yet undreamed of. A little later the increasingly stringent regulations in connection with the keeping of cows in towns forced many dealers to give it up, and so gradually the larger cities became more and more dependent on the country for their milk. London is now regularly supplied with milk from very distant places, and it looks as if the ever-increasing demand for this article would very soon appropriate all that was offered, no matter at what distance.

The change brought about by this enormous traffic in milk, and by the increased herds of cattle which have to be maintained to satisfy it, compelled farmers to look more and more to purchased feeding-stuffs for the support of their beasts. This, again, has had its effect on the land, the manure returned being an active instrument in increasing its fertility. Thus we find action and re-action going on, and it looks as if—up to a point—the more milk produced, the more the land is capable of producing.

To meet the demand in London alone there are about 5000 dairies. With these are connected some 12,000 traders, employing 25,000 hands. The amount of capital involved is enormous, amounting in the case of six of the principal distributing and retail dairy companies to upwards of £1,000,000. But where, of old, most of the required supply was produced in the metropolis itself, the increased facilities and more favourable rates offered by railway companies have made it possible for milk to be brought from very great distances fresher and cheaper than formerly. The number of milk-cows in the County of London diminished from 10,000 in 1889 to 4262 in 1905. The relation between those and the total number of cows may be gathered from the fact that the annual quantity of milk delivered in London on the Great Western Railway amounted in 1900 to some 11,000,000 gallons, on the London and North-Western 9,000,000, on the Midland 6,000,000, on the London and South-Western 8,000,000, on the Great Northern 7,500,000, on the Great Eastern 7,000,000, on the London and Brighton 1,000,000, and on other lines about 1,000,000.

A computation of the total milk-supply of the metropolis reveals a quantity approximating to 60,000,000 gallons per annum, or rather more than a million gallons per week, which, taking 500 gallons as the average yearly production of the cows contributing to this supply, represents the yield of at least 120,000 cows. Not only this, but an army of milkers computed at 12,000 men is required, while the number of horses used by farmers in carting the milk to the station, and by the dairy companies in delivering it to consumers, is not less than 9000. It will, therefore, be understood how far-reaching and beneficial, as affording employment to so many who would otherwise

have flocked into the towns, this enormous demand for milk has proved.

Although the home trade in dairy produce is so vast in extent, yet it forms but a small portion of the total. Large and increasing quantities of milk, butter, and cheese are imported yearly from the Continent and our own Colonies: and one of the most satisfactory features of these imports is that whereas formerly far the larger portion came to us from Denmark and the United States, the trade is falling more and more into the hands of Canadian and Australian exporters. There are also signs that before very long the exports from Siberia will come into competition with those from our Colonies, but it is to be hoped that before such competition becomes keen more stringent regulations will be brought into force for ensuring a higher standard of purity in such foreign produce.

On this and the following page are given the estimated annual home production and the imports of dairy produce and margarine for the years 1904-5, with their value in pounds sterling. It is not so satisfactory to note that although the butter has increased in value, the margarine also shows an upward tendency; but there can be very little doubt that the general level of quality in butter has been raised in the last ten years, thanks not only to the more stringent enforcement of the regulations against adulteration, but also to the spread of enlightened ideas as to what good butter should be like.

The estimated total quantity of milk produced in the United Kingdom is about 7,000,000 tons; of butter, 85,000 tons; of cheese, 140,000 tons. This is supplemented by imports from foreign countries, which, for the years 1904-5, were as follow:

—	QUANTITIES.		VALUES.	
	1904.	1905.	1904.	1905.
	CWT.	CWT.	£	£
Butter	4,241,005	4,147,864	21,117,162	21,585,622
Margarine	960,278	1,088,189	2,494,467	2,736,286
Cheese	2,554,297	2,442,660	5,843,770	6,339,742
Milk (Condensed)	904,136	894,921	1,608,391	1,584,903

It is worthy of note that the imports of butter have shown continuous increases during several years past. In 1891 their value was about £11,500,000 sterling; in 1901 it was something over £19,000,000; while at the present day it is about £21,500,000 sterling. Condensed milk, on the other hand, shows a tendency to decline in value. In 1900 the value of the imports of this article was over £1,700,000, in 1904 it was only just £1,600,000, while last year it was still less. Another satisfactory feature in connection with the import statistics is that the trade in fresh milk shows no signs of making headway. It is very doubtful if imported milk would ever commend itself to any large number of consumers, since not only would it be very difficult to keep it sweet throughout its long journey without the use of preservatives, but there would be no guarantee whatsoever that it had been produced under proper sanitary conditions in the country of its origin.

Canada is now the principal exporter of cheese to the United Kingdom, and out of a total import of about 2,500,000 cwt. in 1905, considerably over 1,750,000 cwt. came from that country. Not only is this the case, but the quality of the cheese has been very greatly improved, so that it would be very difficult for anyone but a connoisseur

to tell the best imported Cheddar from the home-made article.

REGULATIONS FOR ENSURING PURITY IN MILK.

The foregoing statistics teach us the enormous importance of the trade in dairy products. The great increase in the demand and the necessity for controlling the supply and assuring its purity caused the Board of Agriculture to hold an inquiry, with the result that the following regulations were promulgated:

1. Where a sample of milk (not being milk sold as skimmed, or separated, or condensed milk) contains less than 3 per cent. of milk-fat, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk-fat, or the addition thereto of water.

2. Where a sample of milk (not being milk sold as skimmed, or separated, or condensed milk) contains less than 8.5 per cent. of milk-solids other than milk-fat, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk-solids other than milk-fat, or the addition thereto of water.

3. Where a sample of skimmed or separated milk (not being condensed milk) contains less than 9 per cent of milk-solids, it shall be presumed for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, until the contrary is proved, that the milk is not genuine, by reason of the abstraction therefrom of milk-solids other than milk-fat, or the addition thereto of water.

4. These regulations shall extend to Great Britain.

5. These regulations shall come into operation on 1st Sept., 1901.

6. These regulations may be cited as the Sale of Milk Regulations, 1901.

These regulations have caused a considerable amount of trouble, especially to small farmers. It is well-known

that the milk of poor cows is often below this standard, and that in the case of nearly all breeds it falls below the standard at certain periods of the year. Yet it is often a matter of great difficulty for the seller to satisfy the magistrate that poor milk has not been diluted. It is argued that where the milk of the whole herd is mixed together before sale it will generally reach the required percentage of fat, and that if it does not, then the farmer must purchase a better stamp of cows or alter his feeding arrangements.

Another question is whether it should be lawful to put preservatives into the milk. There are arguments on both sides. Those who object to the practice say that boric acid and other preservatives are very deleterious to health, and especially to that of infants; that the quantity increases as the milk passes through the hands of middlemen on the way to the consumer, until the amount may be absolutely poisonous. Their opponents answer that it has never been proved that a small quantity of preservative is harmful; that if the quantity is unusually large and dangerous the seller may be prosecuted; and, lastly, that even if boric acid were liable to have a harmful effect, it would not be nearly so bad as the consumption of lactic acid and bacteria, which the preservative neutralises.

In July, 1901, another departmental committee was appointed by the Board of Agriculture to inquire and report as to what regulations (if any) might with advantage be made under Section 4 of the Sale of Food and Drugs Act, 1899, for determining what deficiency in any of the normal constituents of butter, or what addition of extraneous matter, or proportion of water in any sample of butter should, for the purpose of the Sale of Food and Drugs Act, raise a presumption, until the contrary is

proved, that the butter is not genuine. This has, so far, borne no fruit,* although there was an attempt to pass a Bill through Parliament to limit the amount of water in butter to 16 per cent. Hitherto there has been no limit, and the change is called for to put an end to the lately devised "milk-blended" butter, or butter which has been blended with 20 per cent. of milk. The objection was not to the blended butter as such, for it is perfectly wholesome and cheap, but to the article being sold as butter, which was fraudulent. Where it was properly designated as "milk-blended," no objection could be made.

In connection with cheese there is little to be noticed. What was formerly sold as "filled" cheese seems to be on the decrease, but in its place has come another article. This, while pretending to be made of whole milk, has been found to consist actually of milk partly skimmed. The result is that certain cheeses which up till now had been looked upon as the greatest delicacy are fast losing their good name, and unless the practice is given up at once their sale may be destroyed.

In closing this branch of the subject, I would suggest that since there is so much uncertainty connected with the sale of dairy produce at present, as to whether it is genuine or not, it would be distinctly advantageous if proper standards were laid down by the Board of Agriculture to which the seller would be bound to conform, and for the infringement of which he would be liable to a fine.

* Since writing the above another Select Committee on Butter Adulteration has been appointed.

CHAPTER III.

THE MILK TRADE.

We have already glanced in passing at the rise in the milk traffic, we have seen what a vast number of men and horses are required for the distribution of the produce, and how the railway companies also play their part in this distribution; but it is necessary now to take a more complete survey of the whole position, and see how the system upon which milk-production and milk-distribution proceed affects the quality of the produce.

CONSUMPTION OF MILK.

A report has been drawn up by the Royal Statistical Society dealing with the production and consumption of milk in the United Kingdom. The total available milk is computed at 1,723,000,000 gallons. As the average population of the United Kingdom for the five years ending 31st May, 1903, was estimated at about 41,000,000, it would appear that the milk available for consumption amounts to nearly forty-two gallons per head per annum. The Committee conclude that the milk is consumed as follows:—

	GALLONS.
As Milk	620,000,000
As Cheese	153,000,000
As Butter	944,000,000
As Condensed Milk..	6,000,000

The average consumption per head works out as follows :—

	Milk. Galls. per head per annum.	Cheese. lb. per head per annum.	Butter. lb. per head per annum.
Labourers	5	9	15
Mechanics	12	11	15
Lower Middle Class ..	25	10	23
Middle Class	39	8½	29
Upper Class	31	10⅛	41

This estimate is extremely interesting as showing what a very small quantity of milk, as such, is consumed by the labouring classes. When the importance—the absolute necessity—of milk for infants is considered, it can hardly be thought remarkable that physical deterioration is such a prominent question. But there is an almost worse feature than this of the present-day traffic in milk. In the early part of last century the majority of the population lived in the country, and only a very small percentage in the large towns. This meant that at that period a very large part of the population—which has now become merged in the labouring class of our towns—was in the position of having a sufficient supply of fresh milk at its door, and was in the habit of depending to a great extent upon this for its daily requirements. Two causes contributed to alter this state of things. First, an enormous expansion of trade occurred at about this time; secondly, the down-fall of agriculture was just beginning. The result of these two movements was that an enormous demand arose in the towns for mechanics and labourers at high rates of pay, which demand naturally attracted a certain proportion of the population from the country; and this, coupled

with the contemporaneous fall in the price of agricultural produce, and the turning of much of the arable land into grass, gave a great impetus to the rural exodus. As a consequence, the larger part of the population, which had formerly lived in the country, was now transferred to the towns, and not only ceased to be in a position to purchase a sufficient quantity of fresh milk, but—which was still worse—owing to other causes shortly to be explained, the labourers who still remained in the country found their supply of milk not only curtailed in quantity but raised in price.

The natural result of the large influx of mechanics and labourers into the manufacturing districts was to cause a large demand for milk there. At first this demand was supplied from farms in the immediate neighbourhood, but little by little these were found to be insufficient, and milk had to be transported from greater distances, so that to-day we find milk coming to the metropolis from farms 100 to 150 miles away. It is perfectly evident, therefore, that the conditions of the milk-supply have radically altered in the last thirty years; but it is equally evident to all who have investigated the matter that scientific and proper methods of handling the milk have not kept pace with the expansion of the trade.

There are two main facts to be faced in connection with the new conditions. The one, the spread of disease through unwholesome milk; the other, the ill-conceived attempts to retard the natural changes which are bound to take place in impure milk.

MILK-BORNE DISEASE.

No fact has been more fully established than that diseases of various sorts are constantly disseminated

through the agency of milk. There have been outbreaks of typhoid, scarlet fever, diphtheria, diarrhœa, and sore throat traced with almost absolute certainty to milk. This arises from the fact that many of the most virulent diseases which attack human beings are also found to afflict domestic animals. It is remarkable that this was not discovered earlier, for a moment's consideration reminds us that the cure of smallpox by vaccination was the result of observations made by Jenner, who noted a particular freedom from this disease on the part of those engaged in milking. On turning his attention to the cow, Jenner very soon found that the disease known as "cowpox," evidenced by the appearance of pustules upon the cows' teats, was contracted in a lesser degree by the dairymaids who milked the cow. It immediately struck him that this was due to inoculation with pus from the teat, and he set himself to prepare a vaccine inoculation with which would ensure freedom from smallpox, which he conceived to be the same as cowpox. How successful his efforts were we know, and to-day we find an almost perfect immunity from this disease on the part of those who have been vaccinated.

It was some time, however, before the discovery was made that there were many other diseases equally transmissible by the medium of milk. There is scarcely any doubt as to this in the case of those diseases already mentioned; but there is a considerable amount of controversy in connection with the transmission of one of the most deadly of all—tuberculosis. It is held by some that it is not transmissible from animals to man, at any rate until the udder itself has become invaded by the bacilli; other authorities profess to be equally positive that it is capable of transmission. But whichever of these proves in the end

to hold the correct view, it cannot be denied that the bacillus of tuberculosis is present in a large part of the milk produced for general use; and, therefore, it is only right that no risks should be taken, and that any method of minimising the danger of transmission of this disease should be welcomed.

PRESERVATIVES.

We have seen how the altered arrangement of population had introduced a revolution into the milk trade, and had necessitated a call upon dairy-farms at a great distance for part of the supply of milk required. This immediately brought to light one of the weak spots in the system. Milk which had been fairly satisfactory when used on the spot, and within a very short time of being drawn, was not found capable of standing a long journey by rail. This was only to be expected. The dirty methods in vogue among agricultural labourers fifty years ago could only result in the production of a dirty article. So long as sufficient time was not allowed for the dirt in the milk to produce its natural results, there seemed to be no cause for dissatisfaction; but as soon as the milk was required to undergo a long journey, in a hot van, and in the depth of summer, it generally arrived at its destination in a far from satisfactory condition. As a consequence, it was often returned to the sender, who was therefore forced to devise expedients by which the milk might be enabled to resist the changes which would otherwise occur.

The result was the introduction of preservatives. These are substances—such as boric acid—which, being placed in milk, enable it to remain apparently unchanged in condition for some hours. I say "apparently unchanged"

advisedly, for I do not for one moment believe that it is so in reality. Take the well-known case of the mummy. This has been enabled to resist the action of time for hundreds of years through the ability of the ancients to embalm bodies by means of preservatives. Many of these bodies appear perfectly lifelike. Could it therefore be said that they have not undergone any change? I contend that "preserved" milk is in a similar position, and that although no change is noticeable by the unaided eye, it has, nevertheless, occurred.

There is a second objection, of equal importance, to the use of preservatives. It is often contended that boric acid is quite harmless, and so it may be in small quantities. But how can its use be controlled? The farmer may have used preservative before the milk was despatched on its journey: is there no danger of the consignee adding a further quantity when it reaches its destination? If so, the total amount may easily have become poisonous. This matter has become so urgent that many medical men and agricultural chemists have advised making the use of any form of preservative in milk a penal offence.

SCALDING AND COOLING MILK.

Now, although objection has been taken to the use of preservatives, it should not be thought that there is no alternative. There is one in the shape of the milk-scalder and cooler. These machines have two objects in view. The first is to heat milk at once to such a point that the majority of germs are destroyed; the second, immediately to cool it so that the spores and bacilli which still remain in the milk cannot carry on their work.

A very good form of scalder is that manufactured by

Lawrence and Co., Ltd., of Latimer Road, London. They draw attention to the fact that milk has the property of remaining sweet for a length of time proportional to the rapidity with which it is cooled. They have therefore

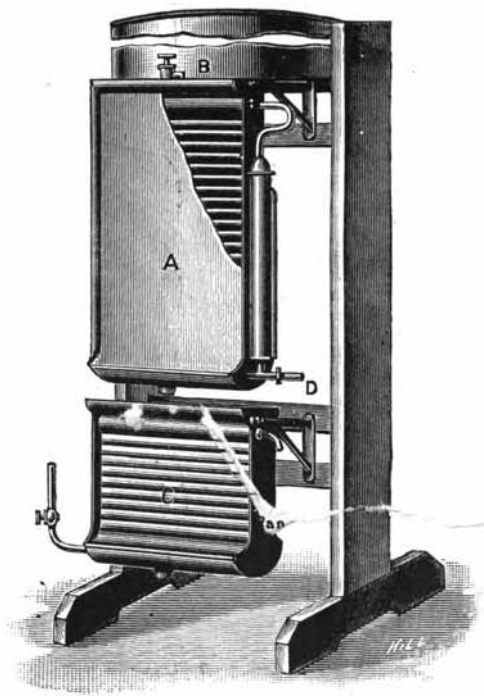


Fig. 3. Lawrence Scalder and Cooler.

invented a machine by which milk may be heated to within a few degrees of boiling-point (it should never be allowed to boil or a smoky taste will be produced), and then rapidly cooled to about 50deg.

The apparatus consists of two machines, A and C (Fig. 3), the one a scalder and the other a refrigerator. The milk is placed in the receiver B, whence it flows over the scalder A, where it is heated to within a few degrees of boiling-point. The scalded milk is then allowed to run over the refrigerator C, and is cooled to within 2deg. or 3deg. of the water within. The heat in A is maintained by the water in constant circulation, actuated by the steam jet D, so that the temperature is never raised to boiling-point, and thus the objectionable flavour of boiled milk is avoided. If it is desirable to cool the milk to a still greater degree, a briner is used in connection with the refrigerator, which reduces the temperature to the neighbourhood of 40deg.

Here, then, we have the solution of the problem of the proper method of treating milk in order to enable it to undergo a long railway journey. The milk should be drawn from the cow in the cleanest way, should be protected from contamination by dust or taint, should be well strained, and, finally, should be submitted to the scalding and cooling operations. If proper refrigerator vans are supplied by the railway companies, and milk is delivered as speedily as possible, there should be no difficulty in landing milk in the large towns, at the end of a long journey, absolutely as fresh and as sweet as it left the farm. But the care of the milk does not end at this point. The number of milkshops in London has been computed at one to every 500 persons. This gives us some idea of the enormous quantity of milk always on sale in the metropolis, and, in most of these cases, exposed to contamination. This contamination arises from the fact that it is not sufficiently protected. It is placed in a large bowl on the counter, and the surface exposed to the dust with

which the air is always charged. Even where it has some sort of covering this is constantly being taken off, and flies are admitted to the milk. It is desirable that some special form of counter pan (Fig. 4) should be employed, and the greatest care is necessary to provide against the entrance of dust or flies. The pan in Fig. 4 is fitted with a stirrer for keeping the cream from rising.

Fig. 4. Counter Pan and Stirrer.

There can be no question that one of the most effective ways of delivering milk is in bottles of different sizes. These may be filled either on the farm, or when the milk has reached the consignee in the town. They should not be opened until the milk is required for use, after which they may be returned to the dairy to be thoroughly scalded or sterilised.

CHAPTER IV.

THE COW.

Of course, the first and most important item in starting a dairy is to decide the question of which type of cattle is to be used and how to obtain it. There are several good varieties of dairy cattle, each of which has its admirers, and it entirely depends on the particular purpose for which it is intended which should be chosen. Broadly speaking, the cow which will do for raising beef is not the cow for milk, and *vice versâ*. The cow which will be found most useful to the milk-seller is not always the one which should be chosen where butter is made, while other considerations of the same sort enter into the choice of a cheese-maker. I shall therefore class the various breeds of cattle under their proper heads—for milk, butter, or cheese.

Before I examine the different classes of cattle it is advisable to say a word or two about rearing one's stock. I am convinced that the highest pitch of excellence in dairy cattle is only to be attained and maintained by each man rearing his own stock. It is often thought inadvisable to use a bull in any way related to the cows for which he is kept, but I think that so long as a change is made once every three years no evil results need be expected. This is most important, for if my contention

is correct a bull may be raised from one of the best milkers, and thus continual improvement ensured in the herd; whereas, each time a bull is bought elsewhere, a factor of uncertainty is introduced into the result, and however great may be the reputation of the strain from which the new sire comes, it is never certain that he will "nick" with the cows to the advantage of the future young stock.

The great point of keeping to one's own herd, even at the expense of a certain amount of in-breeding, is that more confidence may be felt in producing the results aimed at. Therefore if the herd average about 600 gallons of milk per annum, but one cow yields 800 or 900 gallons in that period, don't hesitate to rear her bull calf for the use of the herd—supposing he has no glaring defects in other ways—and a yearly marked improvement in the general average of the milk-yield may be reckoned on if this practice be adhered to. On the other hand, it might easily happen that one year's use of a bull from another herd might ruin the efforts of years, for it has been thought that the sire has the power of imprinting his characteristics not only on his immediate progeny, but also on all future generations. It will therefore be seen how important a matter this is.

The same remarks apply, though in a lesser degree, to the question of raising heifers. There is no better plan than to keep the young female calves from the best cows and rear these until they are fit to take their place in the dairy. Of course it often occurs that a cow will not breed, and this is frequently the case with the heavier milkers. Again, it is the heaviest milkers that are attacked by milk-fever, the scourge of the dairy; so that one may be obliged to go abroad now and then for fresh

blood. If a cow turns to one bull, try her once or twice with another, which sometimes proves efficacious; but care should be taken not to let a cow pass her first heat after calving before going to the bull. I believe this to be a fruitful cause of barrenness. The owner often considers that if a cow goes to the bull at a certain time of year she will drop her calf at an inconvenient date, and so he decides to wait until later on. But when this "later on" arrives the cow will not take the bull.

A cow should never be bought in a public market if this can be avoided. She may look a fine animal and appear very cheap, but it is impossible to tell whether she may not have had milk-fever or some other disease, which she will most probably hand on to the herd. There is generally a good reason for selling a fine-looking cow, which is also a bad reason for buying it.

Now let us consider the breeds of dairy cattle

CATTLE FOR MILK ALONE.

Shorthorn.

I take this breed first, not because I consider it pre-eminently a dairy breed, but because it is undoubtedly the commonest. When farmers buy an animal they naturally look ahead to the time when it must be sold off, and they find that the Shorthorn will always command a ready sale, and is easy to fatten if desired. It is a good all-round dairy beast for milk and beef.

The colour of this breed is roan, red, or white. There is a very prevalent objection to white cattle, though I have never been able to fathom the reason. On the other hand, one or two of the most successful breeders of the

day have confessed to me that they always bought a good white bull whenever they saw one, and they bought him cheaply. It should never be forgotten that a white bull may beget roan or red calves.

The Shorthorn's average yield of milk per annum is 600 gallons, of average quality (3.5 per cent. of fat). Although it seems a curious statement to make, it must be said that the comparatively second-class position of the Shorthorn as a dairy beast is due to shows. Only those animals are chosen for exhibition which are pre-eminent for beef- or fat-making qualities, and therefore that man only will get a great name upon whose herd these properties are stamped, passing to the male descendants. Therefore, if a bull be bought from such a herd, it will probably be found that it lowers the milking average and increases the meat-making qualities. A second evil of shows is that the best animals of each year are sacrificed to gain cups and prizes, being useless for ordinary purposes in the state of fat to which they have been brought.

I give 600 gallons as the average quantity of the milk-yield, but it would be quite possible to find several herds whose yield would average 1000 gallons a head per annum. These, however, are exceptional, but we must look to these for the purchase of sires and be willing to pay a good price.

The dairy Shorthorn is a large-framed cow, with long, narrow head, small, fine horns, fine shoulders, breadth across the hips, deep body, ribs well sprung, large udder, and teats large and wide apart. A good udder should be prominent and square below, not pointed. The skin should be soft, and covered with a fine coat of silky hair.

In the milking-trials at the Dairy Show of 1905 the Shorthorn came out as follows :—Lb. of milk, 56.1* ; percentage of fat, 3.77 ; solids other than fat, 9.5.

Red Poll.

This is the second of the breeds which are well adapted to the requirements of the milk-seller. It is very similar in appearance to the dairy Shorthorn, is deep red in colour, with a medium-sized and long head, and with hips narrower than in the case of the Shorthorn. The milk of this breed is exceptionally rich in fat, and it would therefore suit the butter-maker.

Kerry.

The other breed which I recommend to the dairyman who only sells milk is the Kerry. This is certainly a wonderful little animal for its size, its milk being scarcely second in quality to that of the Jersey. In fact, if we take its moderate original cost into consideration we should be almost inclined to put it in the first rank among milking cattle.

Kerry cattle are black, black and white (under the belly), and red. They have been brought up in perhaps the roughest and most barren part of the British Isles, and therefore when they are brought to this side of the Channel they quickly respond to the change. *Ex nihilo, nihil,* and therefore it cannot be expected that a beast brought up upon a Kerry moor will give a very good account of itself. But where care is exercised and the feeding is judicious, these little animals yield as much as 400 gallons per annum, with nearly 4 per cent. of fat.

* This was the highest daily yield for five years. In 1903 it was 54.1lb., and a few years before 49.3lb., so that it may be noted how great has been the advance in the average daily milk-yield when every attention is given to this one point.

The Kerry is square and bulky: its head is fine and graceful, of Jersey type, with delicate horns. The udder should be wide and square, with good teats. The milk is rich and produces excellent butter. There is little difficulty in fattening for the butcher, so that when the milking period is past the Kerry cow will often fetch what it cost originally.

The Dexter Kerry is supposed to be an "improved" Kerry; it is shorter and more blocky, but I question whether the improvement has extended to its dairy qualities.

Dutch Cattle.

Mention might also be made of a breed of cattle which is not often seen in the United Kingdom, but which seems to have gained a good reputation in its native country and America. I refer to the Dutch breed. I cannot do better than quote the opinion of a leading breeder and authority on the subject, Mr. John Brown, of Marden Farm, Hertford. He says: "I have had cows of the breed which gave 29 quarts of milk per day, and a cow I bought in Cumberland gave 1615 imperial gallons of milk in twelve months; but it might be mentioned that the cow was only two months gone in-calf at the end of the twelve months, which would help the amount of milk she was giving. The Dutch cattle are very hardy, and I winter all my young cattle outside, very seldom giving them any hand-feeding, which is more than I would be able to do with Shorthorns or even any other breed of cattle. Dutch cattle are not easily fattened when in-milk, but when once they are dried off no cattle will fatten quicker. No breed of cattle will give more milk than the Dutch, and I have had a life experience of different breeds of dairy

cattle. I bred and exhibited Ayrshire cattle successfully for twenty years before I had any Dutch cattle or other English breeds."

I think this estimate of the value of Dutch cattle would be sufficient to tempt anyone to buy them whenever the opportunity presented itself, even though a large price might have to be paid.

The cows are black and white in colour, with sometimes a belt of white round the centre of the body. Apart from their colour they have the general characteristics of the dairy Shorthorn—dish-face, "slack" back, width across loins, and large udder. One of their great features is the escutcheon, which is often found to extend over the udder and thighs, and as far as the root of the tail.

CATTLE FOR BUTTER.

Jersey.

This is the butter cow *par excellence*. In fact, to such an extent is this the case, that it is a recognised fact that the addition of the milk of one Jersey cow to that of a herd of inferior cattle will produce an increased proportion of butter over the whole herd. This is a most valuable thing to remember, and whatever breed happens to be in favour I should advise the keeping of one or two Jerseys. The Jersey is a most graceful-looking cow, reminding one of a deer when seen in the distance. Its colour is fawn, golden, or silver grey. Its average quantity of milk is about 500 gallons per annum, but this is exceptionally rich in fat (from 4 to 5 per cent.).

The head should be small, with a dish-shaped face; the black-pointed horns should be yellow at the base, and curve inwards; there should also be a broad, black muzzle,

and a black tongue. The animal should have a thin coat, with yellow skin; slight neck and fore-quarters; wide hips and width between the buttocks to allow plenty of room for the udder. The udder is rounder than usual, not square beneath. The milk-vein should be prominent.

Cows have been shown whose milk has tested as high as 8.5 per cent. of fat, and as much as 900lb. of butter has been produced by one cow in the year. This teaches us that it is worth while to pay a very stiff price for a good cow, for apart from her own value as a butter-maker, she is sure, if judiciously mated, to pass these qualities on to her descendants.

There are one or two disadvantages which I am afraid it will be impossible to overcome. The first is that Jersey cattle are distinctly delicate, and require a great deal of care and nursing, and those who are unaccustomed to them may find their losses somewhat heavy at the start. The second drawback is that when it is time to pass the animal on to the butcher it is a matter of difficulty and an enormous quantity of expensive food before she can be made fit. All steer calves should be fattened at once for veal, when they will do well enough on their mothers' rich milk.

Guernsey.

There are two other Channel Islands breeds similar to the Jersey—the Guernsey and the Alderney. Of these the Alderney is no longer recognised as a distinct breed at shows. The Guernsey differs from the Jersey in being somewhat larger, and being orange and white in colour. It has the usual external points of the dairy cow, and is not so delicate as the Jersey. It yields a large quantity of rich milk. It has one other advantage over the Jersey

in that it is easier to fatten for the butcher, and its calves by a Shorthorn bull are still better in this respect.

CATTLE FOR CHEESE.

Ayrshire.

There is one cow peculiarly adapted to the wants of the cheese-maker—the Ayrshire. It gives a fairly large quantity of rather poor milk, of which casein—the element chiefly required in cheese-making—forms a large proportion. It is red and white, brown and white, and black and white in colour. Its average milk yield is 550 gallons, testing about 3.8 per cent. of fat.

The Ayrshire cow is similar in size to the Jersey. The horns are large and grow upwards and outwards; neck and fore-quarters are slender; the frame increases in width to the hips, which should be wide; the ribs are well sprung and the body is very deep; the udder is large and wide, but the teats are rather too small for the hands of the ordinary milker; the milk-vein is well developed.

This is altogether a most valuable cow. The milk-yield is large, and though not remarkable for its percentage of fat, it is excellent for cheese. The first cost of these cattle is not large, while they will thrive and give good returns on poor cold land unsuited to more delicate cattle.

CHOOSING A COW.

In concluding this portion of the subject I will give a few suggestions for assisting a purchaser in choosing a good cow.

Outline.

The question is often asked, by those who know little of the constitution and conformation of dairy cattle, What

are the properties and attributes of a good cow? It would be very difficult to give an answer in a few words, for, as so often happens with general replies, circumstances might arise which would completely upset one's calculations. If I were asked to give a description in a few words of a good type of Shorthorn, I should say that it should approach in outline very near to a square. Lines drawn from A to B, B to C, C to D, and D to A (Fig. 5), should form the four sides of a square, and anyone who has

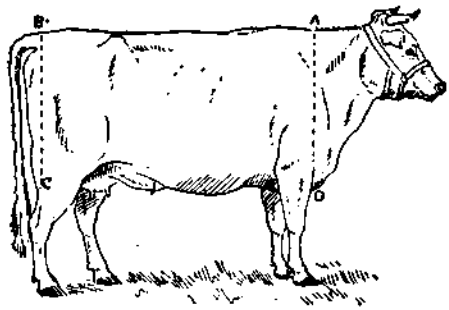


Fig. 5. Diagrammatic Sketch showing the lines on which a good Shorthorn Cow should be built.

attended any of our leading cattle shows will have seen how well these conditions are fulfilled. But certain variations from this standard are found in the case of dairy cows. The top line should remain as straight as possible in most cases, with the notable exception of some of the best Jersey cattle, which often exhibit a marked "slackness" in the back. The line of the flank also should be nearly straight. When we come to the underline, however, we shall find that there is a fall from front to back. Instead of being parallel with the top line, A D is shorter and B C somewhat deeper. This is due to the necessity for

great development in the udder-space. The highest form of milch-cow is built in wedge shape when viewed from behind, the front being narrow, the hinder part deep and wide. There should also be great width across the loins, to allow of plenty of room for the calf; and there should be plenty of depth in the centre for the same reason, and well-sprung ribs. The latter denote strong constitution and the ability to use a large quantity of food and turn it to the best account.

Such are the outward appearances of beef and dairy cattle; but besides these there are many other qualities to which attention must be directed. The purpose of a cow being to give milk, probably the most important consideration is the udder. This will not necessarily be large in size, but it must be of correct shape. It is often supposed that milk is formed in some other part of the body, and then goes to the udder to be stored there until it is milked out, and that therefore, unless the udder is large in size, it cannot give a big yield of milk. This idea is altogether false. Milk is formed in the udder itself, is the product of the decomposition of the gland-cells in the udder, and is being formed while the process of milking is going on. As soon as this fact is grasped, it will be realised that there is no essential value in a large udder as such, though it certainly may happen that a good young milker has this attribute.

Udder.

As I have just mentioned, the thing to look for is a good shape of udder. This is everything. Large udders are often seen hanging well down, and looking as if they must be capable of yielding a great quantity of milk, whereas they are in many cases far outdistanced by a

much smaller and insignificant-looking udder, which the uninitiated would have passed by. The properly built udder should be square in shape, neat, and compact. It should not hang down so as to come almost to a point at the apex. The teats should be well set on at the corners, with plenty of room between to allow them to be properly grasped. They should be fairly large in size, or some difficulty will be experienced in milking the cows. This constantly occurs in the case of Ayrshires. Although excellent udders in other respects are often met with in this variety, the teats are usually so small that these cows are greatly objected to by milkers.

In buying cows the greatest attention must be paid to examining the udder. It will often be found that one of the teats is stopped up or "blind," in which case the value of the animal is considerably lessened. The quality of the udder must also be inspected, for the cow may have had the complaint know as "garget," or inflammation of the udder, and if any evil results have followed, these may be disclosed by the sense of touch. All the teats should be stripped, and if one of them is found not to be in working order the cow should be rejected. It has been said that many a cow will give as much milk from three teats as others from four, and doubtless there is much truth in the assertion; but I fancy that the main objection to a damaged teat lies in the fact that it is evidence of some disorder which has occurred at calving-time, which disorder is very likely to show itself again at subsequent calvings.

Extra Teats.

If a large number of heavy-milking cattle are examined it will generally be noticed that the majority of them are

provided with one or two extra teats, known as "rudimentary" teats. This is a subject of interest merely as an additional test of the possible value of a cow at the pail. The difficulties of choosing a cow about whose performances nothing is known are so great that it is necessary to make use of every indication which she may present. Now these rudimentary teats are not meant for use (although I have known cases where such teats were milked in addition to the other four), but have always been considered a good sign of milking capacity. Exactly how far they are so is a matter of doubt, but they should certainly be taken into consideration in deciding upon an otherwise likely-looking animal. These extra teats are constantly to be found in bulls, upon the purse, and in such cases I think they are an even more valuable indication of a milking sire than of similar properties in the female.

Milk-Vein.

Another important item, and a very valuable indication of milking qualities, is what is known as the milk-vein. If the hand be passed underneath the abdomen a very prominent vein will be felt; this is the milk-vein. It is doubtless a misnomer, since it does not convey milk, but blood; but those who christened it so were probably looking more to the purpose for which it is intended than to its actual physiological nature. It is the vein which carries from the udder the blood necessary for its proper working, and the presumption is that the larger the supply of blood, the larger the consequent amount of nutriment for the udder, the greater will be the activity of the mammary glands and the yield of milk.

The Escutcheon.

The question of the value of the escutcheon has also often been debated; but since it was first mooted by a man whose business it was to handle hundreds of dairy beasts every year, and since it is always much in evidence in dairy cattle, we may take it as a valuable *primâ facie* indication of dairy qualities. Not only so, but since it is often strongly defined in young animals we may be able to pick up heifer calves at an early age, and therefore a low price, which shall afterwards do good service in the herd.

Fig. 6. Hind-quarters of Cow, showing the "Escutcheon." It will be noticed how the hair turns upwards on the inner surface of legs.

The dealer I have mentioned found that in some cows the hair at the back of the udder and thighs turned upwards (Fig. 6); this he called the "escutcheon," presumably because it was the outward evidence of standing among dairy cattle. By continued observation he came to the conclusion that a cow's milk-yield varied with the size of the escutcheon. The French Government were so struck by his theory that they nominated a Commission to inquire into it, and although this Commission could not find that all the arguments were substantiated, yet they decided that the main hypothesis was correct, and that the more clearly defined the escutcheon was, the greater was the milking capacity.

The same dealer also came to the conclusion that a yellowish skin, coupled with fine hair, was a good sign.

When the escutcheon is prominent in the male, it should be looked upon as the sign of a beast fitted to beget good milking stock.

Conformation.

The conformation of the cow is a matter of some importance. This opinion is founded upon two reasons: The first is that certain formations are associated with certain milking properties; the second, that these particular formations denote constitution and good feeding qualities. The first of these reasons is merely a matter of deduction: good cows are nearly always wedge-shaped, therefore this shape is desirable. The second, however, is founded upon a knowledge of anatomy. A good-sized body, deep through the heart, with well-sprung ribs, means that the assimilative and digestive organs are well developed, that the cow is of a hardy constitution, and that there is plenty of room for the development of the fœtus and the production of a large and healthy calf. Where the body is flat-sided, narrow from head to tail, narrow over the loins, with a coat coarse and unthrifty, it may be taken as certain that the cow is a bad doer, and that it may eventually develop tuberculosis.

Temperament.

Having examined the udder for milk, and taken note of the signs of a good constitution, turn your attention to the signs of a good or a bad temper. These are generally fairly evident, which is a matter for congratulation. The cow which is in the habit of kicking over the milking-pail and indulging in other little diversions of the same sort, will generally give evidences of this to the careful observer. The good-tempered cow is placid and mild-

eyed, and offers no objection when its udder is handled by strangers. Although a cow is not in the habit of putting its ears back like a horse, it sometimes uses its heels instead, and often to some effect.

Quality of Hair and Skin.

Finally examine the quality of the hair, which should be thick and silky. The colour of the skin itself is also good evidence of milking qualities. In those cows which yield the richest milk it is of a deep yellow, and this is taken to denote a large amount of fat in the milk, and therefore plenty of butter of the best quality. The ears also are a prominent feature of a good dairy cow. They are often large and covered with fine hair, and the interior surface is a deep orange colour.

Bad Cows.

In conclusion, let me remind the reader that a bad cow is a poor bargain. The first cost of a good cow is only a few pounds more than that of a bad one, while this will be returned with heavy interest. In both cases a certain quantity of milk must be given before the cost of keeping the animal can be liquidated; but the difference lies in this, that the good cow will give a large surplus over this which all counts as profit, while the bad will very often hardly pay for its keep. Besides, it does not necessarily follow that the best milker is also the largest feeder. The Kerry cow is one which is hard to beat as a milk-producer, and yet two Kerries ought to be kept for the cost of one Shorthorn. So the candle is burnt at both ends. Not only does the poor cow very often eat more than the good one, but it returns considerably less milk.

But whatever means may be adopted towards assisting in a proper selection of good dairy cattle, it is not always within the means of everyone to procure the highest type. To such I would say that, with whatever cattle you may be forced to make a start, you may be perfectly assured that by continuous attention to their feeding and health, by using only the best sires from good milking mothers, and by proper selection of the best heifer calves, you may make an enormous improvement in the annual yield of the poorest herd.

Age.

The age of a beast can be told from inspection either of the teeth or of the horns. As the first method is rather more difficult, and the horns give a very accurate indication (unless they have been doctored), it is generally only necessary to examine them. A cow will get the first ring on her horns after the first calf, and another with each succeeding calf, and as she is generally brought into the dairy at the age of three years, the first ring may stand for three years old, and each successive ring for one year additional.

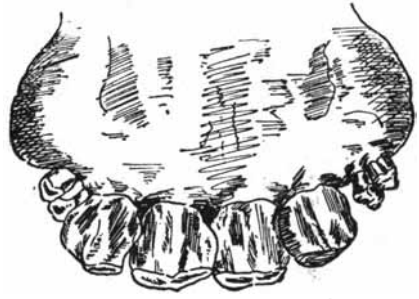
Teeth.

Since all breeds are not horned, it may sometimes be necessary to examine the teeth. In the front of the lower jaw are eight incisors; in the front of the upper there is only a pad of gums. The diagrams on p. 39 (Fig. 7) show the appearance of the lower jaw of animals aged ten months (temporary teeth); one year and ten months, showing first pair of permanent teeth; two years and seven months, four permanent; three and a half, or full mouth.

After the permanent teeth are all in the mouth the age

Heifer at ten months old.

At one year and ten months.



At two years and seven months.

At three years and a half.

Fig. 7. The Teeth as an Indication of Age.

can only be approximately arrived at, and this after some experience, by examining the amount of wear that the teeth have undergone. However, since the most important time of a cow's life is between the ages of two and six or seven years, there is generally little difficulty in arriving at a sound judgment.

The Bull.

Before leaving the subject of dairy cattle and their varieties it will be necessary to devote a few lines to the consideration of the bull. It is often said that "the bull is half the herd," but I think this is placing his value rather too low. The great object of every dairy-farmer should be steadily to raise the standard of his cattle, so that each succeeding generation may surpass in milking capacity, even though only in a small degree, the generation which preceded it. Now nothing plays a greater part in this gradual progress than the sire. Given a valuable set of cows, mated with a sire of a good dairy strain, and progress will be continuous and fairly rapid; but if a sire be used whose pedigree does not show a succession of deep-milking cattle, instead of making any progress the whole batch of calves will be inferior. This is where the importance of the sire is shown. Supposing a bad milker be introduced into a herd, she cannot affect the general level of excellence beyond herself and her heifer calves, and progress may be made in spite of her. If, however, the sire be an inferior animal, his inferiority is almost certain to be reflected in the succeeding generation. It is on this account that I would amend the popular saying, which should run: "The bull is considerably more than half the herd."

Points of the Sire.

Roughly speaking, there are only two points in connection with the sire with which the dairy-farmer need concern himself. (1) He should give evidence of dairy qualities; and (2) he should be of a sound constitution. The dairy qualities of the sire in each breed are denoted by similar signs to those of the female, though, from the nature of the case, he cannot have them all. He will be rather light in build, his skin of a yellowish tint, his hair fine, and the escutcheon and extra teats often well marked. But far the most important point of all is his pedigree. If I were offered a bull calf, which I had not an opportunity of examining, from a cow which had been accustomed to give 800 or 1000 gallons of milk yearly, I should be glad to accept him without any further recommendation and rear him as the head of my herd. There is only one danger in such a course, as anyone would see at once who has followed my remarks upon the influence of the sire: this particular calf may have descended from an inferior bull, and may not therefore be equal in quality to his dam. Apart from that risk, however, the calf would almost certainly be a good bargain.

Constitution in the bull is always desirable. His head should be of a strong masculine stamp, with the crest well developed. The whole fore part of the body should be large and roomy, and wide across the front to allow for plenty of room for heart and lungs. His ribs should be well-sprung, and he should have lots of depth through the body, giving evidence of a proper capacity for digesting and assimilating his food. The general outline of the animal should approach, as nearly as possible, that of a square.

Pedigree or Not?

The question has often been discussed as to whether thoroughbred cattle are suited to the dairy or not. Personally, I am very strongly against their use. The pure-bred cattle have been considered for so long merely from a show point of view, their beefing qualities have been so greatly encouraged at the expense of their milking qualities, that the results are anything but desirable from the dairyman's point of view. It may be well to have a pure-bred sire, if such can be got from a deep-milking cow; but I would strongly advise the use of half-bred, in preference to pure-bred, cows.

It is interesting to notice that the champion cow in the milking-trials at the Dairy Show is nearly always from the non-pedigreed class. In 1904 the Champion Cup went to a cow not eligible for the Shorthorn class with nearly six gallons of milk in the day, as against four and a half gallons for the Shorthorn Society's first-prize animal. In 1905 a non-eligible cow again secured both Challenge and Champion Cups, with approximately six gallons on both days of the trials, as against a rather lower average on the part of the first-prize Shorthorn. This seems to be the usual tale; but it is noticeable that, since greater attention has been paid to dairy qualities, the pedigree animals are showing very great improvement in this direction.

Markets and Price.

As I do not favour the employment of pure-bred stock in the dairy, except in the case of the sire, the prices will be only those which should be paid for good half-bred cattle. They will vary between £18 and £25, depending upon the market and the time of

year. Good Kerries are obtainable for less than half this, and can be best obtained direct from Ireland.

Shorthorns.—The best markets for these are in the North—at Darlington, Newcastle, Durham, Northallerton, Boston, Stow-on-the-Wold, and Northampton.

Channel Islands.—In the Channel Islands, or at Southampton fair and auction sales.

Ayrshires.—The best fair is at Ayr, but they may be obtained at almost any of the fairs in the Southern counties of Scotland.

Kerries are best chosen in the South-West of Ireland, especially around Tralee, and cost little to bring across by the truck-load.

CHAPTER V.

TREATMENT OF THE COW.

BEFORE a cow can be used as a milking-machine it is necessary that she should have a calf, therefore it must be decided at what age she shall be put to the bull. Some farmers make it a rule never to breed from their young cattle before the age of three years, and others insist that this is an unnecessary waste of several months, and not only so, but that there would be fewer barren cattle if heifers were put to the bull at two years old. I am quite in agreement with the latter, and would advise mating young heifers, especially if they are forward ones, at the age of twenty-one months, so that the first calf may be dropped at thirty months. There is no danger of such a course stunting the young animal, as she will continue her growth at the same time; but since this will entail a considerable drain on her energies, she must be fed heavily with the best food. Of course, if the calf has been underfed from birth and has been stunted by the use of skim-milk only, the breeding period must be deferred.

Another common cause of stunted, non-breeding cattle is want of sufficient exercise in their early days. Many people refuse to let their calves out during the first year, but keep them cooped up in warm dark pens, in order, as they think, to push the animals on. The result is the very reverse. We know that plenty of fresh air is required

by young children, and both this and light are equally necessary for young cattle. I have been into pens so dark that you could not see your way in, where perhaps a dozen young animals were huddled together, and as soon as the door was opened your nose warned you of the presence of that awful scourge, diarrhœa, which was bound to pass through the whole lot. There will be very little bother with "scour" in calves if they have plenty of exercise in their youth. If necessary to shut them in at any time, care should be taken that the pens are well limed twice each year, and have an overhead light through which the sunshine can find its way.

Fig. 8. Calf-Feeder, Teat in Centre.

Objections are often made to allowing a calf to run with its dam or suck her, the calf being removed to a separate pen as soon as it is dropped and some form of calf-feeder (Fig. 8) used. I cannot agree with this practice. The mother's licking of her new-born calf warms it into life, which mere rubbing will not do so well; if separated, the mother and calf bellow to each other, become uneasy, and refuse to feed properly; and, lastly, the young heifer will jib at milking-time, and may become permanently bad-tempered. I always recommend leaving the calf with its dam for two or three weeks, tied up if necessary, in which case it should be allowed to run to her at milking-time and take half the milk, while it is gradually weaned on some good food.

Another question to be decided is whether the cows should be calved down in spring, summer, or autumn.

There are many considerations affecting this point. If it is merely a matter of the best time for the calf, I have no hesitation in saying that the calf should be dropped early in the year, say the beginning of February. In this case, the first two or three months can be spent under cover, and by the time the calf is ready to be turned out the weather will be warm, and it can use its first summer to the best advantage.

Generally, however, it is a matter of whether milk or cheese is required. The milk-seller, as a rule, contracts for so much milk all the year round, and will therefore be obliged to have some of his cows calving in every month of the year, but especially in the winter ones, when milk is so valuable. Cheese is only made during the summer months, and therefore the cheese-maker will calve his cows during the spring. There are objections to each practice. Summer calvers are much more liable to milk-fever: in winter calvers the cost of the milk is much greater; but taking everything into consideration, where there is no regular contract to supply milk all the year round I recommend calving most of the cows in spring and the remainder in the autumn.

Particular care must be exercised in the treatment of a heifer with her first calf. She is new to the business of milking, and must be quietly and gently handled. When her calf is taken away she may often express her feelings forcibly, and resent her udder being touched. See that the milker does not lose his temper, but sticks to his work and does it thoroughly. Very often the difficulty of handling a young beast leads a careless milker, when he should be most careful to extract the last drop, to scamp his work, with the result that the animal is permanently deteriorated. Unless the udder is milked out

clean, a cow will begin to go off in her yield, and if this is allowed with her first calf her yield will be less during her life. Not only so, but as the last milk contains far the greater part of the fat, unless a cow is milked clean the test for fat will be very low, and it will be found that the milk, when sold, though it is undoubtedly genuine, will fall below the standard.

My own practice always was to let the calf out to its dam at milking-time, and while it sucked on one side the man milked the other. The mother was quite quiet while her calf was by her, and was gradually broken in to her business. Also, whenever I thought there was any danger of careless milking, I used to make it a point to go round afterwards and see for myself whether the cow had been stripped.

At whatever time of year it is decided to calve the cow, care should be taken not to let her get into too high condition beforehand. If this occurs, there will be a danger of milk-fever at calving-time. Some cows naturally run to fat whatever you may do, and with such the only plan is to give them a course of reducing medicine. Epsom salts (half a pound to a gallon of water) about a fortnight before, and again just before calving, will do good.

After the cow has calved and taken her place in the dairy, care must be taken that she is properly fed and warmly housed at night in very cold weather. The feeding will be separately treated later on. The cows may either stand in one long row, or some on one side, some on the other of the passage. In any case, see that the house in which they are milked is convenient to the food-houses. These will consist of root-house and cake-house, where the choppers and chaff-cutters are, and the

hay-stack should be alongside. Attention to such points will save much time.

It is a disputed point whether cattle should be fed before or after milking. My own practice was always to fill the mangers before milking commenced, so that the cows might feed away contentedly while it was going on. Although, no doubt, objection might have been raised to a certain amount of dust flying about, yet I concluded that it was not of a harmful sort, and was in every way preferable to having the animals fretting and impatient while

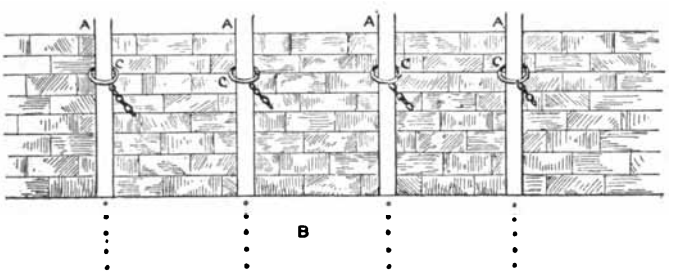


Fig. 9. Bad Form of Manger.
A. Post. B. Plank. C. Movable Chain.

waiting for the meal they knew would be served out as soon as milking was over.

The manger need not be very elaborate, but should on no account be in the form of so many of those in the Western counties (Fig. 9). These consist of upright posts (A) at stated distances, across the bottom of which planks are nailed about 2ft. from the ground (B). There is no cross rail higher up, and in three cases which came under my own observation the consequence was that the beast had walked into the manger to get at some food out of reach, had been hooked by a neighbour and thrown

down, and it was only with considerable difficulty and after cutting away the manger that the animal could be released. I have seen a very simple and excellent device (Fig. 10) consisting of two upright posts, one fixed (B), the other movable (C). When the cow was stalled the movable post was closed and pegged near the fixed one, and the cow's head was thus secured without chains, and though she could move sufficiently to feed from the manger

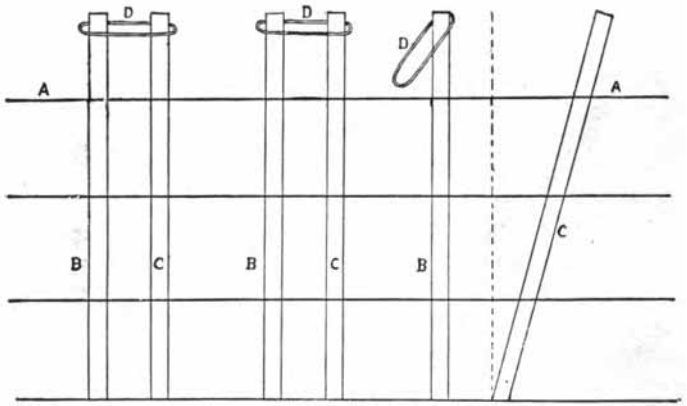


Fig. 10. Good Form of Manger.
A. Top Rail. B. Fixed Post. C. Movable Post. D. Movable Link.

in front, she could not get into it nor interfere with her neighbour.

It is a disputed question when cows should be brought under cover in autumn. It has been the habit for so long to bring most of the farm stock under cover from October onwards throughout the winter, that the views about to be put forward may strike some readers as altogether revolutionary and undesirable. I am quite aware of the arguments used by those who advocate the stabling of stock, but at the same time I hope to advance sufficiently strong

arguments in support of my views upon the necessity of a greater freedom and more open air in winter-time. It should be remembered that the treatment of human beings has already undergone such a change. It was the fashion not so very long ago to insist upon an invalid being confined in one room, in a warm atmosphere from which the smallest particle of really fresh air was excluded. Now all this is changed. It is recognised that in nearly all cases pure air and sunlight are the most potent agents at our command with which to overcome weakness and disease, and instead of the seclusion of olden days, as much open air as possible is prescribed.

Now, human beings and other animals are very similarly constituted. The same dangers have to be avoided, the same principles of healing applied, in both cases, and there can be little doubt that the treatment which has been found so highly successful in the case of the former must be equally applicable to the latter. Instead, therefore, of following the usual plan of bringing all kinds of farm stock under cover as soon as the first frosts make their appearance, I would suggest the more rational method of allowing them to remain in the field to a much later date, provided proper precautions are taken. It would be absurd to suggest that all kinds of cattle should be kept out of doors in wild and stormy weather, exposed to wind and rain, without proper shelter. Such treatment would probably not affect their health in any way, except beneficially, but it might have a very appreciable effect upon the returns of milk and beef. But where rough sheds or good hedges are at hand behind which the stock can shelter, little harm will accrue.

Since the system will probably be thought most objectionable in the case of milking cows, these will be dealt

with first. They are usually considered peculiarly susceptible to frost and cold; but I think that this idea is due to a misconception. When milch-cows have been out all night, and frost has covered the ground, the yield of milk is often seriously diminished next morning. The immediate conclusion is that frost has a bad effect upon the cattle. Now, the true cause of the sudden drop in the milk-yield is that owing to the greater cold the animals have used up a large quantity of their food in maintaining the heat of the body, and therefore there is less material than usual for making milk. It is therefore absolutely essential that as the cold increases at night the cattle lying out should be supplied with extra rations of heat-forming foods. If this is done there is no reason to expect any sudden drop in the milk-yield.

Some experiments recently undertaken by the Harper-Adams Agricultural College throw an instructive light upon this question. The regular practice in that part of Shropshire is to bring the milking cows into the house at night towards the end of October, which, it was pointed out, entails extra labour in attendance and extra food and bedding. Therefore the following experiments were made to determine whether it was possible to keep the cattle out of doors to a later date. Two lots of cows—five in each lot—were taken. Both lots were treated in the same manner with the exception that one lot was kept in at night after milking, and not turned out until after milking next morning. This lot received 8lb. of hay in the racks at night. The second lot of cows were turned out to pasture after evening milking, and left out all night, being brought in again for milking at six o'clock the following morning. In previous years the animals selected for the experiments had calved in the early

summer; but in 1904 one or two late-calved cows were included, as it had been suggested that under such conditions the milk-yield would be more liable to be affected. The animals were weighed at the commencement and the end of the experiments.

The experiments generally started about the beginning of November and continued to the end of December. In each year the climatic conditions showed considerable extremes; the thermometer constantly fell below freezing-point, on one night 25deg. of frost being registered. The following is a summary of the results:

Year.	Average Yield.		Decrease Milk per head per week.	Increase per cent. Butter-fat.	Increase Live Weight.
	Milk.	Fat.			
1901.	lb.	per cent.	lb.		lb.
Cows out	624	4.55	3.2	.77	6.0
Cows in	619	3.84	11.6	.31	1.5
1902.					
Cows out	401	4 2	13.6	.3	10.9
Cows in	405	4.3	26.4	.4	2.8
1903.					
Cows out	662	4.1	23	.52	8.0 Loss
Cows in	595	4.3	22	.49	8.0 Loss
1904.					
Cows out	455	4.19	14.8	.47	7.2
Cows in	406	3.68	15.6	.19	3.4

As Mr. Foulkes, the Principal, notes, the results are decidedly in favour of leaving the animals out at night, and from the fact that there is a greater increase in live weight when the animals are turned out, it is apparent that they do not suffer by the treatment. No shelters were available for the animals, and they did not appear to seek shelter from the hedges.

Could anything be more conclusive than these experiments regularly made during several years? The advantage, not only from the point of view of the milk-yield, but from that of the increase in live weight, is startling. This leads us to the consideration of fattening cattle under cover. Are butchers' cattle so delicate that they would show any different results if treated in the same way? I do not think so. If, instead of being cooped up in yards or stalls, they were allowed their freedom and some extra concentrated food, they would doubtless show quite as satisfactory an increase in live weight. But there is another matter not to be overlooked—the benefit to the land by such a procedure. The cake or corn supplied to the beasts out of doors would be largely returned to the land in the form of manure, and before it had lost any of its fertilising properties in the manure-heap. Again, the greater part of the labour now entailed in attending to the cattle under cover, and in carting out the manure to the field, would be saved, and this one item would represent a very large gain in both time and expense. Straw, also, is becoming year by year more expensive, and by the open-air method it would not be required. Therefore it would seem as if the treatment suggested would be the more advantageous for fattening cattle from every point of view.

A record should always be kept of the date at which each cow goes to the bull, and whenever she comes into season again, and then by adding nine months to this date one can tell exactly when she will calve. When the calf is expected bring her in at night and keep her under observation in a quiet place. There will be little doubt when she is in labour, and the attendant must then be at hand to see that she gets assistance if she needs it. Her stall

must be quite clean and plenty of fresh bedding strewn about, and as soon as the calf is dropped it should be put near her head so that she can lick it; then all traces of the birth should be removed, and the shed left sweet. A great deal of damage is often done to the freshly-born calf by letting it lie about in the dirt, and I am confident that that awful scourge of young animals, diarrhœa, is chiefly due to this.

In a couple of days the cow can go out again for exercise, and if the weather be mild the calf can go with her. It should be allowed all her milk for the first few days, and then if she is a heavy milker her udder must be stripped now and then. But I strongly advise that, if milk-fever is to be avoided, on no account should the cowman be allowed to milk the udder before, or for three days after, calving. (I shall refer to this again in the chapter on "Diseases.") It is a good plan to handle the udder of an in-calf heifer as much as possible during the period of gestation, and to pull gently at the teats and try to lengthen them, thus accustoming her to being handled before she is brought into the dairy.

Milking should be carried out at regular hours, and at, as near as possible, even intervals. If there is too long an interval, it has been found that a great loss of fat is the result. As soon as milking is over, each cow should be groomed if the time can be spared. If this is not done the animal will try to do it for herself, and this is why we so often see cows licking themselves in the fields. But the brush will reach parts that she cannot reach with her tongue, and will do the work more thoroughly, and ringworm and other parasites will seldom be found in a herd where grooming is practised regularly and a hard brush used.

The feeding arrangements will be treated in the chapter on "General Management."

In closing this chapter I cannot do better than quote the following rules relating to the management of cows and utensils, taken from a set drawn up by the United States Department of Agriculture :—

2. Observe and enforce the utmost cleanliness about the cattle, their attendants, the cow-house, the dairy, and all utensils.

3. A person suffering from any disease, or who has been exposed to a contagious disease, must remain away from the cows and the milk.

7. Allow no strong-smelling material in the cow-house.

8. Whitewash the cow-house once or twice a year: use gypsum in the manure gutters daily.

10. Clean and thoroughly air the cow-house before milking; in hot weather sprinkle the floor.

11. Keep the cow-house and dairy-room in good condition.

13. Promptly remove from the herd any animal suspected of being in bad health, and reject her milk. Never add an animal to the herd until it is ascertained to be free from disease, especially tuberculosis.

15. Never allow the cows to be excited by hard driving or abuse . . . do not expose them to cold or storms.

18. Provide water in abundance, easy of access, and always pure, fresh, but not too cold.

21. Clean the entire skin of the cow daily. If hair in the region of the udder is not easily kept clean, it should be clipped.

23. The milker should be clean . . . he should wash and dry his hands just before milking.

25. Brush the udder and surrounding parts just before milking, and wipe them with a clean, damp cloth or sponge.

26. Milk quietly, quickly, cleanly, and thoroughly . . . milk the cows in the same order.

27. Throw away . . . the first two or three streams from each teat.

29. Milk with dry hands. Never let the hands come in contact with the milk.

34. Strain the milk through a metal gauze and flannel cloth.

35. Cool the milk as soon as strained.

36. Never close a can containing warm milk.

40. Never mix fresh warm milk with that which has been cooled.

42. In no circumstances should anything be added to milk to prevent it from souring.

46. Milk utensils for farm use should be made of metal, and have all joints smoothly soldered.

49. Clean all dairy utensils by first thoroughly rinsing them in warm water. Next clean inside and out with a brush and hot water in which a cleaning material is dissolved, then rinse, and, lastly, sterilise by boiling water or steam.

50. After cleaning, keep utensils inverted in pure air, and sun if possible, until wanted for use.

CHAPTER VI.

MILK.

MILK is composed of water and certain solids, such as fat, sugar, casein, and lime. The fat is what is extracted in the form of cream; the casein is the part that gives us cheese, and is often combined with the fat; and the remainder, after the extraction of the other constituents, is what is known as whey, composed of sugar and water. It is worth while remembering this when we hear that whey has no feeding-value: it is not very great, of course, but still it is useful in combination with other foods.

The average quantity of fat in average milk would work out at about 3.3 per cent., but is often as low as 2.5 per cent. in poor milk, therefore care must be taken to test the supply constantly to see that it does not fall below the standard made by the Board of Agriculture, for if it does, there is a liability to prosecution, in which case the onus of proving that the milk has not been adulterated will rest with the defendant.

FACTORS AFFECTING THE MILK-SUPPLY.

The chief factors in determining the quality of milk are breed, age, time of year or day, and food. Certainly the most important is the first. There are cows in

almost any breed which give a high test for fat, but on the average certain kinds, such as the Jersey, give rich milk, others like the Ayrshire comparatively poor.

Age also exercises its influence. A heifer with her first calf cannot be expected to be at her best, while a cow of ten is past her prime. The period at which a cow is supposed to be most valuable is from four to seven years of age. During this time she has attained her full growth, and her milking powers are at their best; afterwards they will begin to wane. The most important time of a cow's life is with her first and second calves, and all that can be done to tune her up to the highest pitch of usefulness must be done then.

The season of the year always has a marked effect on the composition of milk. In the spring the grass is young and watery, and has a purging effect on the cows after their winter under cover. This is quite healthy and probably Nature's way, but yet the result is that the milk in the spring is not so rich as in the autumn. Another reason for the poorness of the milk early in the year is that most of the cattle are calving then; they are in the flush of their milk, which therefore cannot contain as high a percentage of fat.

The difference in fat between morning's and evening's milk has also often been remarked by those who test the milk of their herds. On the other hand, Mr. Lloyd, consulting chemist to the British Dairy Farmers' Association, drew attention in his Report on the Milking Trials at the Dairy Show of 1903 to the remarkable similarity of fat in the morning's and evening's milk.

He says:—"In 1900 I drew attention to the similarity between the actual quantity of fat produced by a cow in the morning and evening milk. I have again calculated

these figures for 1903, which are given in the following Table :—

AVERAGE ACTUAL WEIGHT OF FAT PRODUCED PER COW PER DAY.

Breed.	Morning.		Evening.	
	1903.	1900.	1903.	1900.
	lb.	lb.	lb.	lb.
Shorthorn	.91	.82	1.03	.87
Jersey	.88	.75	.83	.82
Red Poll	.72	.72	.68	.77
Kerry	.72	.57	.67	.54

Comparing these results with 1900, which for this comparison I have inserted in the table, it will be seen that the similarity in the actual quantity produced morning and evening is again striking, except in the case of the Shorthorns."

Now we have here a most remarkable apparent contradiction between the result of the chemist's tests and general experience, and it will be asked, What is the explanation? None is given in the Report, but I venture to suggest the following:—At the Dairy Show approximately equal periods intervene between morning and evening milking, whereas on the farm the cattle are often milked at five o'clock in the morning and three o'clock in the afternoon—intervals of ten and fourteen hours. It is well-known that if a cow whose udder is full is allowed to stand in that condition for some time the percentage of fat in the milk will be reduced; therefore in the case of a farm worked on the above lines we should expect to find the evening's milk richer than the morning's. This is

usually the case, and in the Table given above it will be noticed that this was generally so in 1900.

The last factor affecting the amount of fat to a certain extent is food. Rich food will give rich milk up to a point, but after that by far the greatest effect is due to the inherent qualities of each particular cow.

MILKING.

Milking should be performed at equal intervals of time. Every implement used during the process should be scrupulously clean. The cow-house should be well ventilated, there should be plenty of bedding, and quiet should prevail. Nothing tends so much to upset a cow as noise.

The Handling of Milk.

Before commencing, the milker should cleanse the flank and udder of the cow with a damp cloth. It is not necessary to wash the cow—a good rub will be sufficient. He should then cleanse his own hands, and put on a linen milking-suit. Thus cleanliness of the cow and its milker is secured, and this is the first step in the process. Then our attention has to be on the alert again to discover those lurking bacteria. We find them very close at hand, and it may be said here, once for all, that they have to be reckoned with at every step in the dairy business. The milk in the cow's udder is believed to be absolutely pure; it is not even decided yet whether, in the case of a cow with a tuberculous udder, the milk becomes affected. But this purity does not extend to the teat which is in direct connection with the udder. Between the teat and the udder is placed a valve or muscle known as the "sphincter" muscle, which prevents the escape of the milk under normal conditions. When pressure is applied to this

muscle, either by the hand in milking or by an abnormal quantity of milk being allowed to stay in the udder, the valve is forced open, and the milk escapes. But, as already noticed, this muscle closes the aperture under normal conditions.

It is probably due to this fact that the bacteria which undoubtedly find entrance to the teat go no further. The air of the cowhouse is swarming with these microscopic

Fig. II. Hygienic Milk-Pail with Funnel and Strainer Removed.

organisms, and they find their way into the teat through its orifice. Therefore danger exists in the teat itself. Luckily for the consumer, however, as soon as the seat of the danger is understood it is one which is very easily surmounted. All that is necessary is to throw away the first two or three streams of milk which are pressed from the teat. These first streams of milk will clear out the bacteria in the teat, and render the passage clean and

pure. A milk-pail may now be obtained (Fig. 11) with a movable strainer.

The next point concerns the milker. Although the reason is hard to find, it has always been the habit of the general run of milkers on the farm to prefer to milk with wet rather than dry hands. Why it should be so I cannot say. It is just as easy to milk with dry hands when the process is learnt, and the dry method has two distinct advantages. As soon as the milker with wet hands begins he presses a few streams of milk on to his hands. What is the immediate result? During the milking process this milk falls off drop by drop into the pail, and unless the milker's hands are absolutely clean the whole supply is injured at the source. But even if his hands were clean at the beginning it would be almost impossible that they should remain so after handling a dozen or so cows at a sitting. Therefore the milk from each later cow would be in greater danger still. It can be understood, therefore, how essential cleanliness is in this matter, and how necessary it is that the milker should work with dry hands.

The second advantage of this method is that the cow's teat is not so liable to injury. When the udder or the teat is allowed to become wet, and the cow is then turned out to pasture again, it often happens that the cold wind cuts the cow's teats, and so cracks them. At the next milking the milker's wet hands make the injury worse, and it is no uncommon experience to find cows which are usually perfectly quiet and docile, uneasy and restless at milking-time. This often leads to blows from the milker, with the result that the cow becomes nervous and excitable, and the milk-yield is seriously affected. Therefore, from the point of view both of cleanliness and of securing

the greatest yield of milk, it is essential that the milker should always work with dry hands.

Milking should not be done in the "stripping" method —*i.e.*, moving the fingers up and down the teat—but should be effected by pressure only, just as you would press water out of a rubber bulb. Milk out the very last drop: most of the fat in milk is contained in what is last drawn, and unless the udder is emptied the loss over the whole herd in the year will be very serious. Besides, unless an animal is properly milked out she will begin to go down in her yield, and this is the usual method adopted for drying off a cow before calving. It is especially necessary to continue to milk a young cow so long as she gives even the smallest quantity of milk.

As soon as milking is finished, the milk should be weighed, so that a record may be kept of the yield of each cow. This is most important, not as affecting the quality of the milk, but because a complete knowledge can be gained, by the perusal of this record, of the performance of each cow.

When the milk has been weighed it is passed through strainers into the general receptacle. This must not stand within the cowhouse during milking-time, but should be placed in a cool spot in the open air, and as far as possible from the manure-heap. The strainers should consist of a fine gauze wire and a muslin strainer on the top. The milk in passing through these should part with any hairs or dirt which may have fallen into it. The receptacle containing the mixed milk should thus be perfectly pure and wholesome. This receptacle must be taken at once to the dairy and the milk cooled. This matter of the refrigeration of milk is not sufficiently attended to. It is absolutely essential that all milk which is to be sent to

market, especially when it has to undergo a railway journey, should be cooled at once to as near 40deg. as possible. This enables the milk to remain sweet for a long time, and any bacteria which it may contain are unable to develop. The whole apparatus for the refrigeration of milk is small and easy to manage, and should be found in every dairy. But whether milk be thoroughly refrigerated or not, it is most important that the can should never be closed while the milk is warm. It should at least be left to get as cool as long as possible in the dairy before the can is closed up preparatory to starting on its journey.

Another valuable property of the refrigerator is that it enables us to dispense with preservatives. I am convinced that what has called forth so much of the blame laid upon the milk-supply at the present day is the preservative added to it by the producer with the intention of enabling it to keep sweet until it reaches the consumer. If only the dairyman would properly cool his milk before it goes to market, and the retailer would repeat the process before he starts to deliver it to the consumer, there would be no need of preservatives.

The milk of a cow which has just calved should not be used until four days after the event. This first milk is called "colostrum," and has an unusual composition; it has a purging effect, and is intended by Nature for the use of the calf. I have already said that I am strongly averse to milking a cow at all for three days after calving, during which period her calf should have access to her.

Effects of Bad Milking.

The difficulty experienced of late years in obtaining a sufficient number of milkers of any sort has compelled dairy-farmers to put up with whatever they could get and

be thankful. One of the worst features of the matter is that the grave disadvantages which result from improper milking are liable to be overlooked, and so long as the necessary amount of milk is obtained for market the dairyman has to rest satisfied. There will, however, probably be some alteration in this system before very long, for there can be little doubt that many of the prosecutions which constantly take place might be avoided if more care were exercised in the choice of proper milkers or the training of the unskilful ones.

The commonest cause of a dairyman being summoned is for selling milk deficient in fat. The usual defence is that the milk is actually genuine, but that it is not always possible to ensure the proper percentage of fat. There is much to be said in favour of such a plea in a great many cases. The length of time which elapses between evening and morning milking is well known to have an unfavourable effect upon the percentage of fat in the morning's milk. The general method of neutralising this tendency is to mix the milk of the herd together, and since some of the animals always yield an extra rich milk, they make up for any deficiency in fat in the yield of the poorer cows. But where the whole level of the herd is poor, and the milk at its best barely comes up to standard, it is absolutely essential that the greatest care should be exercised by the milker in extracting every drop of milk from each individual cow. The resulting addition in amount to the pail may not be very startling, but the greater richness of the milk in fat will soon become evident.

It is very well known that the different portions of the milk yielded by any cow at one milking vary very greatly in the amount of fat which they contain. The first milk drawn is poor, the last very rich, in fat percentage. It

has been computed that the percentage of cream, in the case of the milk of good cows, contained in the first and last half-pints drawn may vary between 5 and 32 per cent. This shows how much difference an extra half-pint of milk at the finish may make in the richness of the mixed milk. Again, the difference is not only in the fat, but in the amount of total solids. Under the present standard the total solids must be at least 11½ per cent. Now in the milk first drawn they do not always come up to this, the variation between first and last milk being often as much as 9 per cent. Therefore, here again we have further evidence of the importance of proper milking.

The lesson to be learnt is that every cow must be milked out to the very last drop. The first few streams from each teat may be discarded with advantage. There is no danger of any fat being lost by this, but since the bacteria which are present more or less in the udder of every cow are mostly crowded near the orifice of the teat, it is essential that they should be cleared out with the first few streams of milk and kept out of the milk which goes to market. The probability is that if more attention were paid to this one small matter the milk would keep a much longer time and would be more wholesome in every way. It is no unusual thing to see the first few streams of milk used for wetting the milker's hands, with the result that this milk eventually finds its way into the pail drop by drop. This should be absolutely forbidden, and milking with dry hands, as already suggested, insisted upon.

Having discarded the first streams of milk, every effort should be made to extract the uttermost drop from the udder in order to secure every particle of fat. There are two very common reasons which militate against this desirable result. The first is that the milker is in too

great a hurry. This does not mean that a man who habitually milks fast is necessarily a bad milker; far from it. I have found, as a rule, that the expert milker not only milks faster than the inexperienced hand, but also obtains more milk. Fast milking and hurried milking are not at all the same thing. The good milker handles the teat properly, and makes the operation as pleasant as possible for the cow, which repays him by her larger yield. The inexperienced milker probably hurts her more or less, and she withholds her milk. Moreover, cows begin to fret if too long a time be spent over milking, and the result is evident in the pail. Feeding is usually done after milking, and the animal knows this. Therefore, let the milking be done as quickly as possible, without hurry, and the very last drop drawn.

There is, however, another reason why milking is often imperfectly done. Many cows are nervous and bad to handle, and instead of exercising all the more care and patience the careless milker gives in and hurries on to the next animal. This is one of those things which require the most careful supervision from the farmer, and a great deal of good may be done by taking a walk round at milking-time and stripping a cow here and there to see that they have been properly milked out.

Lastly, probably the very worst feature of bad milking is that it generally permanently injures the milking capacity of the cow. In the worst cases serious injury is often caused to the delicate mechanism of the udder, and garget or mammitis may be induced, resulting in the loss of a teat or quarter. But even if no actual injury is caused to the udder itself the yield of milk is affected. A very common method of drying off cows preparatory to calving is to leave a small quantity of milk in the udder

at milking-time. The yield quickly falls off and the cow goes dry. Now if the milker does his job badly the result is exactly the same: the cow tends to go off her milk. But the mischief does not even end there. It is most important, especially in the case of young dairy cattle, that the animal should be made to do its best with each calf. The whole future record as a good milker depends upon the first year or two. Therefore if milking is not properly attended to in the early years—and it is generally the young cattle which are nervous and hard to deal with—the milking capacity will be permanently affected and the cow will settle down into a poor milker.

Finally, milk as quickly as possible, milk out the very last drop in all cases, and preserve the utmost cleanliness both in the person of the milker and in the utensils.

FERMENTATION.

The process known as fermentation, or souring, in milk is due to the multiplication of bacteria called lactic acid bacteria. The medium which suits them best is a rather high temperature, about 80deg., and therefore, if their ill-effects are to be prevented, care should be taken that the temperature of the dairy never exceeds 54deg., for at this temperature their increase is very slow.

The dysentery which I have already alluded to as so often attacking very young children is supposed to be due to this organism, and therefore the best method is to see that the milk and bottle are always boiled before use and the bottle kept in pure water between meals. Sterilisation has been much in vogue, and consists of putting the milk into hermetically-sealed bottles and boiling it (Fig. 12). Pasteurisation is merely the repetition of the process a

second time, in order to destroy the spores which were thrown out by the bacteria in the milk before their destruction by the first boiling. This requires a rather higher temperature at the second boiling.

But the best system of all is to exercise perfect cleanliness in every process through which the milk passes. Clean milking, clean milk-vessels, keeping the milk away from the neighbourhood of anything likely to taint it, straining it thoroughly and then cooling it —these precautions will go a long way towards making it wholesome at the start and keeping it so.

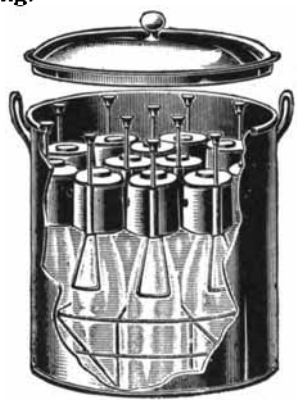


Fig. 12. Steriliser for Household use.

MILK-TESTING.

There are several machines in use for testing the fat in milk, such as the Gerber Butyrometer or the "Standard" Tester (Fig. 14). The principle on which Dr. Gerber has

Fig. 13. Butyrometer Test-Tube.

worked is to release the butter-fat in milk-products by the addition of sulphuric acid. Centrifugal force is employed to ensure perfect separation of the fat. The points aimed at in Gerber's Butyrometer are accuracy,

rapidity, simplicity, compactness, and cheapness. These are secured in the following way. The apparatus consists of (1) the centrifugal machine in which the butyrometers containing the milk and acid are rotated; (2) the

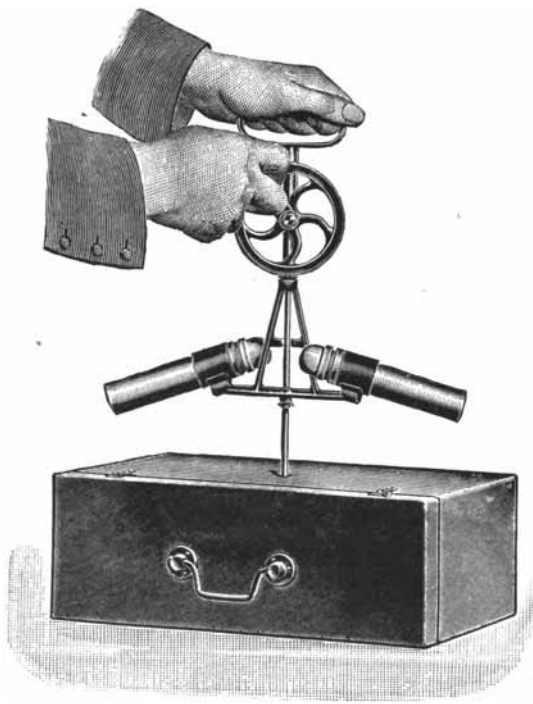


Fig. 14. "Standard" Tester and Tube.

butyrometers (Figs. 13 and 15), containing 10c.cm. of acid, 1c.cm. of amyl-alcohol, and 11c.cm. of milk; (3) pipettes for measuring these; (4) a water-bath for warming the butyrometers. As soon as the butyrometers are filled, they

are placed in the centrifugal machine, which is rapidly rotated with a strap for three minutes, after which they are taken out and placed in a hot-water bath for a few minutes, when the fat percentage may be read off from the scale on the butyrometers.

Nothing could be simpler or more efficient than this machine, and several tests—as many as twenty-four—may be made at a time. Care must be taken in shaking the butyrometers that the rubber stoppers do not fly out, or the sulphuric acid would be dangerous to the operator. Cream, butter, or cheese may be tested with the same machine, and with little more difficulty than the milk. Apparatus for making four tests, with a proper supply of

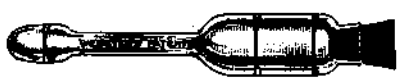


Fig. 15. "Standard" Test-Tube, showing 3 per cent. Butter-Fat.

chemicals, may be obtained for £4 5s. However, since there will be many dairymen who will not feel inclined to make their own tests, the Board of Agriculture has arranged with Agricultural Colleges and Dairy Schools throughout the country to test milk for a fee of sixpence a sample. Almost every county now possesses one public analyst of this sort.

The sample must be taken immediately the cow is milked. The whole milk should be well mixed together, and at least a quarter of a pint removed, and then corked and sealed. The bottle containing the sample must be full, and a label must be affixed bearing the name of the sender, full postal address, and the date on which the sample was taken.

In testing for total solids in milk a lactometer is necessary. This is a graduated glass instrument which is gently lowered into the milk and the scale read off.

The formula for the total solids is then

$$T = \frac{L + .7\,f}{3.8} + f$$

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

Where T=total solids, L=lactometer reading, f=fat percentage.

I have now given the method of testing the fat in milk and the total solids not fat, and as these are all that will be required for ordinary work I will not describe the methods for testing such things as added water, specific gravity, &c.

SELLING MILK.

In concluding this chapter I wish to say a word about the present system of selling milk to wholesale buyers. These insist upon the retention of the old "barn gallon," which is all in their favour and unfair to the seller. The barn gallon contains two gallons and an extra pint of which no account is taken, but which is supposed to be allowed to the wholesale dealer as an offset against his losses (?) in delivery. It would be much fairer if the milk were sold by weight in all cases.

Another point which should have more attention paid to it is the question of the milk contract. I am happy to say that sellers are beginning to combine in several counties to fix the price of milk in each district, so that farmers shall not be forced to sell their milk at a ridiculous price when milk is plentiful. This is the time always chosen for contracts by the wholesale dealer in the towns, and if

possible he obliges the producer then to agree for the next twelve months. If this system of combination comes into play throughout the kingdom, farmers will be protected against themselves, and prices will be settled and revised periodically, while severe penalties will be inflicted for selling milk at a lower figure.

CHAPTER VII.

INFANT MORTALITY AND MILK.

THERE can be little doubt that the increasing interest taken in the milk-supply of the British Isles has let in a flood of light upon some dark spots in connection therewith. One of the most striking of these is shown in a report presented, giving the number of the deaths among infants for the year 1904, and deducing from the figures certain conclusions as to the reason for the striking mortality. "The total deaths in England and Wales during 1904 were 549,393. Of this number, 137,490—about one-fourth of the whole—were of children under one year. Further examination of these figures shows that half of the children died from preventable diseases, diarrhœa alone causing 28,957 deaths. This startling statement is exercising the minds of nearly every sanitary authority in the kingdom, and efforts are being made by leaflets, lady health visitors, and the supervision of the milk-supply to abolish or to remedy the ignorance and prejudice responsible for the greater proportion of the 28,000 deaths from diarrhœa, for the active cause of diarrhœa in most cases is improper feeding."

I have quoted the report as it stands, but I must not be taken as agreeing with the deductions made. There can be no blinking the fact that in this, as in so many

other cases which have been repeatedly brought to the notice of the public, we are left to infer that the evil at the root of the matter is an unwholesome milk-supply, The report practically says as much, for it continues that at a meeting to be held shortly "the question of the use of cows' milk for infants will be dealt with, but the larger question of the milk-supply for the whole of the population will not be touched."

Now, farmers have been so long accustomed to abuse about the way they conduct every department of their business, that they have become rather callous and indifferent to outside opinions. They know that so many of these are based on insufficient knowledge on the part of their critics, and are so undeserved, that they "grin and bear it." But the present crusade against the milk-supply from the farm, and the loud and increasing clamour for the control of this supply by bringing it into the hands of municipal authorities, are of such grave import to farmers that it will no longer do to take the criticism "lying down"; but farmers must make an effort to refute the falsehoods spread broadcast, and then see to it that the produce they are offering for public consumption is always above suspicion.

There can be no question that impure milk is highly dangerous, and is liable to contain in itself, and spread to consumers, many virulent diseases. It has often been found to contain the typhoid bacillus, the tubercle bacillus, and others, and there are serious grounds for believing that, objectionable as the theory may appear to the farmer, the use of unwholesome milk is often the cause of diarrhœa among infants; and that when, as in the cases quoted in the report, these infants are only a few months old, the results may be fatal. But it should not by any

means be assumed offhand that because milk may cause diarrhœa and death it is necessarily unwholesome. A very similar state of things exists on the farm, where one of the direst scourges of the breeder and the dairyman is diarrhœa, numbering thousands of victims every year. But the reasons for this do not always lie in the impurity of the milk, and these reasons, which have been repeatedly pointed out in the Agricultural Press, are equally applicable in the case of infants. I shall refer to these later on when I come to deal with some of the contributory causes of diarrhœa in infants.

But in order that milk may be certain of starting well —in order that suspicion may be prevented from resting upon the source—it would be well if every milk-producer paid very strict attention to a few hard-and-fast rules. First, he should make certain that the cows which produce the milk are sound and fit for the purpose. Since the milk-glands which yield the milk are intimately connected with the blood-supply, it would appear almost impossible that the milk could be above suspicion unless the blood were healthy. It has never yet been proved—in fact, has been absolutely denied by some of our leading authorities —that a cow suffering from tuberculosis can infect human beings. The same might be said of the germs of other diseases. At the same time, a great deal of danger would be avoided if every cow-keeper were to make certain that all his cows were in sound health.

The second point, and one upon which it should be unnecessary to dilate, is the insistence upon absolute cleanliness in the manipulation of the milk upon the farm. Strange though this may seem, this is by no means universally the case. The cows must be cleaned before milking, the milker's hands and person must be clean, the milk

must never come into contact with the milker's hands, it must be thoroughly strained, and must be well cooled before it is put into the milk-cans preparatory to starting upon its journey (Fig. 16). If the above points are attended to by the producer, he will have done his part, and cut away the ground from under the feet of those who wish to replace him by a system of municipal milk.

Even, however, supposing that the farmer has taken every care to ensure thoroughly sound, clean milk leaving the farm, it does not by any means follow that it will reach the consumer in the same condition. This arises from two causes: (1) Preservatives are often put into the milk by the town dealer; and (2) sterilisation may not perhaps produce the results expected from it.

Fig. 16. Milk-Churn and Ice-Chamber.

Preservatives.

This matter, with which I have dealt at greater length elsewhere, is becoming more pressingly urgent day by day. It has been found that certain doses of chemicals enable milk to be kept a considerable time without any evil results being apparent. Perhaps there would be very little harm in the use of such preservatives if they were only employed in small quantities; but this it is impossible to ensure. As soon as the milk arrives in town after its long journey, the wholesale dealer puts into it what he

considers to be the right amount of boric or other acid; but he overlooks the fact that the retailer probably does the same, and everyone through whose hands the milk passes before arriving at the consumer. What the state of the milk may be when it finally arrives at its destination, I shudder to think, and when it is intended for the use of children the results may be anything but good. In this lies one of the first causes, as I believe, of sickness and diarrhœa among infants. For though certain doses of preservatives may be almost harmless in the case of adults, they cannot be considered so for infants, and the use of preservatives in any form—especially in milk intended for the food of infants—should be absolutely forbidden by the Legislature.

Sterilisation.

As is the case with every other new discovery which opens up avenues of escape from certain deadly diseases by its proper employment, sterilisation is being adopted in every direction until it is almost run to death. I think this is unwise. I have often given my opinion about what I think are the deficiencies of sterilisation. Briefly, they amount to this, that in sterilising milk you undoubtedly kill the germs of disease, but you will also kill those useful germs which are always present. The germ-theory is still in its infancy, and, so far, attention has only been paid to those which are harmful. I believe this is a great oversight. As soon as it becomes recognised that there are good as well as bad germs in milk, and that possibly in these good germs the valuable and health-giving properties of milk reside, there will be less anxiety to sterilise and pasteurise milk in the present fashion until it has become something entirely different from what it was

originally, and therefore unwholesome and indigestible for infants.

I have just touched upon these two matters in connection with the milk-supply because it seems to me that they are quite sufficient in themselves to account for the high rate of mortality among infants. When the milk is supposed to be at fault—and so far as the majority of infants are concerned this must necessarily be so—the farmer is blamed. But it is not by any means necessary to go so far back as that, and if the use of preservatives in milk were forbidden a great advance would have been made. The subject of sterilisation demands a great deal more examination on the part of experts before we should be ready to take it for granted that it does more good than harm. I know that it will be said that unless you take measures to prevent milk from souring you are making it impossible to send it from long distances. I deny that this is so, and I believe that I am not unsupported in my denial, and I hope presently to suggest methods for securing the object in view; but even supposing that a certain quantity of milk were prevented from being sent to town from long distances, it would be better that this should be so than that young children should be fed upon an article which is poisonous, and which is not of the nature and substance of milk.

Granted that preservatives and sterilisation have a very important bearing upon the milk-supply, let us now consider the question of municipal dairies, and discuss their advantages and disadvantages.

The only conditions under which municipal dairies could be established with any benefit to the consumer would be, not only that the milk should be received there as it comes from the farm and be cleansed or sterilised, but that the

cows themselves should be maintained and supervised by the municipality. This is evidently essential. What object would be gained by treating the milk on arrival in the town, if the evil at the source—such as dirt or unhealthy cows—remained unaffected? The greater part of the mischief arises from the unwholesomeness of the milk, from whatever cause, and therefore the supervision of the municipality, to be thoroughly efficacious, must extend from start to finish.

There are many grave objections to such a course. Let me examine only two of these, which will sufficiently indicate the difficulty. First, each municipality would be obliged to maintain its town dairy in order to avoid the evils which now arise from the long journeys that country milk has to undergo. But the present condition of the milk trade, the problems with which we are at present confronted, arise directly from the fact that town dairies have for some years been found impossible to maintain, and that probably one of the causes which contributed to this condition was the issuing of compulsory regulations by urban authorities for the control of these dairies. Such regulations were found too irksome in practice; therefore most of the town dairies were shut up, and hence the recourse to the country districts for so much milk. Even supposing, however, the municipality were able to overcome the difficulty, is it to be believed that cows which were kept in the foul air of towns from their earliest years would yield milk of better quality than those bred and kept in the pure country air? I doubt if many would be willing seriously to support such a contention. There is little doubt that a large proportion of our dairy cattle, especially among heavy milkers, which are just those which would be selected for the municipal dairy, are

liable to develop tuberculosis; but whereas in the pure country air this liability remains in abeyance, it would very soon show itself when the cattle were kept continually housed and in a more or less foul atmosphere. Thus one of the great dangers with which many of the would-be reformers are so anxious to deal to-day would merely be the greater by the institution of municipal dairies.

At a lecture delivered a short time ago at the Royal Institute of Health, the lecturer, in dealing with the diseases conveyed by milk, called special attention to tuberculosis. He stated that it was now an established fact that bovine and human tuberculosis were intercommunicable. It was therefore far from pleasant to be reminded that from 20 to 30 per cent. of all milch-cows were suffering from generalised tuberculosis. Now, first, I deny that it is an established fact that bovine tuberculosis is communicable to human beings. This is one of those statements which are so constantly and rashly made by those hostile to the present dairy system. But even supposing it were accurate in fact, did the lecturer mean to argue that the danger of spreading tuberculosis would be minimised by keeping the milch-cows confined in town stables? I doubt it.

My second objection to municipal dairies is that they would mean unfair competition; and not only would this competition be unfair, it would also be unnecessary. I say the competition would be unfair. Every farmer or dairyman works on his own capital, necessarily limited, and is bound to see that that capital returns him a fair interest. A municipal dairy, on the other hand, would be controlled by councillors not necessarily conversant with farm procedure, with the unlimited capital of the ratepayers behind them, and feeling under no obligation

to earn a dividend on their outlay. Could any competition be more unfair? Besides, the farmer's livelihood would eventually be threatened in every branch. As soon as the municipal dairy was in full swing, it would be found necessary to take up land whereon the hay, straw, and corn might be grown to feed the dairy cattle. As in the case of other farming, it would soon be found that store cattle must be kept to eat off the aftergrass, and doubtless in a very short time young cattle would be bought in and fattened for the butcher. All this on an uncommercial basis; for admittedly the health of the population, not a profit, is the object in view. I cannot see that the project is anything but objectionable, and would certainly enormously increase the already grievous difficulties with which the farmer has to contend.

But would it fulfil its object? I doubt it. I said in the early part of the chapter that diarrhœa was quite as awful a scourge on the farm as in the cottage. One of the worst diseases which the farmer, and especially the dairyman, has to contend with is "scour" or diarrhœa in calves, and nobody has yet succeeded in coping with the disease. Yet I believe it is due to two causes—dirt and the improper use of milk, and that the latter cause plays the more important part. When the young animal wanders about the field with its dam, it runs to her constantly and sucks a few drops from her—and a few drops only—of warm milk. But the dairyman cannot afford to let his calves run with their dams, and so he shuts them up and feeds them on milk from the pail. This milk is necessarily fed at a cooler temperature than that at which the calf would have sucked it first-hand. Also, since—owing to the exigencies of farm life—the calf can only be fed at considerable intervals of time, it is given its food in too

large quantities at a meal. There can be very little doubt that these—too much milk and too cold—are the reasons for the large amount of mortality among young cattle. Now compare the young infant with the young animal, and what do we find? That the two are on all fours, and that improper feeding of the same sort, with the same food, results in the same disease.

Will municipal dairies remedy this evil in the smallest degree? Certainly not. You may guarantee the milk to be fresh, but you cannot guarantee that it will be fed to infants with discretion. First, teach those in charge of infants the importance of following natural and rational methods of feeding and examine the results, and if a great improvement is not noticed in the rate of mortality, then talk of municipal dairies.

The truth is that there is no valid argument at all for the handling of the milk-supply by municipal authorities. They already have the power to appoint inspectors to examine the conditions under which milk is produced, they have special regulations for controlling cowsheds and milkshops, and if these inspectors carry out their duties all will be well.

To sum up what I have already said: See that every precaution is taken to keep the milk absolutely pure as it comes from the cow; cleanse every utensil employed in the handling of milk thoroughly by scalding with steam or boiling water; cool the milk to as near 40deg. as possible before it is despatched on its long journey by rail; see that it is delivered as quickly as possible on reaching its destination; allow no preservatives to be introduced at any time or in any quantities; and feed young infants with milk at the natural temperature and in small quantities at a time.

We hear more and more every day of this question of the milk-supply and infant mortality, but having had a very intimate acquaintance with young cattle, and having seen the avoidable mischief which can be wrought by pure carelessness, the problem does not seem to me to be one which is incapable of solution. The farmer is open to control, and it is in this direction that an effort must be made; but do not lay one more burden on his already over-weighted shoulders, lest it be the last straw which shall cause him to sink, and the practice of agriculture become altogether a thing of the past.

In connection with this subject an account has appeared in the *Times* of an experiment which has been tried for the last twelve months in the industrial village of Longwood, in Yorkshire, and which is intended to form an object-lesson of what might be attempted on a larger scale. The township of Longwood has been absorbed into the county borough of Huddersfield. The population is 5359, and the acreage 1334; its height above sea-level varies from 150ft. to 1200ft.; there is no congested population, there are no slums; portions of the area are really urban, whilst other parts are almost purely agricultural. By far the greater part of the population, male and female, are factory workers engaged in the manufacture of woollen goods, with a sprinkling of quarrymen, masons, labourers, and small farmers. Very few married women go out to work; there is a prejudice against it in the village. The death-rate for ten years has averaged 13.44, and the birth-rate 19.39, whilst the infantile mortality figure has been 122 per 1000 births.

As this community seemed in no way exceptional, but quite typical of many localities in manufacturing districts, it was decided to see if there could be any appreciable

effect produced on the wastage of infant life. The particular method took the form of a promise to pay one pound as a birthday present to each baby born in the district between Nov. 9, 1904, and Nov. 9, 1905, on its attaining the age of twelve months. This promise was, however, the smallest part of the plan. The really effec tive part of the scheme was a small committee of ladies. Armed with the promissory card the ladies obtained an introduction to the homes and paid visits periodically as occasion offered, helping the mothers with advice and sympathy. On various occasions, such as Christmas and Easter, little remembrances were sent to the individual babies, and at the commencement of the diarrhœa season and at the onset of cold weather short personal letters of advice as to the precautions needful were sent to each mother through the post.

The results speak for themselves. The average infantile mortality figure for ten years is *122*; for the twelve months period referred to above the figure is 54. In other words, the rate of infantile mortality is less than one-half the average. A more intimate analysis of the figures and the facts would enlarge and emphasise the value of the statistical result. This is only an intermediate stocktaking, and there remains still one-half the period to elapse before the complete result will be apparent. It should, however, be noted that the time already covered comprises a whole year with all its varying seasonal influences. There is no reason to anticipate a less favourable figure being arrived at for the whole period. On the contrary, it may well be that, with the additional experience and the further measures which have been elaborated as the results of that experience, together with the spread of information and the growing

weight of public opinion, all reinforced by the encouragement afforded by the success already secured, a still greater improvement may be attained.

Although it may seem somewhat dangerous to attempt to draw conclusions from so short a time and so restricted an area, there are certain deductions which, confirmed as they are by facts noted on other fields of observation, may be formulated as indicated, if not proven.

First, that this particular series of facts confirms the conclusion of the Physical Deterioration report that there is no indication of degeneracy, and that measures taken for the preservation of infant life help not only to save the lives of some who might have died, but, what is of still more importance, to improve the physical development of all.

Second, that an infantile mortality rate of over 100 is easily avoidable, and as a corollary that a rate higher than this means that the infants do not die, they are killed.

Thirdly, that there is no general lack of maternal affection on the part of the mothers; speaking broadly and with a certain reservation, the mothers are not to blame for the excessive mortality. A note without an exception is that where the husband does his duty to the wife, even approximately, the mother will always do her duty to her child.

Fourthly, that there exists a most marked ignorance on the part of many mothers of how to feed, nurse, and tend their children, but with this ignorance there is generally a perfect readiness to learn as far as there is capacity, and on the part of young mothers an eager anxiety to be advised and helped in the rearing of their babies.

Fifthly, that there are many conditions of modern life

that tend to a high infantile mortality, the chief of these being the employment of married women as bread-winners for the family, and next to this the total exclusion from the instruction given to girls of everything bearing upon the care and upbringing of infants.

Sixthly, that the primary object of every effort to prevent the wastage of infant life should be to help the mother in her home, never to separate mother and child, for a very second-rate mother is far superior to a first-rate nurse.

CHAPTER VIII.

STERILISATION.

I HAVE already incidentally touched upon the subject of the sterilisation of milk; but the question is of so much importance that it would seem worthy of more extended consideration. Not even the introduction of the separator, with its great value and almost universal use, produced such a profound effect upon the dairy trade as did the sterilisation of milk. And yet these effects were, in a very large measure, both unexpected and undesirable. So long as little interest was evinced in the quality of the milk supplied to our towns, no more was expected of the dairy-farmer than that he should keep a sufficient number of cows to furnish the necessary quantity of milk, and should despatch it twice a day at regular intervals. Towards the end of the nineteenth century, however, as soon as the full significance of the germ-theory began to dawn upon men's minds, it became understood that milk, which was a food in almost universal request, might be a very fertile medium for the conveyance of disease. Investigations were made, and it was discovered that the microbes of almost every disease under the sun could be found in milk. At the same time it was also discovered that the majority of these microbes were incapable of surviving the effects of very high temperatures, and the

result was the introduction of the system of sterilisation of milk, under which it was submitted to a high temperature with the object of killing any bacteria or germs that might happen to be present in it.

At first sight the system seemed to be a very excellent one, and to solve the difficulty of unclean milk—but only at first sight. A closer scrutiny speedily revealed its deficiencies. The first of these was related to the question of dirt in the milk. Anyone desirous of reforming the methods of milk-production would find himself confronted at the outset with this huge task. He would see dirt in the cowhouse, dirt on the cows, on the hands and clothes of the milker, and, probably, also on the milk receptacles. Now, how would sterilisation touch this question? Would it effectually eradicate all traces of this dirt or ward off any danger which might otherwise have ensued? By no means. Much good though the practice of sterilisation may effect, it is absolutely powerless in the face of dirt. We may manage to kill the germs which are the result of this dirt, but we cannot touch the source itself. Therefore we are forced to the conclusion that, in spite of the value of sterilisation from certain points of view, it leaves us much in the same position as we were before: so that the reformer in the future must still continue to insist upon the old lesson—greater cleanliness.

Not long ago a writer in the *British Medical Journal* related his experiences of a dairy farm. He said: "Against a wall of the shed was banked up a great heap of manure; while on the opposite side all the cinders, old bones, and general rubbish of the farm were accumulated. . . . I was horrified to see the filthy state of the milk as it flowed out of the pail. It was discoloured with grit, hairs, and manure. 'Look at that,' I said, pointing

to a specially large bit of manure. I regretted my zeal, for he dipped his whole hand into the pail, and, as he brought it out, said, 'Oh! that ain't nothing: that's only off the cow'!" Does this account seem overdrawn? I can only say that it has been the experience of a great many investigators. And what is the reason? Simply ignorance on the part of the agricultural labourer. He has been forced by a paternal Government to attend school regularly for many years, to learn a smattering of the three R's, perhaps a little geography and singing, but he has never been taught the value of cleanliness in his business—this was not considered sufficiently important or necessary to his advancement in life. Cleanliness may be next to godliness—but then both godliness and cleanliness are at a discount in the new system of elementary education. It may be thought necessary that the schools should provide so many cubic feet of "air space" for each scholar—this looks well, and reflects upon the care and competence of the powers that be; but whether the scholar carries his learning away with him, and applies it in his business as a farm labourer, seems to be a matter of very small importance. There can be very little doubt that our present system of education is grievously at fault, and until the boy whose whole future career will be spent in country pursuits is taught how to make the most of his intelligence in this direction, and not how to solve a problem of Euclid, there is a great deal of very uphill work before the reformer whose efforts are directed towards procuring a better milk-supply.

Even supposing, however, that this obstacle were overcome, it is extremely doubtful to what extent the sterilisation of milk is desirable. It must be remembered that sterilisation implies the subjection of the milk to a

very high degree of heat for a considerable period. This great heat cannot fail radically to alter its composition. It has been shown that sterilisation produces the most profound chemical changes. Many constituents are rendered quite insoluble; the albumen is coagulated, and digestion rendered extremely difficult; while albuminoid toxins may be produced. As a food for infants the milk is absolutely valueless in many cases; at the worst, it may be even poisonous. It is becoming more and more evident that nearly all foods contain certain valuable principles known as "ferments," and that these are destroyed by submission to high temperatures, with the result that the food is rendered valueless and indigestible. This seems to be certainly so in the case of milk, whose living elements are destroyed by sterilisation; so that infants fed for any length of time upon such a food develop anæmia, rickets, and other complaints. The worst feature of sterilisation probably lies in the fact that, as I have already noticed, it does not touch the root of the evil—the impurity of the milk. No pasteurisation or sterilisation can turn dirty into clean milk. And although it may kill the microbes themselves, it has no effect upon the poisons already produced by these microbes. Thus these poisons are still capable of exercising their deadly influence upon the consumer.

The following is the opinion of Mr. Dunlop, the Wilts. County Council Dairy Expert:—"The question which most troubles our public health committees at the present moment is: 'How are we to proceed to obtain a pure and safe milk-supply?' Some towns have already proceeded by starting sterilised milk depôts. I doubt whether their methods are either economical or for the benefit of the public health. The processes adopted in the sterilisation

of milk, at present, may or may not destroy all disease spores. Whether the spores are destroyed or not, the milk is, to a certain extent, very appreciably depreciated in value as a food. It destroys the natural enzymes which aid in the digestion of the food. It volatilises certain nitrogenous constituents, and makes others less soluble and therefore less digestible. To ensure sterility in milk by sterilisation would entail the absolute destruction of the milk as a food for the human system. When we come to know and understand these facts, we do not wonder when we hear mothers complain that the baby does not thrive on sterilised milk.

"If the supply is to be good and clean, the best method is to begin at the source. . . . The milk comes from the cow sterile; why not do our utmost to keep it so until it reaches the consumer? How is it to be done? . . . We will verify that 60 per cent. of the cowsheds and dairies in England are a disgrace to the name. We hear of agricultural depression; what we want is a very deep agricultural impression that there is a paying price to be got a hundred times over for produce properly produced under sanitary conditions. . . . The most economical, quickest, and most efficient method of arriving at this seems to be, that each public health committee should appoint persons who have had a thorough practical grounding, as well as a good college training, to visit the premises of the dairymen supplying the district, and then inspect the farms and stock supplying the dairies. From these inspections, publish in the district paper an exact straightforward report of the actual conditions of each supply. Then, and then only, will the sluggard realise his position, and the enterprising, cleanly, deserving supplier will for the first time reap his merited benefits."

No better exposition of the evil and its remedy could be found than the foregoing. It leads up to the teaching of to-day that milk, to produce its full benefits upon the consumer, must be unboiled. All the leading authorities upon the subject of infant feeding in this country are now of this opinion, and we have lately heard the views of a Danish expert which are to the same effect. Dr. Ostertag first points out the prevalent demand for the pasteurisation of milk, and then shows the objection to the system. "It is now believed," he says, "that if milk is heated for pasteurisation in the ordinary way its condition becomes so much altered that instead of being an article of nourishment it may become a source of danger." He concludes by discussing the danger of pasteurised milk, and gives it as his opinion that, in future, efforts must be directed to producing milk under such conditions that it may be consumed raw, even by infants.

There is no doubt that this is the tendency of the present day, and if proper inspection by local authorities is carried out, and precautions are taken in the way of cooling milk immediately it is drawn, sterilisation and pasteurisation will be quite unnecessary, and will soon have become a thing of the past, with great advantage to future generations.

CHAPTER IX.

STANDARDS OF QUALITY IN DAIRY PRODUCE.

WHETHER or not standards of quality affecting all articles for sale are advisable, is a debatable question. Whatever opinions may be held on the subject, however, the law has now laid down certain standards which must be conformed to by the seller of dairy produce on pain of a fine. The Sale of Food and Drugs Act, 1899, contained several sections relating to the trade in dairy produce. Under Section 4 of the above Act the Board of Agriculture was empowered to make regulations for the sale of milk. The following regulations were accordingly made :—

1. Where a sample of milk contains less than 3 per cent. of milk-fat, it shall be presumed, until the contrary is proved, that the milk is not genuine.
2. Where a sample of milk contains less than 8.5 per cent. of milk-solids other than fat, it shall be presumed, until the contrary is proved, that the milk is not genuine.
3. Where a sample of skimmed or separated milk contains less than 9 per cent. of milk-solids, it shall be presumed, until the contrary is proved, that the milk is not genuine.

In July, 1901, a departmental committee was appointed by the Board of Agriculture to enquire and report as to what regulations, if any, could with advantage be made for determining what deficiency in any of the normal

constituents of butter, or what addition of extraneous matter, or proportion of water, shall raise a presumption that the butter is not genuine. The results of this enquiry were embodied in a Bill which was introduced into the House of Commons but has not yet become law.

The Departmental Committee of the Board of Agriculture issued a Report on preservatives and colouring matters, and in this report the use of such matters as regards milk was prohibited. This step was justified by the fact that milk is the special food of infants and invalids, and may be subjected to several doses of chemicals before reaching the consumer, and that, being an entirely unmanufactured article, it is one which ought to be supplied in a natural state.

From the above extracts it will be seen how much has been done of late years to place the whole question of milk and butter standards on a proper basis. It has always been urged by those in favour of such standards that it is absolutely essential for the protection of the public that they should be introduced. Milk is the chief food of infants, and unless they can get it quite pure they will be injured in physique in the early days of their existence. Moreover, it has been argued that the more certain you make it that the purchaser is getting what he pays for, the higher you raise the standard of quality, the more you will extend the demand for milk, and thereby benefit the producer of it. In fact, it has been openly asserted by purveyors of milk themselves that they are in favour of still further raising the standard and allowing no excuse for not conforming to it.

But is there nothing to be said on the other side? Assuredly there is. Many farmers complain of the impossibility, with their present stock of cattle, of conforming

with the requirements of the law. They say, with much truth, that they are being summoned for supplying milk which does not contain the necessary amount of fat, although they know themselves that the milk is delivered in the same state as it came from the cow. Of course they are given the opportunity of showing that such is the case; but the difficulty of doing so is so great, the bias of the magistrates is so strongly against them, that in the majority of cases a summons is looked upon as equivalent to a fine, and so the fine is paid at once and as little as possible is made of the matter.

There are many reasons why milk does not always come up to the standard. The quality of milk is not so much under the control of the producer as might be imagined. He may do his best, by good feeding and proper care, to coax his cows to yield rich milk, but unless the animals possess the proper characteristics, which are largely hereditary, they will fail to meet the demand. I know that the reply to this is that a farmer or a milk-seller should provide himself with the proper sort of cattle. I cannot say that I think that such an argument is as sound as at first sight it would appear. However anxious a man might be to secure only the right class of cattle, it might be out of his power. The type of animal which produces the very best quality of milk is limited to certain classes in which there is a monopoly exercised, and the animals are difficult to obtain, since those who own them are naturally unwilling to part with them. Again, why should the milk-seller be obliged to use any particular type of cows? The laws regulating the supply of milk, and especially these milk standards, were passed to prevent adulteration. Surely it is carrying the principle to excess to deny the right of the producer to use whatever breed of

cattle suits him. All that he should be bound to attend to is the purity of his milk, and if this is satisfactory, if he is really selling the produce of the cow, then he is doing all that he ever professed to do. It seems to me that it would be just as rational for the purchaser of stockings, say, to complain that they were made of cotton and not silk, although the seller had never pretended that they had silk in them. I say again that good, sound milk was the purpose of these regulations from the start, and I hold that a man has a right to use any cattle he pleases, provided they are healthy and that he can guarantee the purity of the article he dispenses.

But the cattle themselves are not the only obstacle to the milk coming up to standard. Other factors which affect the quality are age, average amount of milk yielded, food, season of the year, interval between milkings, and excitement or worry. When all these are taken into account it will be easily understood how difficult it is to fix any standards which shall hold good for all breeds and in all places.

The age of the particular cow is always a prominent item. A cow is at her best for about two years after her third calf—from five to seven; after that she begins to decline in her yield. This is very easy to understand if we remember the way in which milk is produced. It is the result of the decomposition of the gland-cells of the udder, and naturally this decomposition is most efficiently performed by a young cow. Again, it has been shown that the average amount of fat produced by an average animal is fairly constant, while the quantity of milk yielded varies very greatly. Therefore, it is perfectly self-evident that the fat percentage of the milk of a cow must be liable to variation according as she is giving a large or a small

quantity of milk, since the same amount of fat is distributed over a greater or less quantity of fluid. This fact is well exemplified in the spring of the year. Cows which have lately calved are then yielding a large amount of milk. Owing to the watery nature of the grass at that season the milk would anyhow tend to be poor in quality: this, coupled with the larger yield, often causes the milk to fall below the necessary standard. As the year progresses, and the cow declines in her milk-yield, greater and greater richness is apparent; so that it is often found that very nearly the same amount of butter is produced in autumn from a given quantity of milk as from twice the amount in spring.

Although, in a general way, the food has only a secondary influence upon the quality of the milk, yet there are cases in which it affects it more markedly. It has been shown that in many instances in which analyses have been made, and the milk found to be poor, this has been remedied by a change of food; but yet it would hardly be fair to attribute this to the food beyond the fact that the cow was not receiving a sufficient quantity, or a proper amount of certain necessary constituents. The same state of things is well exemplified in cases where the cows are subjected to changes of temperature. Animals which are left exposed to a cold wind cannot be expected to do as well as those which are housed in a warm stable, *upon the same rations*. This is often overlooked, and the fallacy has arisen that animals must be housed in early autumn if satisfactory results are to be obtained; whereas, if the rations were increased in proportion to the extra demand upon the animal heat, there would be little necessity for early housing. There is also one other way in which the food may indirectly affect the milk-yield. If,

through an excess of carbohydrates, such as sugar or starch, the cow is induced to store up fat instead of producing milk, the quality of the milk is liable to be considerably altered. A cow which runs to fat is seldom a profitable animal for the dairyman.

No matter has caused greater difficulty than the variation in the quality of milk due to the long interval between evening and morning milking. The majority of prosecutions for selling milk below standard are probably due to this. It is often imperative that milk should be sent off to the town early in the afternoon, with the result that the interval which must elapse before the milking of the cattle next morning is a long one. It is well known that this means a low fat percentage; but what is to be done to remedy this state of things? A case of this sort is on record in which it was decided that the morning's milk was not of the nature and substance of milk! Could anything be more unreasonable or absurd? It is not disputed that the fluid is milk, that it is sold as it came from the cow and not tampered with; yet it is not "of the nature and substance of milk." It only remains to ask, What is milk? for the foregoing enlightened decision has quite upset all preconceived ideas upon the attributes of that fluid.

The Board of Agriculture has been struck with the absurdity of the position, and has issued the following recommendation:—"Although the quality of genuine milk offered for sale will usually be well above the official limits of milk-fat and non-fatty solids, there may occasionally, and especially in certain seasons of the year, be cases in which a sample of genuine milk may fall below those limits. To meet cases of this kind, it is suggested that in the absence of any special circumstances indicating that

the case is a fraudulent one the Local Authority might, in the first instance, call the vendor's attention to the analyst's report, and ask him whether he desires to offer any explanation, and if the explanation is one which they are able to accept, they might, in the exercise of their discretion, refrain from the institution of proceedings or withdraw any summons which, in order to prevent the failure of proceedings, by reason of the time-limit imposed by the Act, it may have been necessary to take out. But it may be desirable that further samples of milk should be taken in such cases, in order that a satisfactory conclusion as to the character of the milk supplied may be arrived at."

The only fair way of treating this matter, where there is any question of adulteration, would be to take samples of both morning and evening milk, and then to strike an average. The evening milk is generally well above the standard, and the balance should be set down to the credit of the morning milk.

Various causes contribute to cause poverty in milk. The majority of these have been referred to elsewhere. It is not, however, generally known that excitement by overdriving, or worrying by dogs, also tends to affect the quality of milk.

The Milk Regulations Committee reported that the evidence submitted to them went to show that it was a common practice to add gelatin to cream for the purpose of giving it a fictitious appearance of richness or thickness. Local authorities are urged to take steps to ascertain whether this form of adulteration is practised within their districts, and if a public analyst reports the presence of gelatin or other similar substance in a sample of cream the local authority is advised to consider whether

the case is not one in which proceedings might be instituted.

What is the conclusion? The system as at present worked is often very unjust to the farmer. He is prosecuted for selling as genuine what is often undoubtedly so. Can this be right? It may be said, and justly, that the public have a right to good sound milk, but I contend that so long as the producer supplies the article from healthy animals, and in the same state as it came from them, he is doing all that should be required of him.

There are not the same standards of quality in the case of butter and cheese; but, as was already mentioned, a Butter Bill was introduced into Parliament to prevent its adulteration with milk or the addition of water. It should also be unlawful to sell what is known as "filled" cheese, containing a large proportion of animal fats and margarine.

The foregoing facts and considerations tend to show that the law which requires dairy produce to conform to a particular standard fails. It is almost impossible to prove whether milk, cream, butter, or cheese is genuine or not. Opinions will always differ as to what are the characteristics of a genuine article, especially where there are such wide natural variations as in these products. If standards of quality are considered necessary, and are not intended to work in an unfair manner, then they should be fixed low enough to allow the inclusion of all produce which is genuine. There would be little difficulty in fixing such standards.

CHAPTER X.

MILK-RECORDS.

I WONDER what percentage of farmers throughout the British Isles is in the habit of keeping a proper record of the yield of dairy cattle. I fear it would be but a small one. There is no reason for this state of things, except, probably, a want of familiarity with the process. There is no large amount of paraphernalia required, the apparatus is compact and cheap, and it only requires the minimum of time to work it. But these considerations are almost as nothing compared with the value of such a record, and as soon as the saving effected thereby is appreciated, together with other advantages, no dairyman who has once been shown the utility of keeping a proper milk-record will omit to do so in future.

Utensils Necessary.

As I have said, the utensils necessary for such a record are not of a complicated nature. They consist of a tripod, a spring-balance with an enamelled dial-plate, on which are marked the number of pounds and gallons of milk, a milk-pail, for which allowance has been made on the dial, and a flat memorandum book, containing enough sheets for every week of the year, upon which the milk is entered. The whole apparatus may be obtained

from the Dairy Supply Co. (Museum Street, London), and should not cost more than 50s. or 60s. (Fig. 17).

The advantage of using the special pail adapted for the

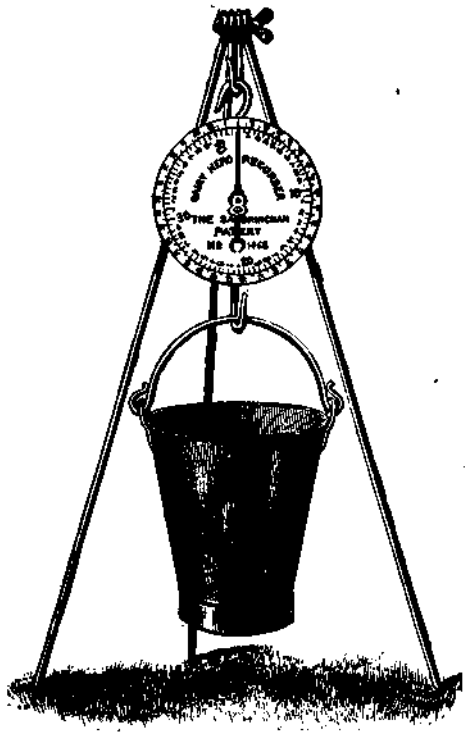


Fig. 17. Milk-Weighing Machine, Tripod, and Pail.

dial is that when the milk is poured into this pail the amount on the dial may be read off at a glance without the necessity of any calculation for weight of pail. The milk should always be strained into the pail on the weighing-

machine, and a very good strainer—with fine gauze wire—is obtainable to fit the pail.

As soon as the amount of milk has been noted it should be entered upon the memo.-sheet, against the name of the cow which yielded it. It is an advantage to have a sheet of paper pinned in the cow-stable, behind each cow, containing the cow's name, and morning and evening milkings for each day of a week. Immediately after milking the amount should be entered upon this in pencil by the cowman, and at the end of the week all these can be copied into the larger memo.-sheet. When the record for the year is complete, the total yield of each cow for this period is very quickly computed by adding together the amounts against her name for each week of the year.

It can hardly be an objection to this system that it takes too much time. The actual weighing with the proper pail occupies only a few seconds, and as for the record, it is a matter of the cowman jotting down the amounts in pencil, which amounts may at the end of each week be entered into the larger sheet by one of the younger members of the family.

Advantages.

Now let us turn to the advantages of the system. The first and foremost of these is that it effects a very large saving to the dairyman. Without such a record it is possible to have a more or less vague idea of what cows are good and what bad; but until a record is kept it is never known how some cows are an actual loss to their owner. There are many animals which give a fairly large yield soon after calving, and leave the impression that they are really heavy milkers; but when the milk-sheet comes to be added up at the end of the year it tells a

different tale. It is found that although one cow gave a large yield for a time it soon went dry, while another animal which did not start off so well continued to milk for the best part of a twelvemonth. The one pays, the other does not. It may be taken for granted that a minimum of six hundred gallons is necessary if a cow is to leave a profit, and any cow which gives a record of less than this during two consecutive years should be dispensed with.

Not only does the record save the dairyman from loss with bad cows, by enabling him to select those which are profitable, it also permanently and continuously increases the value of his stock. If only the best cattle are kept for the service of the herd, and if these are mated with a bull from a deep-milking dam, and the heifer calves reared for the dairy, the improvement in a few years is enormous, and will be the immediate result of keeping a proper record and knowing the capabilities of every animal in the herd.

As a Health Indicator.

But there is a further advantage in keeping a milk-record which must never be overlooked. The milk-yield is a very good criterion of the state of the health of the cow. At the seasonal period it is a matter of common experience that there is often a sudden drop in the milk; but this is only of a temporary nature, and a return is soon made to the normal. On the other hand, sudden variation may often point to the approach of some disease, and the cowman should always pay particular attention to such variations and report them to his master. The nervous system must be intimately connected with the udder and its operations, though I am aware that there

are some who deny this, for anyone who knows the effect of fear or nervous excitement upon a cow cannot help believing that such is the case. Therefore, when there is any sudden and unaccountable drop in the milk-yield, separate the cow from the herd and watch for any additional symptom of disease.

This valuable indication of approaching disease, coupled with the other advantages to the cow-keeper, should make the keeping of milk-records universal; and it is not too much to say that a far greater general level of excellence might very soon be attained in this way than has so far resulted from the efforts of the breeder alone.

CHAPTER XI.

BUTTER.

BUTTER is chiefly composed of the fat of milk, generally known as cream. There are other constituents in it, such as water, but when butter is made according to the best methods, these should be reduced almost to the vanishing point. Even good butter contains a large percentage of water, but this should never be more than 15 per cent., and when a proper machine is used for drying it will fall considerably below this point. Repeated attempts have been made of late years to manufacture butter into which very large quantities of water have been incorporated, and with considerable success; but it is hoped that the Butter Bill now under consideration will put an end to this form of adulteration.

BUTTER-TESTING.

Since cream is what we require for butter-making, we should naturally choose for our dairy herd cows which give the largest percentage of fat, and these are undoubtedly to be found among the Jersey breed. This has been repeatedly brought out in the tests for butter made year after year. The following tables give some idea of the enormous butter-yielding capacity of the Jerseys, their butter ratio (the number of lb. of milk to a lb. of butter) being in one case as low as 13.83lb. :—

BUTTER TESTS, SHORTHORN AND JERSEY COWS, DAIRY SHOW, 1905.

Cows.	Milk per Day.	Butter.	Milk to 1 lb. Butter.
	lb. oz.	lb. oz.	lb.
Shorthorns—			
1st	56 14	2 13	20.22
2nd	45 11	1 13	25.20
3rd	58 7	2 0½	28.76
Jerseys—			
1st	43 5	2 5⅝	18.35
2nd	40 2	2 7¼	16.35
3rd	37 12	2 2¼	17.63

JERSEY CATTLE SOCIETY'S TESTS, 1886 TO 1899.

Cows' Ages.	Av. Milk-Yield.	Av. Butter Yield.	Milk to 1 lb. Butter.
Years.	lb. oz.	lb. oz.	lb.
1 to 2	15 2	0 13	18.43
2 to 3	24 15¼	1 5¼	18.74
3 to 4	29 14⅜	1 10	18.42
4 to 5	32 5½	1 11¼	19.01
5 to 6	32 15¼	1 12	18.76
6 to 7	34 7⅜	1 13	18.92

The average results are: One day's milk, 32lb. 2¼oz., or about 3 gallons; one day's butter, 1lb. 10⅜oz. Butter ratio, 19.13, or about 16 pints of milk to 1lb. of butter.

TESTS OF JERSEYS AT THE TRING SHOW, 1899.

Cow.	Butter.	Butter Ratio.
	lb. oz.	lb.
Sundew 4th	3 6⅜	15.10
Madeira 5th	3 15½	16.14
Em	3 4⅜	13.32

The butter ratio of the last is extraordinary. At the Tring Show of 1900 a Shorthorn cow gave as much as 4lb. 4½oz. of butter in 24 hours, and her butter ratio worked out at 15.79.

In the six years 1895 to 1900 inclusive, 285 cows of the Shorthorn, Jersey, Guernsey, and Red Poll breeds were subjected to butter tests at the London Dairy Show, and the general results were as follow :—

Breed.	Butter.	Butter Ratio.
	lb. oz.	lb.
Shorthorn	1 11	28.81
Jersey	1 10¼	19.15
Guernsey	1 9½	21.86
Red Poll	1 4¾	30.29

ADVANTAGE OF A JERSEY IN A MILKING HERD.

Quite apart from its high yield, and its very low butter ratio, the Jersey possesses an additional advantage which makes it advisable to have at least one of this breed in every herd kept for butter-making. It is a well-known fact that the fat globules in Jersey milk are unusually large, and the result is that when Jersey milk is mixed with that from cows of other breeds, in whose milk the fat globules are much smaller—many of these never rising at all—the large Jersey fat globules attach themselves to the smaller, and bring these to the surface in their train. The result is a greater percentage of butter from mixed milk to which Jerseys have contributed.

METHODS OF OBTAINING CREAM.

There are two methods of obtaining the cream from milk—(1) by setting, (2) by a separator. As the first

is fast going out, I need say little about it. The milk as soon as it arrived in the dairy was poured into pans and left for the cream to rise. (There were variations in practice according as the deep or shallow system was employed.) After rising to the surface it was skimmed off twice at intervals of twelve hours and put into a large crock, in which it was left to ripen. There were two grave disadvantages in this system. The first was that much of the fat in the milk never rose to the surface, especially when it had lost heat before being set; the second was that owing to the fact that the milk had to be left for at least twenty-four to thirty-six hours, by the time the skim-milk was drawn off it had become sour and unwholesome for calves.

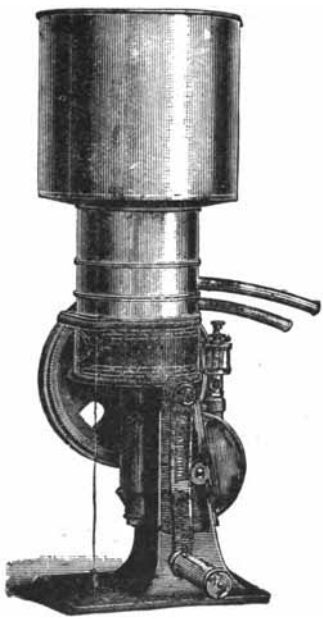


Fig. 18. Alfa-Laval Separator.

Both the above objections are obviated in the separator, and since these machines are now made in very small sizes and at very moderate prices, and are reliable and easily handled, nobody who makes butter should be without one. There are several makes of separator on the market, but the oldest, the Alfa-Laval, is the one I always used and can recommend (Fig. 18). The "Melotte" is another.

In the separator the prineiple employed is centrifugal force. If you swing matter of various densities quickly

round in an enclosed sphere, the heaviest portion is flung off from the centre, where the lighter portion collects. The lightest part of milk is the cream, and as it rises it finds its way out by an opening near the part of the machine where it collects. The skim-milk has another outlet. These machines do their work well, the skim-milk showing hardly a trace of fat. Each maker sends out minute

Fig. 19. Champion Churn.

directions to be used in connection with his particular machine, but roughly speaking there are two points which affect the perfect creaming—(a) speed of rotation, and (b) temperature, and special attention must be paid to the instructions concerning these matters.

Cream is not ready for churning immediately it is separated, but requires to be ripened. This is effected by

letting it stand for some days in a jar and stirring in carefully each new lot added to it. Quite lately, however, a different method has been introduced, consisting in the addition to the cream of what is known as a "starter." This is merely a culture of the lactic acid bacillus. It has no great advantages over the ordinary ripening of cream, but its chief value lies in the fact that by the preservation

Fig. 20. Disc Churn and Butter-Dryer below.

of a portion of "starter" or buttermilk from one churning to the next, great uniformity in quality is assured.

Cream set in the ordinary way in a dairy whose temperature is 54deg. Fahr. should be churned twice a week. Before churning in summer the temperature should be reduced to 54deg., and in winter may be as high as 58 or 60deg. (I differ slightly here from the temperatures laid down by the Royal Agricultural Society.) When it is ready it should be strained into the churn.

Little need be said about the various sorts of churns. They chiefly differ in some having beaters, others not (Fig. 19, p. 111). I prefer those without beaters, but I also used a churn known as the "Disc" (Fig. 20, p. 112)

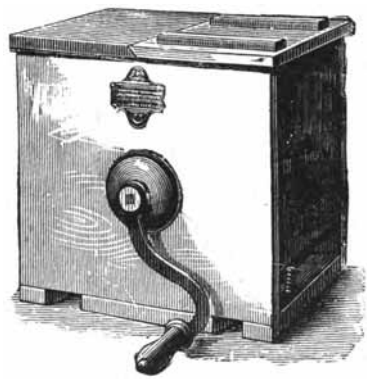


Fig. 21. Bradford's Declivity Churn.

for small quantities of cream, which produced butter of excellent quality in a few minutes—altogether a most useful little churn for small dairies. Fig. 21 shows another form.

BUTTER-MAKING.

I now give the rules for butter-making laid down by the Royal Agricultural Society :—

Prepare churn, butter-worker, wooden hands, and sieve as follows: (1) Rinse with cold water. (2) Scald with boiling water. (3) Rub thoroughly with salt. (4) Rinse with cold water.

Always use a correct thermometer.

The cream, when in the churn, to be at a temperature of 56 to 58deg. Fahr. in summer, and 60 to 62deg. in winter. The churn should never be more than half full. Churn at the number of revolutions suggested by the maker of the churn. If none are

given, churn at forty to forty-five revolutions per minute. Always churn slowly at first.

Ventilate the churn freely and frequently during churning, until no air rushes out when the vent is opened.

Stop churning immediately the butter comes. This can be ascertained by the sound; if in doubt, look.

The butter should now be like grains of mustard seed. Pour in a small quantity of cold water (1 pint of water to 2 quarts of cream) to harden the grains, and give a few more turns to the churn gently.

Draw off the buttermilk, giving plenty of time for draining. Use a straining-cloth placed over a hair sieve, so as to prevent any loss, and wash the butter in the churn with plenty of cold water. Then draw off the water, and repeat the process until the water comes off quite clear.

To brine butter, make a strong brine—2lb. to 3lb. of salt to 1 gallon of water. Place straining-cloth over mouth of churn, pour in brine, put lid on churn, turn sharply half-a-dozen times, and leave for ten to fifteen minutes. Then lift the butter out of churn into sieve, turn butter out on worker, leave it a few minutes to drain, and work gently till all superfluous moisture is pressed out.

To dry-salt butter, place butter on worker, let it drain ten to fifteen minutes, then work gently till all the butter comes together. Place it on the scales and weigh; then weigh salt, for slight salting ½oz., medium ¾oz., heavy salting 1oz. to the pound of butter. Roll butter out on worker, and carefully sprinkle salt over the surface, a little at a time. Roll up, and repeat till all the salt is used.

Never touch the butter with your hands.

There is no particular difficulty in the act of churning itself, but sometimes it will happen that the butter refuses to appear. This indicates the condition known as "sleepy." In such case you might go on churning indefinitely without result. Having had experience of this condition, I believe it to arise merely from too high a temperature within the churn, and if you will remove the cover for, say, five minutes and then continue churning, you will generally find that the butter will soon appear.

Another item which sometimes affects churning is the feed of the cows.

It is still a common practice in some districts to churn butter with the hand. This seems almost too barbarous to be true, but it is so nevertheless. Butter should never on any account be touched by the hand, or its flavour will be affected.

Fig. 22. Bradford's Butter-Worker.

When the butter has come, you should stop churning and pour into the churn about a quart of cold water. Then give it a few more revolutions, draw off the buttermilk and wash. Wash the butter in cool water (about the same temperature as the churn in summer) until it drains away clear, then take it out and put it into the butter-

dryer. Next put it into a brining solution, 2lb. to 3lb. of salt to the gallon of water. Never use the dry-salting process for fresh butter: unless it is very carefully done the butter will have a mottled appearance.

When the butter has been in the brine for about twenty minutes, take it out with a scoop and place it on the worker (Fig. 22). There are several excellent machines on the market which have movable rollers. Work it until all the buttermilk has been squeezed out. Very particular care should be paid to this point, since the retention of much of this milk in the butter will soon render it rancid.

Fig. 23. Milk-Strainer.

Well-made butter should never be "greasy." It should have a well-defined "grain," and when broken should resemble the fracture of a piece of cast iron. It should never contain more than 16 per cent. of moisture, unless the fact is stated, and I have already given my reasons for the necessity of legislation to this effect and the adoption of a standard of 16 per cent.

Although it is essential that the casein should be thoroughly washed out, yet butter is often so carelessly made, and the casein has been allowed to become so thoroughly incorporated in it from overchurning, that

the only effect of continued washing would be to take away any flavour it might possess. Too much washing of good butter will always destroy its naturally delicate flavour. Brining assists in bringing this out.

Always use strainers in every operation; strain the cream into the churn, the water for washing, and also the brine. This will prevent the incorporation of foreign particles in the butter (Fig. 23).

Remember to keep a good thermometer, and have it in constant use. Never trust to your sense of touch to guide you as to the proper temperature of the cream or churn.

A pair of "Scotch hands" are the only other implements necessary for butter-making, and you should be careful to use them, and not your own, in handling butter.

JUDGING BUTTER.

The following are the points generally allowed in the judging of butter:—

	POINTS.
Flavour	50
Grain or texture	25
Solidity	15
Colour	10
	100

Flavour.

It is evident, not only from the large number of points allotted thereto, but also from a consideration of the *raison d'être* of butter, that proper flavour is of the first importance in butter-making. It is useless to produce an article which cannot be sold at a good price when made. Therefore, it is usual to allot half the total points to the flavour. This depends upon the food, the treatment of

the cream, and the washing of the butter. Whatever may be thought of the effect of food upon the quantity of cream in the milk, there can be little doubt that it has an important influence upon the quality, as shown in the butter. The appearance, texture, aroma, and flavour of butter are all dependent upon the food of the cow. Hard, tallowy butter has been shown to be due to foods poor in nitrogen. Potatoes, turnips, and mangolds are among the worst foods for butter; whilst oats, peas, bran, and rice-meal improve the flavour.

The treatment of the cream during ripening also exercises its influence upon the quality of the butter. The best samples are only obtainable when the cream has been properly treated. Under-ripening would conduce to a want of flavour; over-ripening would mean a "strong," sometimes rancid, butter; but of all the factors that play their part in producing a good flavour none is more important than proper washing. During the process of butter-making the casein present in the cream remains unaltered, and may be seen in the shape of white particles among the butter-granules. Unless churning be arrested at the proper moment, and the particles of casein washed out, they will become incorporated in the butter, and no subsequent working will eradicate them. Therefore, there is no more important item in butter-making than the washing of the butter-grains before they have collected in large lumps.

Texture.

The question of texture crops up in considering most of the other points. Good butter should have a proper grain, which is best seen if a sample is broken across, not cut. The butter should be grainy, not oily. Churning

has the most effect upon this. It should only be carried to the proper point, and the correct temperature should be kept in the churn. The most usual temperature in the dairy competitions is 52deg., when the dairy is about 64deg., and it is also noticeable that the temperature during churning is not allowed to rise more than two or three degrees. This is due to proper aëration of the churn, and also to accelerating the process as much as possible. The longer churning lasts, the more the temperature tends to rise, and the texture is affected.

Solidity.

This is chiefly a matter of the amount of moisture in the butter. Many samples are sold with as much as 20 per cent. of moisture, whereas good butter should not contain more than 12 per cent. Butter which has been well worked and dried should never offend against this rule; for it is wrong to charge the consumer at the rate of one shilling a pound for water instead of butter-fat.

Colour.

The last points to be examined in judging butter are colour and general appearance. It is not always possible to obtain butter of a deep rich colour from the milk of all classes of cows and at all seasons of the year. We can select the best breed, but we cannot give the cows summer pastures in mid-winter. But this fact is sufficiently well known, and therefore it is a very foolish fraud to try to imitate the golden butter of summer-time by the introduction of annatto or other colouring matter. This can hardly fail to have a prejudicial effect upon the flavour of the compound.

MARKETING.

There are so many variations in price in the different markets that it is difficult to say whether butter-making will pay or not. If there is a factory in the district, I strongly advise sending the milk to the factory, unless private customers can be found. The price may not be so good as would be obtained from a private customer, but, on the other hand, there are no railway expenses to be incurred or for packing cases, &c., and there are no risks of the butter being returned owing to its becoming rancid on the way in hot weather.

If you wish to send butter by rail, there are some excellent boxes on the market made to hold certain weights. The butter should be first wrapped in damp muslin, and then carefully packed and a label attached to the box.

If the butter is intended to be put down for future consumption, it should be packed tightly into large jars, firmly pressed down to prevent the entrance of air, a layer of salt inserted between each addition of butter, and finally a thick layer on top of the jar. Such butter may fetch a higher price in winter than if it had been sold fresh.

MILK *v.* BUTTER FOR PROFIT.

It will often happen that there is a great demand for milk in some districts, and it may then be the better policy to sell the milk direct. As a rule the price of butter will work out at about 1s. a lb. all the year round. As it takes on an average three gallons of milk to make 1lb. of butter, and the milk should average 7d. a gallon at the factory all the year round, the corresponding quantity of milk would be worth 1s. 9d. Against the difference in value there is

the skim milk, but still the balance of these considerations may often lead to the conclusion that it will pay best to sell milk and leave butter alone. There can be no doubt at all about it where there is an opportunity of selling direct to the consumer, as it should fetch 4d. a quart, or 1s. 4d. a gallon, at least. This will show what enormous profits are made by the middleman in the milk business.

CHAPTER XII.

CHEESE.

It would be useless to attempt the manufacture of a good sample of cheese unless the maker had a very clear idea of its characteristics. The truth of this statement becomes more evident when we consider the numerous varieties upon the market. These are not the result of chance, but have been evolved in response to a demand in particular districts for cheeses possessing different characteristics. In some counties a cheese of a mild description is in demand; in others it must have a sharp flavour. In one district the cheese is eaten fresh; in another after several months' ripening. Therefore it is always desirable that the cheese-maker should know the requirements of the particular market for which he caters, and should take every step in the process of manufacture with these requirements in view. But although the cheese in each locality has its own special attributes, there are certain broad, general characteristics which all good cheese, of whatever variety, should possess, and it is with these that I would deal. They are (1) quality, (2) flavour, (3) digestibility, and (4) soundness.

(1) Quality may be of two kinds: eating quality or richness, and keeping quality. It should not be thought because I have classed them under the same head that they are determined by the same conditions. What I

call eating quality in cheese is the richness or mellowness which is the result of using milk very rich in fat. The mellow nature of good cheese is almost entirely a matter of the quality and richness of the milk, though proper ripening also plays its part. Still, however rich the milk may be, it does not follow that the cheese will necessarily be correspondingly rich unless it has been properly made. It is quite possible for the fat of the milk to be wasted during the process, and a very little want of care may turn a very good curd into a very inferior cheese.

Keeping quality, on the other hand, does not so much depend upon the amount of fat in the milk, as upon the system of manufacture which has been followed. In some districts a type of cheese is in demand which is eaten quite fresh, in others it is necessary that it should mature; therefore, each of these requirements should be taken into consideration, and the curd handled accordingly. Speaking generally, it may be said that in order to produce a quick-ripening cheese, fermentation must be encouraged at every step, and where the cheese is to be kept to mature slowly every effort should be made to retard fermentation.

(2) The flavour of cheese is a matter of as much complexity as that of good butter. It is even more so, owing to the varieties of cheese to suit every palate, whereas there is only one standard for first-class butter. Flavour depends upon ripening, which itself is a matter of fermentation and acidity. It is also affected by taints, either in the milk or produced subsequently through the action of objectionable bacteria. Just as in the case of butter, however good the cheese may be in texture and quality, it is quite useless for its purpose unless the flavour is good. This point does not seem so prominent

as it should be to-day, because there is so much inferior cheese made at home and imported from abroad that the public taste has become vitiated, and flavour is not now so vital a matter as it used to be.

(3) To most people the digestibility of cheese has hitherto been a matter of secondary importance, the chief desideratum being the production of a pleasant sensation upon the palate. But yet digestibility is a matter of the greatest moment, and to-day we find that, owing to the greater attention paid to cheese as an important article of diet, the question of digestibility is in the forefront. "Cheese and nuts" is now the prescription; but in order that the cheese may produce the desired results it is essential that it should be of first-rate quality, and, before all, that it should be absolutely digestible. To secure this end it is necessary that the milk used should be of good quality, quite fresh, and free from taint, and also that the cheese should be properly made and matured before consumption. If these objects are not gained the result will be injurious to the digestion of the consumer, and the sale of all forms of cheese will suffer.

(4) To say that cheese is sound simply means that it is well made, well kept, and free from taint. It should also be good in texture. Therefore it is necessary that every step in the process of manufacture should be carried out under the best conditions in order that the resulting product may be described as sound.

HARD CHEESES.

There are so many varieties of hard cheeses made that I shall only attempt to describe the method adopted in the manufacture of two of these, but these two may be taken

as representative of the remainder. They are Cheddar and Stilton. What is generally known as the Cheddar system is that which is adopted, with variations, in making most of the hard cheeses such as Cheshire, Gloucester, &c. Those which are half-way between hard and soft, such as Wensleydale, are made on the Stilton system.

This cheese is far more frequently met with than any other, and most of the cheese imported from abroad is in the form of Cheddar. Good Cheddar is not easy to find, what is usually sold as such being inferior and wanting in fat. Cheddar cheeses are not made of any particular size, but vary from 20lb. to 100lb.

Cheddar Cheese.

This cheese is made from two milkings, and, therefore, the process commences with adding the evening's to the morning's milk. (The evening milk should have been stirred for about an hour when brought to the vat overnight, to prevent the cream from rising.) There are two sorts of cheese-vats to be found in use, one of which, however, is gradually losing ground. This consists merely of a round tub, sloping from the sides to the centre, so as to incline the curd to settle there, and provided with a tap by which the whey may be drawn off. In this form of cheese-vat whenever it is necessary to warm up the milk or whey a portion is scooped out, warmed up to a high temperature, and then returned to the remainder in the vat. This is a slow and an inaccurate method, and would never suit the scientific system of cheese-making of to-day.

The modern form of cheese-vat has double sides and a double bottom, and is known as the " jacketed " vat (Fig. 25). It has a proper inlet at one end for steam or hot

water, and outlets at the other for the hot water and the whey. Fig. 24 is another form of vat. As soon as milk or whey is to be heated, hot water is gradually introduced beneath in the double bottom, and all that is then necessary is to keep a thermometer in the whey to mark the rise in temperature, and turn off the hot water just before the proper temperature is reached. This saves all calculation concerning the amount and tempera-

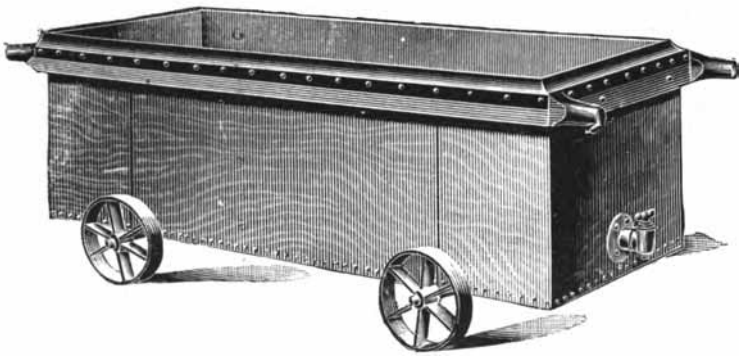


Fig. 24. Single Form of Cheese-Vat.

ture of what was formerly known as the "scald," and is quick and accurate. The whey also is drawn off when necessary by means of a second tap. In the morning the evening's milk should be about 65deg. Fahr., and must be warmed up to 85deg., and the morning milk at the same temperature added to it. The evening milk should always be tested for acidity, for if it is too acid it should not be warmed to so high a temperature in the morning. When this is the case the morning milk should be raised to a higher temperature to compensate. The cream should

always be removed from the night's milk in the morning and heated separately.

The test for acidity is as follows:—Take 10 cubic centimetres of milk, add 3 drops of phenol-phthalin, then slowly add to this 1-2c.cm. of caustic soda, and watch when the pink colour ceases to be absorbed. If the acid is normal the percentage should be from .12 to .16, and variations either way will give you a clue as

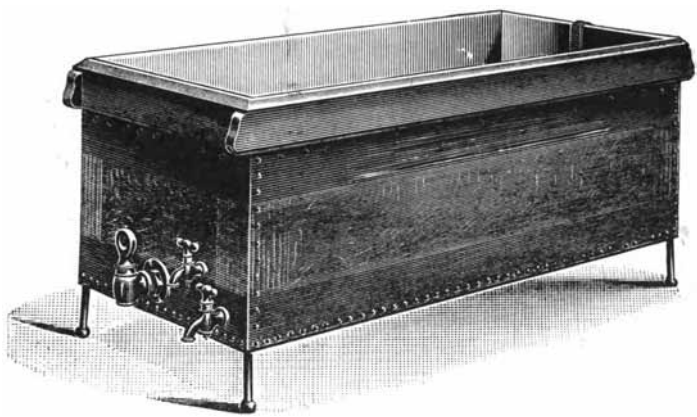


Fig. 25. Double or Jacketed Cheese-Vat.

to whether the milk has too much or too little acidity. Every cubic centimetre (c.cm.) of soda added to the milk represents .01 gramme of lactic acid; every tenth of a c.cm. represents one-thousandth of a gramme. Multiplying by 10, we arrive at the percentage. Thus, if $1\frac{3}{10}$ c.cm. of the soda are required to neutralise the acid, the lactic acid is .013, which multiplied by 10 gives .13. This is a most valuable test, and should be used before renneting, and again when drawing the whey.

When the amount of acid present in the milk has been found, the rennet must be added. If the acid be above normal the process of coagulation must be hastened, and therefore more rennet added. Having raised the milk to the proper temperature (generally 84deg.), the rennet must be put in—1 drachm to 3 gallons of milk. If

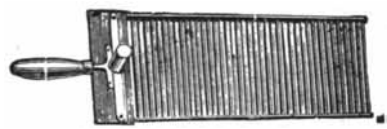


Fig. 26. Curd-Knife.

a "starter" is used, it should have been well stirred in when the milk was first warmed. After putting in the rennet, it must be stirred into the milk for about ten minutes, and the vat covered up until coagulation has taken place. This ought to be in about fifty minutes, and can be recognised by pressing the back of the finger down upon the curd, when if it is ready for cutting no curd will stick to the finger. If the milk was not suf-

Fig. 27. Curd-Knife.

ficiently acid, coagulation takes longer to set in. In that case the curd should be cut into larger pieces, scalding should be protracted, and the curd should remain some time in the whey.

The curd is cut twice with curd-knives, first one way, then across (Figs. 26, 27). These operations should not be

done at the same time, but about three minutes should be allowed to elapse between them. The object of cutting the curd is to allow the whey to drain out, and it is most important that each block of curd should be the same size, in order that draining may go on evenly. If some pieces are larger than others, the whey in these will not be quite expelled when the smaller are ready, and the resulting cheese will not be of the best quality.

Ten minutes should elapse after the second cutting, and then the curd be broken. In Cheddar-making this is done with a particular implement, with the result that the curd is still further reduced in size. After fifteen to thirty minutes' stirring, the curd should settle for about ten minutes—the vat being covered to retain the heat—and then be scalded.

The jacketed vats almost universally used nowadays make the operation of scalding a simple one. Formerly it had to be done by taking out some of the whey, warming it up, and putting it back into the vat again. Now, however, this is much more easily effected by turning hot water or steam into the jacket beneath the vat, keeping a thermometer in the whey, and stirring continually to prevent the curd from being burnt. The temperature must not be raised too quickly—about 1deg. in three minutes is sufficient—and heating must be stopped when the temperature reaches 98deg. as a general rule. This, of course, depends on the amount of acidity and the time of year. Stirring is continued until the curd seems inclined to sink and is rather "shotty" and elastic. The whey should be green; if white, it denotes a loss of fat in the curd.

When stirring is finished, the curd is allowed to settle at the bottom of the vat for ten minutes, a light weight being

placed on a board on top. As soon as the whey shows acidity, .21, it should be drawn off and the curd cut into

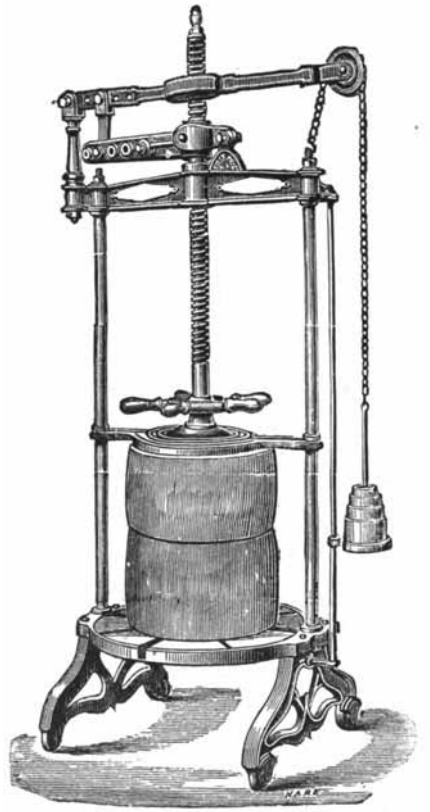


Fig. 28. An Improved Form of Cheese-Press.

blocks, piled in the vat, and weighted. It should be covered with cloths to retain the heat. Let it remain for half an hour, and then cut it into blocks again, tie these in cloths,

and put them on the cooler or table for airing the curd, with a weight on top of 1lb. to each pound of curd. Turn the cloths in ten minutes and again at intervals of fifteen minutes. If the curd is too acid, it must be well cooled (85deg.) on taking it from the vat. The proper amount of acidity is best determined by the hot iron test. If it is right, a block of curd pressed to a red-hot iron should draw out in threads 1in. long.

As soon as the curd is ripe it must be ground in the curd-mill, and then salt added. The curd should be weighed and 1oz. of salt added to each 3lb. of curd. The temperature should be below 80deg. before salting. The effect of the salt is to bring out the flavour and preserve the cheese. After the salt has been well mixed into the curd it should be put into the moulds, but not before the temperature has fallen below 73deg. If it is above this point a loss of fat in the press will be the result. The moulds are lined with cheese-cloths and the curd well packed into these, the follower or cover is put on, and the vats go into the press (Fig. 28).

Too much pressure should never be applied at the start. The screw only should be used for the first two hours, then a weight of 6 to 10cwt. Next morning the cheese is removed, cleaned, a fresh cloth put round it, and it is again returned to the press. This time a weight of 15cwt. is used. The same process is repeated on the third day, and a pressure of 20cwt. applied. It must be remembered that over-pressure may cause loss of fat, will make too thick a coat, and prevent the whey from escaping. Under-pressing, on the other hand, will cause the cheese to split.

The last process is that of ripening. After the cheese is finally removed from the press it goes to the ripening-

room, which should be dry and at a temperature of 60 to 70deg. If signs of swelling are noticed, the cheese must be removed to a lower temperature. In the ripening-room the cheese, wrapped in a calico bandage, is turned daily until it is fit for consumption—in from three to six months. Formerly good Cheddar used to be kept for the best part of twelve months, but this is not now considered necessary owing to the better method of manufacture.

The weight of cheese should be :—

In spring, 14oz. to the gallon of milk.
In summer, 16oz. to the gallon of milk.
In autumn, 18oz. to the gallon of milk.

Cheshire Cheese.

This is made on much the same principles as Cheddar, but acidity is encouraged throughout the manufacture in order to advance its ripening and allow it to be placed on the market as soon as possible. In cutting, only one knife is used, as large blocks of curd are wanted. Cheshire cheese is coloured by the addition of annatto.

Stilton Cheese.

The typical blue-mould cheese is the Stilton, on which cheeses such as Wensleydale and Gorgonzola are modelled. Every effort is made to obtain as rich and mellow a cheese as possible, and only the best milk will produce a good article. The milk should be renneted before the natural heat is lost (80deg. is a good temperature) and the curd from this added next day to that from the morning's milk. Acidity should be prevented as far as possible in the milk. If there is abnormal acidity, the addition of a small quantity of lime-water before renneting is advisable.

The want of uniformity in Stilton is due to the varying

amounts of fat in different milks. Fine pasture and time of year exercise a great effect, and care should always be taken to analyse the milk for fat so that the precise quality may be known. The fat-globules should be evenly distributed in the milk by stirring; the cream should never be allowed to rise. Rennet as for Cheddar. The richer the milk, the more rennet is required.

The curd should be ready for draining in about an hour. It is then removed in thin slices with a proper instrument, and ladled into cloths put ready for it on a rack in the vat, and not removed from the whey. (Note that the curd is not cut with knives as in the Cheddar system.) The cloths are tied and tightened at intervals. In the evening the curd is removed to the draining-table, where it remains until the following day. It is then, together with the curd from the milk of a previous milking, broken carefully by hand and salted. When the salt has been well mixed in, the curd is put into the moulds (temp. 60deg.) and allowed to drain, the moulds being turned after one hour. As soon as the cheese is firm, it is removed and bandaged with calico, which is changed daily and the cheese scraped. The cheese is turned daily and bandaging repeated until it is quite firm, when it goes to the ripening-room, which should be somewhat damp, and at a temperature of 60deg.

All that remains is to watch carefully for mites, which can be eradicated by a dip in hot water.

SOFT CHEESES.

The soft cheeses are made on rather a different system from that employed for the hard varieties, and are mostly intended to be eaten fresh, except one or two such as Pont l'Évêque and Coulommier. They are chiefly of

foreign origin, but one or two are believed to have been invented at home. The following are representative soft cheeses :—

Cream Cheese.

Take two quarts of thick cream at 90deg. Fahr., adding a small quantity of " starter " if the cream is not thick enough. Leave it for about an hour and a half, and then tie it up in a calico cloth. In another hour put it into a fresh cloth, and scrape the sides down and tighten it up at intervals of an hour. In thirty hours the cream should be ready for use, and may be shaped in moulds specially made, lined with greased paper.

Cream cheeses should be eaten fresh : after a few days they develop a certain amount of bitterness.

Cambridge Cheese.

This cheese is in the form of a brick.

Set three gallons of milk at 90deg. Fahr., add 3 cubic centimetres of rennet and water, and stir for three minutes. Leave for one hour covered. Then, having scalded the mats and moulds specially made for this cheese, ladle the curd into these and leave to drain, taking care that the cheese does not adhere to the side of the mould as it sinks. In thirty hours the cheese may be taken from the mould, but left on the mat ; it is then ready to eat.

Gervais Cheese.

This is a small and dainty article, cylindrical in shape, rather similar to cream cheese, but slightly acid.

Set two quarts of milk and one quart of ripe cream in a bowl or wooden tub at 65deg. Fahr., add three drops of rennet and water, and stir for three minutes. Repeat the

stirring at intervals until coagulation begins, usually in from two to three hours. When this occurs, leave the bowl covered over with a cloth. Next morning, when the curd will have become firm, ladle it out in thin slices into a cheese-cloth or strainer. Having finished, bring the four corners of the strainer together and tie them up. Next hang up the strainer to allow draining to take place. In a few hours scrape down the curd from the sides of the cloth into the centre; then tie up, and again hang up the cloth to drain. Continue this scraping until the curd is sufficiently consistent to be put into the moulds, which is usually the case in about twenty-four hours from the start. Before putting into the moulds add a pinch of salt by way of flavouring. The moulds consist of twelve tin cylinders fixed to one plate. These should be lined with greased paper and then carefully filled. In two or three hours the moulds may be taken off, and the cheese is ready for consumption.

Pont l'Évêque Cheese.

This is a small square cheese with rounded corners, about 4in. long and 1in. thick. When fit to eat it is brownish-red.

Set five gallons of milk at 90deg. Fahr. in a wooden tub (Fig. 29), add 5 cubic centimetres of rennet and water, stir for three minutes, cover up the tub, and leave it covered for about an hour. When it is firm enough to cut, the cutting must be done in three directions, across each way and then diagonally. Now take a skimmer and insert it about ¾in. deep, thus cutting the curd horizontally. Lift the contents of the skimmer into a moist, warm strainer, stretched out upon the draining-table. When one-half of the curd has been ladled out, tie it up

lightly, and place another strainer for the remainder of the curd. Cover up the bundles with cloths to retain the heat. In about thirty minutes tighten the strainers, and repeat the tightening at intervals until the curd is ready for the moulds—usually in about two hours. See that the curd is not allowed to get dry. Next place a mat on each of four boards and two moulds on each of three of the mats, and fill in the curd with the fingers. Take care that the curd is evenly and tightly packed. As soon as two moulds are well filled, using the fourth board and mat, turn the cheeses upon it. Repeat the process with

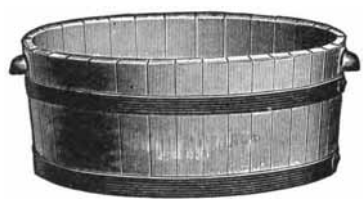


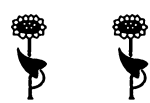
Fig. 29. Wooden Tub for Setting Milk.

the other moulds, and finally turn the cheeses back again. Turn them again at intervals of ten minutes during the next hour, which will assist the whey to drain, and will ensure each cheese having a good surface. Then turn the cheeses two or three times at intervals of an hour. As soon as the cheeses are ripe enough (usually detected by the smell), sprinkle some salt over them and leave until next day. On the following morning sprinkle salt over them again, and repeat this in the evening. On the third day the cheeses will be ready for the drying-room. Here they should be placed on straw mats, and be turned daily until the characteristic mouldy patches appear. Lastly, they should go to the curing-room, where they should

again be turned until ripe—at the end of six or seven weeks.

It will be noticed that in the case of these soft cheeses no pressure is applied. Their particularly fine flavour is due to the relatively low temperature at which they are worked, the very small quantity of rennet used, and the proportionately long time taken in coagulation. They have several excellent points. They require little outlay for implements; only small quantities of milk are needed for their manufacture; they command a good price, and are soon ready for consumption.

All the proper implements necessary for the manufacture of each cheese are easily obtainable from any good maker.



CHAPTER XIII.

CHOICE OF THE DAIRY FARM.

PROBABLY the most important of all considerations, once it is decided to go in for dairy-farming, is the selection of the spot best adapted to the business. It might not strike a beginner, but yet the difference between a good and a bad situation may decide whether there shall be a profit or a loss.

SIZE OF THE FARM.

The first thing to settle is the size of the intended farm. Of course, this must depend very largely on previous experience and financial resources. As a general rule a farm of 200 acres will be a good size to undertake. This will very soon show whether there is to be a profit or not, and will be large enough to occupy all the owner's time in supervision. If after a year or two it is found to work satisfactorily, it will be easy enough to enlarge the sphere of operations. If the tenant makes cheese and attends to it personally, he will find that this occupies most of his spare time.

ARABLE LAND.

Next, is it desirable to have any arable land or not? It is a difficult point to decide for all cases, but as a general thing I can see no great advantage to be gained in working any arable on a farm of 200 acres. It means machinery and a pair of horses, and probably an

extra hand, and if the extra cost of these is calculated, and also the amount of time they are idle in the stable reckoned, I do not think that it will be found profitable. Crops can be bought nowadays in many cases at about what it cost to produce them—some farmers will tell you that they grow certain crops actually at a loss—and therefore if there is no arable land on the farm there ought to be so much to the good in the saving of expense at the outset. If the farm is much larger and requires a good staff of labour and horses for its general work, then it might pay to have some plough land, for probably the teams could be usefully employed on the arable at times when they might otherwise be idle. Only in this case it must not be said that the crop was grown at a loss, if it does not show any actual profit in cash; for it should be recollected that it was grown to fill in idle time when the teams would otherwise have been eating their heads off in the stable. The cropping of arable land will be discussed in the chapter on general management.

SITUATION OF THE FARM.

Always look for a farm with a southern aspect. It is wonderful what a difference this one point will make. It is no uncommon thing to see land on one side of a hill bathed in sunlight and warmth, while snow is lying on the other. Cattle respond readily to changes of temperature, and a small difference in the amount of sunshine or a cold wind will immediately affect the flow of milk.

WATER-SUPPLY.

Water is the largest constituent of milk, and unless cattle are liberally supplied with it the milk-yield will

soon suffer. Find a farm where there is a stream if possible, but in that case make certain that nothing which could affect health enters it higher up. Try, if possible, to avoid having wells or ponds about the place. Ponds become very foul, especially when they are low in summer, and are a fertile source of infection to stock; while wells, generally in hot summers when they are particularly wanted, have a knack of running dry. I have in my mind's eye now a farm such as this, supplied by ponds and wells, where water had to be carted a long way daily to the stock from the beginning of June. This gave an enormous amount of unnecessary trouble, and took up a great deal of time just when time was most precious, and this was certainly not taken into consideration in assessing the rent.

If the farm is in a valley near a stream, find out further whether it is subject to floods. Very often, where this is the case, the fields which appear so valuable and attractive for stock are rendered perfectly worthless for grazing owing to the silt left behind by a summer flood; and it is not uncommon for crops of hay to be carried bodily away by floods in June or July. Learn as much as possible about the soil. Some soils are dry and porous; others clayey, heavy and damp. Damp soils are generally colder, and are certainly inimical to the health of dairy cattle, inducing garget and other ills with which we shall deal in the chapter on Veterinary Advice.

PASTURAGE.

Take a slow walk round the farm and examine everything minutely. A farmer should be something of a botanist, and able to tell the most objectionable weeds at

a glance. Very often fields look full of excellent pasturage to the uninitiated, which, if he really knew, are almost worthless owing to the presence of garlic and such weeds.

And here I would enter a general plea for the study of botany. It is often disregarded as outside the province of the farmer, but I must say that my own experience alike of its utility and its interest leads me to wish that it might be introduced into the compulsory curriculum of all schools. I knew a case where the want of such knowledge led a landlord to remonstrate with his tenant about a field with a special crop in it, considering that it showed signs of great neglect on the part of the tenant. The truth of the matter was that it contained an excellent mixture of seeds of various kinds which the landlord took for weeds.

BUILDINGS.

Lastly, carefully examine the buildings, decide what is wanted, and, if it is not there, have the matter put right before a lease is signed. It will be far more difficult afterwards. The buildings should be near the homestead, and well situated as regards one another, the object being to save time and labour in every operation. See that the cowsheds are well lighted and ventilated, not draughty but warm, and close to the food-houses. Remember that there is a special Order dealing with this matter, and giving Local Authorities power to make regulations in connection with it.

Under the Dairies, Cowsheds, and Milkshops Order of 1885, Councils of Rural Districts are empowered to make regulations for the following purposes :—

The inspection of cattle in dairies.

For regulating lighting, ventilation, cleansing, drainage, and water supply.

It shall not be lawful for any person to carry on the trade of cowkeeper unless he is registered.

The Local Authority shall register every such person.

It is highly advisable that those who are starting business in a new place, or putting up buildings for the purpose, should submit the plans of such buildings to the Surveyor beforehand, in order that no objections may be afterwards raised. The following Section applies to this point :—

7. (1) It shall not be lawful for any person following the trade of cowkeeper or dairyman to begin to occupy as a dairy or cowshed any building not so occupied at the commencement of this Order, unless and until he first makes provision, to the reasonable satisfaction of the Local Authority, for the lighting and the ventilation including air-space, and the cleansing, drainage, and water supply of the same, while occupied as a dairy or cowshed.

(2) It shall not be lawful for any such person to begin so to occupy any such building without first giving one month's notice in writing to the Local Authority of his intention so to do.

The suggested regulations provide for lighting and ventilation, and then deal with cleansing in the following manner :—

5. (1) Every cowkeeper shall cause every part of the interior of every cowshed in his occupation to be thoroughly cleansed from time to time.

(2) Such person shall cause the ceiling and the walls of every cowshed in his occupation to be properly limewashed twice at least in every year.

Then come suggestions for drainage, and the following should be noted :—

6. (2) He shall not cause or suffer any inlet to any drain of such cowshed to be within such cowshed.

Of course, it is evident that such stringent regulations will not be necessary in the case of rural cowsheds as in those of towns, and so it is especially stated that only certain of the precautions are to apply to cowsheds the cows from which are let out on grass during the greater part of the day.

CONSTRUCTION OF THE COW-HOUSE.

A word or two about the construction of the cow-house. The floors should be of rubble and tar pounded together, or of brick, with side drains running into the main, and then passing outside before entering the manure-tank. The ventilation should procure the free ingress of fresh air without draught, and also egress for the foul air. Ventilators should be placed in the walls above the heads of the cattle, and louvre windows in the roof. Windows should be so placed as to supply plenty of light to all parts, so that there may be no excuse for dirt. I have no sympathy whatever with those who still hold that cattle fatten best in darkness. They certainly contract disease more readily, and this tendency would quite neutralise any advantages in other directions—even if any were proved to exist. Remember always that sunlight is the best germicide.

Examine the food-houses carefully, and see that they are rat-proof. Have a loose-box or two for sick or calving cows. See that the calf-house has overhead lights to let in plenty of sun; and it should be quite close to the cowshed, so that calves can be quickly admitted to their mothers when necessary. Have a good water supply near each cow, so that it may drink when it comes in to be milked (Fig. 30). See that all the

drainage is in good order and well trapped, and that the outlets run into the manure-tank outside in the centre of the yard. All the liquid should run into the tank, whence it may be afterwards pumped out and used on the grass land. It is the most valuable of all manures for grass, and should not be allowed to waste.

Try to obtain a covered yard for the cattle and young stock to exercise in during winter. These yards should

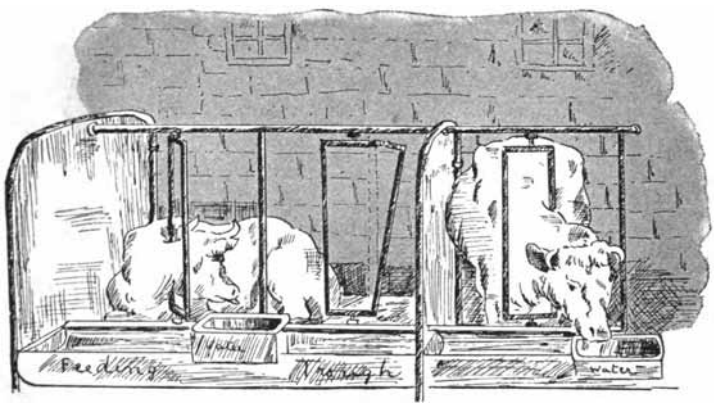


Fig. 30. New System of Tying Cows: Revolving Halters.

be—though they certainly are not—looked upon as a necessity. Not only is the outdoor exercise imperative in winter for in-calf cows, but the manure made by the cattle treading the straw is of the very best. It should be left until it is fit to use, fresh bedding being continually added, and then, instead of being carted out to the manure-heap, where a large proportion of its fertilising ingredients are lost, it should be taken straight away to the spot where it is to be used and spread at once.

There is more waste on farms in the British Isles, in this one matter of the proper treatment of farmyard manure, than would suffice to return a fair percentage of interest on the capital if it were prevented.

Such a farm as I have described should certainly be obtainable for £1 an acre, unless it has particular attractions. These very often exist in the shape of close proximity to a good market, or railway facilities, in which case the extra rent is often more than compensated by the additional advantages. I should always advise the inspection of a farm at its worst, generally in the winter, for then objectionable features are liable to flash out at you which might pass unnoticed in the sunny atmosphere of summer—the wind whistles through draughty cowhouses, the cattle stand shivering in the field for want of proper shelters, the drains are blocked and not working properly. On the other hand, if the water-supply depends on ponds or wells, they will show at their best and may deceive you. Find out, therefore, if they ever run dry in summer.

CHAPTER XIV.

GENERAL MANAGEMENT OF THE DAIRY FARM.

CROPPING.

I HAVE elsewhere suggested 100 to 200 acres as the ideal size of dairy-farm sufficient to tax the energies of a hard-working man. The question I wish to deal with now is this: Is it desirable that any part of a farm of this size should be given up to the plough? I may say at once that I would answer in the negative. The labour required by arable land is constant; it is expensive, and requires a staff of men, horses, and machinery; in many cases the crop produced by all this labour could be purchased for less than it has cost; and for these reasons my advice to the small holder would be to leave arable land alone and to buy what grain or straw he requires.

But since all my readers may not feel inclined to follow my advice in this matter, I will briefly give the principles followed under the plan of a "rotation" of crops.

Rotation of Crops.

Long before the science of farming was understood, it was well known that some crops grew more luxuriantly after certain crops than after others. We know the reason of this to-day, and we know that it is sound; moreover, it enables us to economise manure to a great extent.

Since the chemists have given so much attention to the various constituents taken from the soil by different plants, we know that the food of one is poison to another; and further, that not only do many plants take from the soil the particular food necessary for their growth, but they also leave behind them other ingredients useless to themselves, but greedily consumed by the next crop.

This leads us to the first great principle of cropping: Never (or seldom) put two similar crops consecutively into the same ground. The first of two straw crops has exhausted the elements required by such a crop, and the second will be starved, therefore you would have to manure for the second. This rule is often broken where barley is grown. It has been found that the best malting barley is not grown on fresh manure, and that if a straw crop is first grown, followed by the barley crop, the latter is superior in quality.

Therefore, in cropping, all rotations are founded on the principle of corn, roots, corn, clover, and its variations. One manuring is usual in the rotation, generally for the roots. They principally feed on the phosphates, and very often have an extra supply of superphosphate given them as they grow up. Then comes the corn crop, whose chief demand is on the nitrates which have hardly been touched by the roots. A very wonderful discovery was made in this connection towards the close of last century. It was well known that a crop of wheat could be grown without manure after a clover crop. It had also been known for some time that nitrates were the chief requirement of grain crops. When clover and other leguminous plants, such as beans, were examined, it was noticed that their roots were furnished with multitudes of little white nodules or tubercles. Further investigation showed that

the effect of these nodules was to attract nitrogen from the air to the plant and soil to such an extent that after a heavy leguminous crop there was more nitrogen in the soil than before the crop was planted. The enormous value of this discovery was not long in becoming realised, and a commercial substance called "nitragin," supposed to contain the nitrogen-forming bacteria present in the clover root nodules, was put upon the market, the supposition being that the addition of a quantity of this substance to land would augment the nitrates in the soil. It does not seem to have fulfilled the expectations of its promoters, and although the idea was undoubtedly a clever one, we do not hear much about nitragin to-day.

After the roots, corn, and then clover. The clover is usually sown soon after the corn shows above ground, so that no time is wasted, and it can be of use very soon after the corn is harvested. In the clover lies the variation of the ordinary rotation. It may be down for two or three years, and the cropping thus becomes a six-year rotation, and so on.

The above is briefly the principle of rotation in cropping. I will now make a few remarks about other crops especially suitable for dairying.

First and foremost comes the bean crop. There can be little doubt that no more valuable crop is grown than this, as far as the dairy is concerned. If there is a good supply of beans, besides corn and a few roots, one will be enabled to dispense with cakes altogether. However, beans require a particular soil, and the following is the method of cultivation:

February is the best month for sowing beans. They are especially suited to heavy clay land—known as wheat-bean land—and are none the worse for being sown in a

moist and sticky seed-bed. The cultivation is simple, and is performed in various ways. In Norfolk the beans are dibbled into drills. In Essex they are dibbled two in a hole on a newly-turned furrow; three men dibble to one plough. As soon as the young plants are above ground they are well harrowed (Fig. 31) and afterwards hoed. In Holderness, when beans follow wheat or oats, the stubbles are dunged and ploughed and harrowed; holes 2½in. deep and about 5in. apart are made with a dibble in each furrow. Nowadays hand labour has been largely

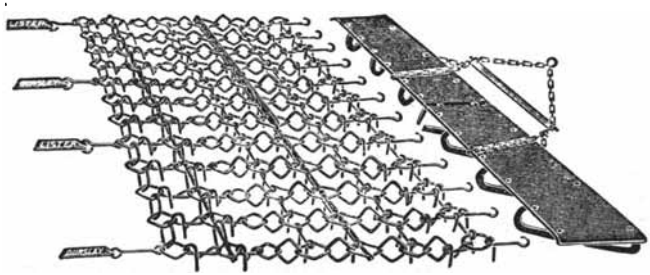


Fig. 31. Lister's "Farmer's Progress" Chain-Harrow.

superseded by the drill, but as the bean should be planted deeply, the dibble seems to manage it better. In some districts the land is raised in 27in. ridges and dunged. The beans are sown on top of the dung, and the ridges split as for potatoes. They should be harrowed before the plants appear, to destroy weeds. After the plants are 2in. or 3in. high the horse-hoe is run down the rows, and this should be repeated several times. Another very common practice was for the sower to follow the plough and drop the beans into the furrow at regular distances, and this seems an excellent plan. The amount sown is

from 3 to 4 bushels an acre, according to whether the beans are drilled or sown by hand. The crop may be from 20 to 40 bushels per acre. Farmyard manure is the best for beans, but dissolved bones, basic slag, kainit, and nitrate of soda or potash may be used.

Therefore, if the land is suitable we might confine ourselves to wheat and beans. But roots are often wanted, so we will make the rotation roots, grain, beans, grain, roots. This would be a four-course rotation manured for the roots, and whenever the turn of "grain" comes we can sow wheat, oats, or barley.

Both oats and barley are excellent cattle foods when crushed, and we could scarcely improve on a mixture of crushed oats and bean-meal for dairy cattle.

As regards the roots in the rotation, I would forcibly remind the reader of the advantages of the mangold. They are many and incontestable. First, from the manurial point of view, the mangold is a great consumer of nitrates, and would, therefore, come well after grain after beans, since the grain crop would not exhaust the accumulated nitrogen in the ground. Secondly, they provide an enormous quantity of excellent succulent food of the most wholesome kind. Thirdly, the mangold, unlike the turnip, has no effect on the milk in giving it a flavour. If cows are fed with turnips at milking-time, the milk often develops a "turnipy" flavour, and if these roots are used at all, it should only be after milking is over. The mangold, on the other hand, may be used with perfect safety. Lastly, mangold does not suffer from "finger-and-toe," the curse of turnips. This is a disease said to be due to a want of lime in the ground, which causes the turnip to grow in a deformed way, and eventually to rot. In reality it is due to a slime-fungus.

The mangold is an excellent food from every point of view, but it should not be used until well into the new year. The root undergoes considerable changes in a few months of storing, sugar being evolved. It may, of course, be used at any time, but is at its best from March onwards. Supplemented with hay and straw, they would be quite sufficient for milch-cows, say 12lb. of hay, 4lb. of oat straw, and 30lb. of mangold; to which might be added a few handfuls of bean-meal.

But so far I have only dealt with land that is heavy and suited to beans and wheat. Let us now consider the reverse case of light sandy soil. Of course, here beans are out of the question, but we find two crops excellently suited to such land—barley and potatoes. Substitute barley for the wheat and potatoes for the beans, and your rotation is again complete. Furthermore, both barley (crushed) and potatoes form excellent foods, and the latter have come greatly to the front of late years.

In considering this part of the subject, and especially the question of the rotation, I cannot leave it without bringing to the notice of the reader two valuable forage crops—lucerne and sainfoin—which never receive the attention they deserve. The former is suited to the wheat-bean, the latter to the barley-potato *régime*. Each of these will be discussed in its place, but I may say here that they form most valuable parts of any rotation, can remain down from four to eight years, producing heavy crops, and at the end of their tenancy the ground should be in a fit state to give a magnificent grain crop, or even two running. They are succulent when cut young, much relished by cattle, and splendid for producing milk. Moreover, they are deep-rooted and capable of resisting drought.

PRINCIPLES OF FEEDING.

Before proceeding to discuss separately the different crops at the service of the dairy-farmer who farms his own arable land, it would be advisable to examine the principles upon which all useful feeding is based, and especially feeding for milk.

The first thing to understand is how milk is formed: we can then consider the effects of the various foods. Milk is formed in the milk-glands of the udder, from the breaking-down of the gland cells. Thus, in the ash of milk we find lime and phosphoric acid derived from these tissues. And since milk is a direct product of cells, it becomes the highest form of food in the nourishment of the young. Again, if we examine "colostrum" (the name given to the first milk after the birth of a calf), it is easy to find whole cells, which later on disappear.

The cells from which milk is derived were composed of albumen, while the casein so largely present in milk is the result of the decomposition of cells. The milk-glands absorb their nourishment from the blood, and the quantity and quality of milk depend entirely on the size of the milk-glands. This fact must not be confounded with the mere size of udder: it is the rapid breaking up of the cells, not mere size, that produces milk.

It may be seen from this short analysis that diet is only a secondary consideration in milk-production, but yet the manner of feeding has an effect on the quantity of milk. There must be a good supply of albumen for the production of gland-cells. The albuminoid ratio—the proportion between digestible albuminoids and carbohydrates—must always be kept at the right level. If it be too low, the secretion of milk will be arrested by the necessity of

storing up flesh or fat; if too high, a considerable proportion of the albumen will become decomposed and unfit for milk-production.

The diet of a milch-cow should be especially rich in nitrogen. Therefore, hay alone would never do, but must be supplemented with bean or some other meal. The importance of this rule is often overlooked owing to the fact that deep-milking cows will keep up their yield for a long period even on foods that are poor in nitrogen. Such a yield, however, is only accomplished at the expense of their condition, and the cow loses flesh. This should never be permitted, as it eventually tells on the quality of the milk, and some time is required to get the cow back into condition again.

The albumen in the food provides the casein of milk as well as the milk-fat. A very fair standard for milch-cows is an albuminoid ratio ("A.R.") of 1 : 5, which represents the feed of a good pasture. There should never be less than 2½lb. per diem of digestible albuminoids in the food, and the results of an increase in these will show sooner in the case of good than in that of poor milkers. Fat in the food also increases the yield of milk, but it should be in a form easy to assimilate, such as linseed or cod-liver oil.

One thing has often been noticed in connection with this question of change of food, which is that, although the immediate effect may be to increase the quantity or quality of the milk, it wears off in time until the old level of production is reached. This leads us to the conclusion already insisted upon—that the amount and quality of milk (especially the latter) depend more on the individual animal and its breeding than on the particular food it receives. On the other hand, it is undoubtedly the case

that the food may increase the fat in the body, and, therefore, when it has no apparent effect on the milk, the improvement in the animal's condition is often quite marked.

Another important point in feeding is the effect of different foods upon the quality of butter. The flavour, consistence, and keeping qualities of butter, are all influenced by the food; and when this is poor in nitrogen or is not liked by the animals, the butter will be greasy and poor in flavour. Oats are an excellent milk food, and all starchy food, such as grain, bran, or rice-meal, improves the flavour of milk and butter; while oil-cakes should be used with great caution, or the butter may be found soft and greasy. It has also been noticed that if cows are fed on a very high diet, the percentage of milk solids and fats increases throughout the lactation period.

Finally, it is desirable to keep a supply of salt always before the cattle. Nothing is so conducive to a good flow of milk or to general condition as a lick of rock-salt now and again. This may be put in the fields in lumps, or in the mangers, or hung up against the wall. It may also be added to the food at the rate of half an ounce a day, when it will increase the appetite, and the greater the consumption of food the greater, other things being equal, will be the milk-yield.

THE VARIOUS FOODS.

Having now examined a few of the leading principles of feeding milch-cows, let us discuss some of the most useful foods in detail. Of course, the most universal and indispensable of all foods is hay, but as I wish to treat this rather more in detail in connection with the question of hay-making, I shall leave it until the end of the list.

Oats.

This is a typical and valuable grain crop having an albuminoid ratio of about 1 : 6; it is cheap and unsurpassed as an ingredient in mixtures supplied to milch-cows. The straw, chaffed up with hay, forms a useful addition. Oats, and indeed all grains, are highly digestible, and none more so than maize. The grain of oats is rich in nitrogen, and especially so in fat (4 to 7 per cent.), and this, as we have seen, shows its great value as a milk-food. The heavier the oat the better as a general rule, provided the extra weight lies in the grain and not in the husk.

A theory has been put forward of late years that oats contain a ferment valuable as an aid to thorough digestion, but only when eaten whole, and it has therefore been suggested that grains should not be given in the form of meal.

Wheat and Other Grains.

Wheat bran is an excellent food for milking-cows. So are rye-meal and barley-meal. Barley, however, is not so rich in nitrogen as other grains, and therefore not so valuable for cows. Rice-meal also is a valuable food, but it should only be bought with a guarantee, as many of the very cheap meals (this also applies to barley-meal) are often adulterated with gypsum and chalk. Maize-meal is useful in combination with other foods, but too much of it is heating and causes constipation. For this reason, as we shall presently see in discussing oil-cake, it may be fed with advantage when cattle are out to grass, for it then counteracts the loosening effects of the latter. The albuminoid ratio of bran is about 1 : 5; those of maize and barley are slightly lower.

Brewers' Grains.

These are a fairly cheap food, and in the dried form take a very prominent position as milk-producers. The albuminoid ratio is high, and they are much relished by animals, but objection is often made to them on the ground that cows fed on them are worked at too high pressure and are quickly worn out. Personally I cannot agree with this argument. They can now be bought dry, in a concentrated form, and are better than the wet grains. As much as 12lb. a day may be given to milch-cows. Brewers' grains are apt to become fermented and filled with bacteria, which sometimes renders them dangerous.

Beans and Peas.

These are generally fed in the form of meal. They are exceptionally rich in albuminoids ("A.R." 1 : 4 or 5) or nitrogenous constituents, and herein lies their great value. About 90 per cent. of their albuminoids is digestible, but in addition they help to render the non-nitrogenous portion of hay and other foods more digestible also.

Bran.

This is one of the most valuable foods for cows, being very highly nitrogenous. Bran of all kinds has an albuminoid ratio of 1 : 4 or 5. Samples of wheat bran or "middlings" are often sold which contain corn-cockles. These are bitter in taste, and cause animals to refuse their food, but have been proved to be non-poisonous.

Roots.

Under this head may be mentioned turnips, mangolds, cabbage, swedes, parsnips, and potatoes.

For the reasons already given, I do not recommend the use of swedes and turnips; but if they are fed at all it should be after milking, when the flavour may disappear before next milking-time. It is often said that cooking the turnips prevents the flavour from affecting the milk, but I am not satisfied of this, and never recommend cooking any of the ordinary foods.

Mangolds are in every way superior, are no more trouble to grow, give an enormous crop, and are excellent for milk.

Kohl rabi is a useful plant, for its leafy top will often grow where other roots will not. It keeps well, produces a large amount of food—12 to 20 tons per acre—and is also good for milk.

Cabbage is another good food, richer than mangolds or turnips, is useful on heavy soils, and produces a very heavy crop. It may be given at the rate of 40lb. or 50lb. a day, but since it causes looseness it should be fed in combination with some concentrated food. It is said to be a very impoverishing crop for the land, and requires heavy manuring.

Potatoes.

These are coming more and more into fashion as a food for cattle. They should never—this also applies to other roots—amount to more than a quarter of the ration. However, the quality of these roots varies greatly according to the soil on which they are grown, some containing more starch than others. The more starch, the less albuminoids. The "A.R." of the average potato is 1 : 10, and although this cannot be considered high, it becomes extremely useful in combination with concentrated foods. Rich clay soil produces a nitrogenous, sandy soil a

starchy, potato. The effect of manuring on the composition of the crop is great; potatoes manured with ammonia salts being nearly twice as rich in albuminoids as those treated with potash and lime. Further, it should be remembered that potatoes contain very little soda or lime, and the deficiency must be made up in the other food when feeding milch-cows or growing cattle.

Artichokes.

In these we have another very valuable form of root. They are easily grown, palatable to cattle, and useful for milkers.

CONCENTRATED FOODS.

These consist for the most part of the various cakes, such as linseed, cotton-seed, and rape.

Linseed is good in small quantities, but the objections to it are that it is expensive and too fattening. I always preferred to use cotton-cake. Of this there are two sorts —decorticated, or that from which the crude fibre has been extracted, and undecorticated. The latter is supposed to be dangerous, and care should certainly be exercised in its use; but I have found it distinctly beneficial on account of its binding properties when the cattle are out on watery grass, as in early spring, or whenever they are getting plenty of fresh fodder. At other times the decorticated cake is safer. Its digestibility is nearly 80 per cent., and its proportion of albuminoids and fats is considerably higher than in linseed cake.

Rape cake is another food against which there are no sound objections. They are fairly summed up in the following, which I once heard after a discussion upon its

merits: "It's an excellent food, only—the cows won't eat it." I don't think this is always so, but many samples contain noxious constituents such as mustard oil, which not only make it unpalatable, but also cause it to affect the flavour of milk and butter.

In addition there are palm-nut, sunflower-seed, and other cakes, but when using these they should only be given in very small quantities—2lb. or 3lb. at a time—and great care should be taken that they are not mixed with all sorts of impurities.

It has been said that cakes such as Egyptian, which come from hot climates, are frequently loaded with bacteria and mould spores, and soon undergo decomposition, and so are positively harmful. The only safeguard is to have a guarantee of quality, and to watch closely the effect on the animals.

Hay.

And now let us turn to hay, the chief of all foods. If hay is good in quality and has been well made, it will not need very much assistance from more concentrated foods. But hay is not always well made—in fact, my own experience of the usual methods leads me to a very contrary conclusion—and therefore I will offer a few suggestions which may be followed with advantage.

Time to Cut.—Probably the one point which has the greatest effect on the quality of hay is cutting it at the right time. There seems to be an almost universal objection to cutting grass before it is dead ripe. (Incidentally it may be mentioned that this applies equally to the oat crop.) Farmers are wont to go too much by rule—they "never cut before June 21," and so on—and, no matter what the season, they adhere to these rules. Grass should

be cut soon after the majority of the heads have flowered. If you wait until the whole has flowered, an enormous quantity of seed will be lost in the making, and there will be too much dry fibre. Another objection urged against early cutting is that the grass is too sappy and liable to heat in the rick. This is easily obviated by giving it a little longer to dry, and turning it well in the windrows. I always made hay in the manner I suggest, and was never troubled by the hay becoming overheated. On the other hand, if hay is cut at the proper time it will come out in winter bright and well-coloured, smelling almost as sweet as it did in summer.

Promptness in the Hayfield.—This is the second point. It should seem almost unnecessary to refer to it, but such is by no means the case. After hay is cut it is often left to lie in the sun until one side becomes absolutely bleached, while the other is still green and damp. Keep turning it over. It may be necessary to do this twice in the day in very hot summers such as we have had in some years of late. Don't knock it about; for this reason I object to the tossers often used. The hay is thrown roughly about when it is half made, and much of the most valuable part—the seed—is lost in the process. Of course, if you have a very large acreage to get in, you are obliged to have recourse to every form of machine, and are only too thankful to be able to get them, but if you can do without I believe the hay will be all the better. If you must use a mechanical turner, get a "swath-turner" (Fig. 32) in preference to a "tosser."

Never allow the hay to remain on the ground until it becomes bleached and brittle. The main thing is to eradicate the moisture, and as soon as it seems dry (winding a wisp round and round in your hand will soon tell

you) cart it to the rick. If it looks green, so much the better, provided it is dry; and this depends on the amount of sunshine.

Lastly, as soon as the rick is finished and the heat has escaped—generally in about three weeks' time—get it thatched. This work is almost always left until autumn,

Fig. 32. Blackstone's Swath-Turner.

so that a great quantity of the upper part becomes soaked with rain and useless.

I cannot forbear expressing the hope that before long some cheap and easily-handled material will be at the command of farmers for roofing their ricks. A few years ago, when the straw for thatching cost me more than

the hay was worth, I wrote to two or three leading manufacturers asking for suggestions, but the replies were very unsatisfactory. The prime cost of the various roofing materials was too great, and I had to put up with straw. I see no reason why something in the nature of woven straw and felt, in regular widths, which could be easily and speedily handled, should not be made at a very moderate price and of sufficient strength to last for years. Men who can thatch are becoming scarcer each year, and the first manufacturer who thinks it worth his while to patent such a material as I have suggested might make a good thing of it.

Of course, there could be no better system than that of Dutch barns, seen on many farms, but not on all. These are invaluable to the farmers, and obviate a very great deal of trouble and loss, and I hope that before long they will be looked upon as quite as essential as good cow stables.

LAYING DOWN LAND TO GRASS.

As I am discussing the question of hay, I will say something about laying down land to grass. This has become highly important of late years owing to loss suffered over corn-growing and the constant failure of the root crop. There can hardly be a total failure on grass land, and though the initial cost is doubtless great, it is spread over many years.

A great deal of consideration has been given to the subject by Mr. R. H. Elliot, who has found that certain plants are much more useful than others owing to the depth to which their roots go and the residues they leave

behind as humus. His selection for dry soils is as follows:—

	lb.
Cocksfoot	14
Tall fescue	7
Tall oat grass	7
Rough-stalked meadow grass	1
Perennial red clover	2
White clover	2
Alsike clover	1
Yarrow	1
Burnet	8
Kidney vetch	3
Chicory	3
Total	49

This mixture would cost about 55s. per acre, and the expense is a serious one. Objections have been also raised to the inclusion of chicory, burnet, and yarrow.

It is important that whatever the mixture it should produce abundant herbage, and this leads to the use of Italian and perennial rye-grass and red clover. Red clover cannot be depended upon, and therefore it is mixed with white, alsike, and hop. These seeds, as a rule, make up the mixture, and are used in the following proportions: 8lb. of red, 4lb. of yellow, 1lb. of alsike, and 1lb. or 2lb. of white, with 1 bushel of Italian or perennial rye-grass.

Within recent years there has been a tendency to introduce some of the meadow and pasture grasses into mixtures for alternate husbandry, and among them timothy or catstail is the most familiar. It is fairly cheap and germinates well. 2lb. of timothy is a useful addition to any mixture meant to lie for two or three years. It does best on low-lying, rich land, but helps to make herbage on almost any soil. Another well-

known grass is cocksfoot, a coarse but nutritious grass well suited for grazing, and adapted both for low and for high land. Another popular grass is foxtail, but this has the disadvantage of being expensive and somewhat uncertain. The result is a class of mixture which goes beyond the old-fashioned ones, and includes the following :—

	lb.
Italian ryegrass	4
Perennial ryegrass	8
Cocksfoot	6
Meadow fescue	4
Catstail	2
Red clover	4
White clover	1½
Alsike	1½
Total	31

However excellent such mixtures may be on certain soils they may not do well on light lands. The first year ought to be the best for mowing, and there is nothing like ryegrass for this. If a heavy cut of hay is to be grown, half a bushel of Italian and half a bushel of perennial ryegrass with some red and other clover will be found in most cases the best mixture. If the land is "clover-sick," the red clover may be omitted.

Clover-sickness.

It has been found that after clover has been grown upon the same land for some years the plant fails altogether, and even though the land be ploughed up and replaced by a corn crop, a subsequent sowing of clover fails to grow. The land is said to be "clover-sick." It is not easy to explain the reason of this sickness. Examination of the clover-plant reveals the fact that it is attacked by a fungus, but yet it is denied that this fungus is the prime

cause of the disease. It is more probably merely the result of the already enfeebled condition of the clover-plant.

Some very interesting experiments have been made at Rothamsted in connection with clover-sickness. When it was found that clover could no longer be made to grow upon the arable land it was transferred to a garden only a short distance away, the soil of which had been under ordinary kitchen-garden cultivation for two or three centuries. In this garden the crop has grown continuously ever since, from 1854 to the present time—over fifty years.

Of late years, however, an increasing difficulty is being experienced in maintaining the clover-plant. The fungus *Sclerotinia trifoliorum* has also made its appearance. Two highly important facts are worthy of notice. One, that although the clover refused to grow any longer on the experimental plots it grew abundantly on the grass paths separating the plots. This would hardly have been the case if the failure of the plant had been due to the fungus, for this could easily have been spread to the grass paths.

The second point to be noticed is, that when clover grows in mixed herbage on grass land, so far from failing after a few years, it increases from year to year when the land is suitably manured. There is no doubt that the cause of clover-sickness still remains very uncertain; but if I might venture an opinion I would suggest that it is somehow connected with a surfeit of nitrogen in the ground. The ability of clover to draw a large quantity of nitrogen from the air and fix it in the soil tends, when it is continuously grown on the same land, to produce an unhealthy amount of nitrogen in the upper layers of the soil. Since the plant does not require nitrogenous

manuring, the result may be that it becomes surfeited and diseased. The reason why this cause is not so apparent in some cases as in others may be that the nitrates formed are washed through the soil into the lower layers and drained away from the plant. This would always be liable to occur when the field was on the slope of a hill.

There are a few important rules applicable to grass land. It should be given as much farmyard manure as possible, and every alternate year should have a dressing of artificials. For this purpose I can recommend none better than basic slag in cases where the land is at all wet. It should not be mown every year, but grazed and mown alternately. A very light dressing of nitrate is often beneficial, but too much of it would soon wear out the land. Meadow land should be constantly rolled, especially in the autumn. In order to give all the various grasses a proper chance the meadow should not be grazed with only one sort of stock. Graze first with cows, then with dry or store stock, and lastly with horses and sheep.

Sainfoin.

Sainfoin is excellent for poor chalks and limestone. It is good for cutting and grazing. No charlock will grow in sainfoin, and as long as the root holds out a moderate cutting may be looked for. Care must be taken that the crop is not grown in a field that has held it within twenty years. It lasts from four to five years, and supplies the best form of temporary pasture.

Sainfoin may be drilled upon wheat or spring corn in the month of March at the rate of four bushels an acre. The seed should be bright in colour, not dusky or weather-beaten. It should be of English growth. The

best way is to sow it across the barley, or at the same time as the corn crop. If sown upon wheat it should be drilled across and harrowed and rolled. Young sainfoin should not be grazed in the autumn, but reserved for the following spring, when it may be fed or mown. It makes excellent hay.

Lucerne.

It is remarkable that more lucerne is not grown. It will not grow on all soils, and is chiefly confined to the East of England. It is said that it will not grow on land deficient in lime, yet it is often highly productive on clays. There can be no doubt that the soil should be in good heart, absolutely clean, and fine at the surface when the seed is sown, for if a plant is obtainable it remains for years. In the winter a foul field may show no trace of lucerne, but yet when spring comes it pushes its way through, and grows luxuriantly when other grasses and weeds fail to thrive.

Lucerne seed is worth about a shilling a pound, and about 20lb. an acre are necessary for drilling. It is important that the seed should be new and clean, for dodder if often found in it. Lucerne should be sown early, before the sun becomes too strong, say in March; its roots go straight down and are soon out of harm's way.

The advantages of lucerne are that it remains many years on the ground without any trouble, and grows luxuriantly during the greatest drought. It makes fine fodder for horses in summer, and in winter effects a great saving in the corn bill. For dairy cows, considering that lucerne is much richer in albuminoids than grass or clover, and that, cut just before flowering, it is one of the richest foods used, it follows that where it can be cut four times,

as is the case after the first year, a herd of cows should be kept with great economy, although, in consequence of the ratio of nitrogenous to starchy matter, the addition of some starchy food like maize or rice meal is almost necessary. The first two cuts just before flowering may, if the weather be fit, be converted into hay; it may be possible to make the third cut into hay also, and to graze the fourth right into October.

THE PRINCIPLES OF MANURING.

Strange though it may appear, the principles by which the manuring of crops should be governed are not yet universally understood. This state of things is in no wise attributable to a lack of scientific investigation, but is due to the very prevalent objection on the part of "practical" men to what is called "theory." It has always been the habit among a large number of those engaged in the practice of agriculture to decry the work of the chemist, although at the same time the methods in use were in perfect conformity with those suggested by the latter, and when they were not it was generally the practitioner, not the scientific investigator, who was forced by stress of circumstances to abandon his position.

In considering the several directions in which improvement might still be made, the most striking fact with which we are immediately confronted is the enormous yearly waste of fertilising material. This is due to two causes, both of them preventable. (1) The first of these is the reckless waste continually going on at the homestead owing to the manure-heap being subjected to every variation of weather or temperature. For this state of things there can be no excuse, whatever may be pleaded in extenuation in the case of the second point. (2) A

want of knowledge concerning the principles of scientific manuring. Waste is not only incurred by the use of unnecessary quantities of manure; it is also the result of the misuse or improper combination of various chemical fertilisers. Both the foregoing causes of loss will be investigated at greater length later on.

Nothing has contributed in a greater degree to cause us to reconsider our preconceived ideas concerning the proper system of manuring farm crops than the discovery of the power of leguminous plants to attract the nitrogen of the air. The immediate result of this discovery was the restriction of the quantity of nitrogenous manures employed, and since nitrogen is the most expensive of all manures the saving resulting thereby was incalculable. Yet the idea at the base of this discovery was not itself by any means a new one. Years before the nitrogen-forming nodules of leguminous plants had become the subject of investigation, Liebig had drawn attention to the amount of nitrogen continually present in the soil, to the renewal by snow and rain of such stores, and to the consequent needless waste on the part of those who held to the old belief in the universal efficacy of nitrogenous manures. Yet he did not affirm that nitrogen was of little value—and this it is important to remember in connection with what follows—but merely that the efficacy of the nitrogen is entirely dependent upon the presence in sufficient quantity in the soil of the other manurial constituents demanded by the crop. If this principle were constantly kept in mind there would be less disappointment over the results often attributed to the use of expensive nitrogenous manures.

In this connection it is of the utmost importance to remember that the amount of the crop depends entirely

upon the quantity of that nutritive substance which is present in minimum proportion. In every soil there are certain substances present in large or maximum quantities; there are also others which are present in minimum quantities. Now the amount of the crop depends upon the minimum substance, whether lime, nitrogen, or potash. Therefore, if a field were largely deficient in lime it would be foolish to expect the highest returns from a large outlay of nitrogenous manures. Before the benefit of these could be experienced it would be necessary to supply the soil with lime or its equivalent.

Not only has too much attention been paid in the past to the value of nitrogen as a manure, but there has been a corresponding failure to note the poverty of many soils in potash. The reason of this is not far to seek. The potash present in farmyard manure, and which should be returned to the soil with the solid portions, is mostly to be found in the liquid excreta. Now, farmyard manure is generally left open to the weather, is washed by every storm of rain, and the liquid parts are allowed to run to waste. When this manure is returned to the land from which it was manufactured, most of the constituents originally taken from the ground find their way back, but there is a great deficiency of potash. This fact is well worth remembering, and there are many soils from which far higher returns might be reaped by the supply of a small quantity of potash.

On the other hand, while potash is generally deficient there is usually an excess of nitrogen. Not only does every soil contain a large quantity of this manure in its upper layers, but this store is further increased by every shower of rain. The growth of deep-rooted crops also is continually bringing fresh supplies of nitrogen to the

surface. It has been computed that some virgin soils contain in the upper 12in. as much as 4cwt. of nitrogen per acre, and that as much as half of this is present in the upper 4in. of the soil. Again, experiments have shown that an ordinary rainfall will carry into the soil as much as 24lb. of nitrogen per acre. When these facts are borne in mind, coupled with the extensive use of farmyard manure, it will readily be understood that instead of there being any danger of a deficiency of nitrogen in the soil, this constituent will usually be present in excess.

Farmyard Manure.

The whole subject of manure falls naturally into two departments—farmyard and "artificial" manure. I will deal with the former first. No one who has ever contemplated the manure-heap in the centre of most farmyards can have failed to notice the enormous waste continually going on thereat. The heap stands open to the weather, washed by rain and shrivelled by sun, while all around it may be noticed the dark-coloured liquid which has leaked from the pile. When it is realised that this liquid contains a large proportion of the nitrogen of the manure and practically all the potash, the magnitude of the loss will be understood. The phosphoric acid, on the other hand, is chiefly contained in the solid manure. When the manure-heap is exposed to all the inclemencies of the weather there is bound to be an enormous loss of two of the most valuable constituents—nitrogen and potash.

The first improvement, then, to be introduced in all such cases is the contrivance of some method by which the liquid portions of the manure may be preserved. There seems to be no better way of effecting this than by

roofing over the yard, and allowing the cattle to use it as an exercising-ground, and thus manufacture the manure under cover. It is difficult to understand why the existence of covered yards is not universal. I have heard it said that the manure manufactured by this plan is too dry, but, even if it were, such an objection is quite easily overcome. When, on the other hand, the yearly saving of nitrogen and potash is realised, constituents which have to be replaced at considerable cost to the farmer, it would seem as if it should only be necessary to point out the advantages of such an improvement in order to gain the acquiescence of both landlord and tenant. The tenant would benefit immediately by increased crops, the landlord indirectly by the greater fertility of the soil in the future. It would be only fair that the latter should reap his share of the benefit in the shape of additional rent.

But even when the expense of covering over the yard might seem prohibitive, there are other methods of conserving the liquid manure. The yard floor upon which the manure stands should be impervious to liquid, and should slope from front to back. All liquid should drain into a central tank, whence it could be pumped from time to time.

The waste of liquid, however, is not the only loss suffered by the manure-heap which has been improperly built: it is liable to damage from over-heating. Owing to the combustion a large quantity of nitrogen is set free and escapes into the air, and thus the total weight of organic matter is reduced. The loss of weight during the winter will often amount to as much as 30 per cent. Of course, a moderate amount of heating cannot be prevented, nor is it even undesirable, so long as there is no waste; but one of the best methods of keeping it in

hand is constantly to pour portions of the liquid which has drained away over the heap again. Another method of preventing over-heating is to keep the heap properly compressed, and this may be secured by allowing the cart to pass over it or by adding layers of earth from time to time. Combustion is due to the presence of air in the heap, and if this be prevented as far as possible, either by saturation with liquid or by compression, over-heating may be avoided. It is often the practice to turn the whole heap over once or twice in order to assist its thorough decomposition, but considering the amount of labour and the loss of nitrogen entailed by such a course it cannot be recommended.

Suggestions have often been made for preventing loss in the manure-heap by the addition of gypsum, lime, or potash; but it is doubtful if these have any effect. On the other hand, it is always advisable to add layers of earth, which not only suck up the liquid which would otherwise drain away, but also have the property of fixing the ammonia and encouraging the formation of nitrates. Moss-litter is an excellent fixer of ammonia and absorbent of liquids, and for this purpose alone it may be thoroughly recommended for bedding.

As soon as the manure is considered fit for use, it should be carted out and ploughed in. It is a common practice to take out the manure in winter and form heaps about the field, and though such method gives employment to carters and horses at a slack time of year, it has some disadvantages. The loss from so many small heaps is, of course, far greater than if it were to remain in the yard; but, what is still worse, it is bound to result in rank patches appearing in the ensuing crop, which, especially in the case of barley, are objectionable. If it be necessary to cart the manure

out at any particular time, it should be spread at once and as evenly as possible. When the dung is to be used for grass-land it should always be spread in autumn, not only that the liquid may be washed into the ground for the use of the plant early in spring, but chiefly because it should be harrowed as early as possible and the remains of the dung taken out of the way of the hay crop.

Artificial Manures.

Although there is no manure capable of taking the place of farmyard, yet owing to the fact that there is generally a deficiency of this, agriculturists are forced to employ what are called "artificials." In all such cases, however, it is absolutely essential that the requirements of the soil should be well understood. For example, it would be worse than useless to manure ground with potash that required phosphates, and *vice versâ*, and—a far more important point—it is quite impossible for the stores of nitrogen or potash or other mineral matter in the soil to produce their maximum effect so long as there is a deficiency of another ingredient required by the crop. Once more it must be urged that the amount of any crop is dependent upon the quantity of that manurial substance which is present in the ground in minimum proportion. If the land be rich in nitrogen and deficient in potash no additional manuring with nitrate alone will have any effect, whereas a small quantity of potash alone would often produce immediate results.

The advantages of having these artificial manures at our disposal are manifold. First, they are portable and easy to handle. There are many positions in which the use of farmyard manure is quite out of the question owing to

the difficulty or expense of hauling it. Fortunately, however, we have other means of effecting the same purpose as the dung. We can grow green crops with the use of artificials, and by feeding these off with sheep the ground is rendered capable of supporting a subsequent corn crop. Herein lies one of the greatest advantages of artificials—they are comparatively compact and easily handled.

Secondly, instead of using several manures some of which are not required by the particular crop, we can select just that ingredient which is demanded and which is deficient in the soil. It is just because farmyard manure is a combination of several constituents that its use is not only expensive, but often wasteful. It would seem absurd when manuring with artificials to give a supply of potash and nitrate to a crop which required phosphoric acid, yet this is just what is often done by the use of farmyard manure. We give several manures where only one is asked for. The use of artificials obviates this difficulty, and as soon as we understand the requirements of the crop, and the amount of any particular manure present in the soil, we can employ just that constituent which seems to be deficient.

Thirdly, artificials are quick in their action. Not only is it necessary that dung should be allowed to ferment in the heap, but it takes some time for it to dissolve and become incorporated with the soil after being spread on the land. This is not the case with an artificial manure. It is spread at once, and after the first shower of rain is washed into the ground and is at the service of the roots. Besides, it is economical. Instead of spreading the manure about the field as we do in the case of dung, we can place the artificial manure in such a position that it is immediately at the command of the young rootlets of

the plant. The result is a much faster growth, and the minimum of loss.

In olden days it was always considered necessary to manure with dung once or twice in the course of the rotation. This was done, not that the particular crop to which the dung was supplied might exhaust it, but in order that future crops also might find a store of fertility in the soil. It would appear as if the importation of artificial manures had altered all this. Instead of arranging beforehand for all the requirements of the rotation, we now employ for each crop only those quick-acting manures which it can use, and we attend to the wants of each crop in the rotation as they arise. There is yet another valuable result of the extended use of artificials—not only do they tend to minimise the call upon the dung-heap, but they also increase the size of that heap. The more artificials used, the larger the crop at the service of stock, the larger the manure-heap. So there is a gain in both directions.

Before concluding the subject it will be advisable to draw attention to the particular requirements of different crops in the way of artificial manures. All straw crops respond readily to nitrogenous manures such as nitrate of soda, and since this is a very quick-acting manure it should only be employed when the crop has started to grow in spring. If spread in autumn a large part of the manure would be washed out by rain. There are exceptional reasons in the case of barley why the amount of nitrogen should be curtailed. It is generally taken after a root crop, when the ground is already in good heart, and it is undesirable that barley should be allowed to grow too rank. Many good farmers prefer to grow barley after a straw crop, because, owing to the fact that the

ground has been depleted of some of its nitrogen, a better sample is obtained.

In the case of roots the chief manure should be dung, supplemented with artificials. Potatoes are a very greedy crop, and require anything up to 20 tons of dung per acre. They also call for liberal supplies of potash. In treating leguminous crops, such as beans or peas, it should be remembered that they require little nitrogenous manure, as they draw their nitrogen chiefly from the air. Their chief want is lime—basic slag will do well—and potash. The remainder of the crops grown on the farm will generally call for nitrogenous manuring, with small quantities of superphosphate and kainit.

Turnips.

A good manure for turnips contains superphosphate and nitrate, say :

Per acre.

4cwt. of superphosphate.
2 ,, ,, bone meal.
3 ,, ,, kainit.
½ ,, ,, nitrate of soda.
½ ,, ,, sulphate of ammonia.

Finger-and-Toe.

Turnips are particularly liable to the fungoid disease popularly known as Finger-and-Toe, Clubbing, or Anbury (*Plasmodiophora brassicæ*), and provision must be made for it in the manure. This organism is capable of existing for many years in the soil, and when the particular crop for which it has an affinity is sown it enters the roots, multiplies rapidly in the tissues, and produces malformation and decay.

It is of an extremely contagious nature, though it is not borne in the air like potato disease. It is very often carried from field to field by the cart-wheel or the plough, or even on the boots of the labourer. It is even possible that the disease may be carried from place to place by sheep which are folded on the turnips; or it may lie buried in the manure-heap until it is transferred to the field.

The disease may be kept down by the proper employment of lime. The artificial application of burned lime has long been employed as a preventive, and is the most effective substance known. The usual custom is to give dressings of 5 to 7 tons per acre in the autumn a year or two before the turnip crop is to be grown. Gas-lime is often used, and should always be applied eighteen months before the crop is sown.

Experiments have shown that acid manures encourage Finger-and-Toe, and this fact should be borne in mind in the cultivation of land with a tendency to the disease. The best phosphatic manures under such circumstances are basic slag, bone meal, or precipitated phosphate. As cabbage is similarly affected, care must be taken not to visit a field in which the disease is prevalent and then to go to a healthy area on which, say, turnips are being cultivated. As too many of the commonest cruciferous weeds are liable to Finger-and-Toe, it will be obvious that these must be kept down.

Potatoes.

For these farmyard is the best manure, supplemented with:

Per acre.
1cwt. of sulphate of ammonia.
4 ,, ,, superphosphate.
1 ,, ,, kainit.

Corn Crops.

These require nitrogen, which may be given as nitrate or sulphate of ammonia. In case the latter is used it should be sown ten days before the seed, and the nitrate should be given after the crop is up. The superphosphate and kainit may be mixed with the ammonia and sown before the seed.

Per acre.
1cwt. of sulphate of ammonia.
3 ,, ,, superphosphate.
2 ,, ,, kainit.
and 1 ,, ,, nitrate of soda when the crop is above ground.

Mangolds.

These require a different manure from turnips. The latter require superphosphate, while the mangold crop asks for nitrate. This should be applied at the rate of ½cwt. twice after the crop is above ground. A little salt should be added to the manure in the drills.

It is very important to bear in mind that mangolds can be grown continuously on the same land by the use of proper manure. Certainly no manure is at all comparable to dung. In good seasons a crop may be obtained by the use of artificial manures only; but the great advantage of dung is that it assists germination of the seed, through its ability to retain moisture, and thus is invaluable in dry seasons.

The Rothamsted experiments show that, with farmyard manure as a basis, the crop will be further benefited by the addition of some active nitrogenous manure such as nitrate of soda. A free supply of potash salts is also essential to the development of the mangold, even on a soil naturally rich in potash. When nitrogenous manures

are used in addition to dung, the potash salts should be increased *pro rata*, in order to maintain the health and feeding-value of the crop and to bring it to maturity. Superphosphate is unnecessary with dung. A dressing of salt should always be included among the manures for the mangold crop.

Hay.

For the hay crop far and away the best dressing is farmyard manure, especially that from the liquid-manure tank. Two tons of hay take about 3½cwt. of nitrate, 4cwt. of kainit, and 1½cwt. superphosphate out of the land, and therefore it requires to be well treated. The following is a good mixture :—

Per acre.

1cwt. of nitrate.
2 ,, ,, superphosphate.
2 ,, ,, kainit.

There is no better manure for wet or boggy grass land than basic slag, and in many cases the addition of kainit to this gives the very best results, especially on what is known as "brashy" land.

Rolling and harrowing (Fig. 31) are most important for both grass and grain. In the case of corn crops the land can hardly be too much rolled. Once after the drill and again when it is above ground has been known to make a difference of 8 bushels to the acre. The straw is also much stiffer after land has been frequently rolled.

Mixing Manures.

Basic slag must not be mixed with manures containing ammonia or soluble phosphate. Nitrate of soda must not be mixed with superphosphate or dissolved bones unless

sown at once, or part of the nitrogen may be lost. All manures should be thoroughly mixed before sowing, and lumps broken up to allow of even distribution in the soil.

FEEDING CATTLE.

I can give no better rule for the feeding of milch-cows than this: Give them as much as they can make use of. This means that no two beasts are alike in their capacity for consuming food and turning it into milk, and you must find out by experiment what is the best amount. Some cows are always thin, but yet have a large milk-yield; others are poor milkers but always half-fat; therefore it is difficult to overfeed the former, while the rations of the latter may be reduced.

The following would be a standard ration for milch-cows, working out the albuminoid ratio at about 1 : 5 :— 8lb. of hay, 8lb. of oat straw, 20lb. of mangolds, 1lb. of bean meal, 30lb. of grains, per 1000lb. live weight per diem.

Linseed cake, good cotton cake, and bean meal are worth about the same lb. for lb., while decorticated cotton cake is half as rich again in albuminoids. One pound of dried grains is equal to a pound of second-rate cotton cake.

Young Cattle.—In conclusion, I think it may be of use to give the method of procedure of a well-known breeder —Mr. Ferguson, of Pictstonhill, Perth—in feeding stock. All the male calves may not be sold as veal, and then they will have to be turned into beef.

By the following method Mr. Ferguson produces bullocks weighing 10cwt. to 12cwt. each at 18 to 20 months. He buys in May well-bred Irish heifers,

eighteen months old, at £8 a head or less, and turns them out to grass with a good Aberdeen-Angus bull. They are economically fed up to the time of calving, when they are hand-milked until the calves will take all the milk they yield, after which they and their calves are turned out of the stalls, the former being fed on turnips and straw till the grass grows, when they with their calves are again turned out to graze with the bull. The calves are weaned in October, after which they are allowed to run out by day, being housed at night and fed on turnips and cake. As winter comes on they are divided into three classes, the best being fed for selling in the following August, the second lot a few months later, and the late and small calves kept chiefly for store cattle, to be fattened in their second winter. Their mothers are sold at good prices after calving the second time.

Mr. Ferguson strongly advocates new milk for calves, at least for the first eight or ten weeks. After that time they may be weaned, and porridge made with oat and linseed meal makes an excellent calf food. They should never be allowed to lose their calf flesh. Good hay, roots, potatoes, and cake with treacle, are found profitable. He gives the following quantities:—50lb. of cut swedes, 8lb. of inferior potatoes, 2½lb. linseed cake, 1½lb. inferior grain meal, 5½lb. of sweet hay, and oat straw *ad lib.* These quantities are increased as the season advances and the young beasts are finished off for the butcher. The system is good, as cows and calves are constantly growing into money, while healthy cross-bred calves are obtained for rearing and fattening.

CHAPTER XV.

LABOUR, MACHINERY, AND EXPENSES.

LABOUR AND IMPLEMENTS.

WHEN we come to consider the amount of labour necessary to work any particular farm we find ourselves at once on difficult ground. There are no "constants" in estimating labour. It varies so much in quality, that oftentimes two men are employed—sometimes even three who have had no previous experience—to do work that should not have overtaxed the energies of one man, or one man and a boy. Then again, the land varies so greatly in quality. Some soils are heavy, others light; some farms lie on the side of a hill, others in the valley; in some cases there is more arable than in others; and all these factors have a good deal to say to the result in estimating the number of men or horses required.

It does not seem out of place here to refer to the increasing inferiority of the labour at the command of a present-day farmer. In very many country districts this is strikingly evident. The labourers of any sort are so few that an employer is too content to get anyone at all to complain when he finds his workmen hopelessly bad at their job.

The reason of this is not far to seek, and it must be admitted that the farmers themselves are in a large

measure to blame. In olden days when farming was in a prosperous condition, and the country districts were full of well-trained men and boys, there was not so much competition among employers for workmen, and wages were low and cottages bad. A man was expected to support a family, often a large one, on 12s. a week, while his wife had to supplement this by piece-work in harvest-time, or by taking in washing. The system was undoubtedly an unfair one. The work was hard and continuous, holidays were almost unknown, and although a great many of the labourers were distinctly of the class called "skilled," they were paid at the rate of a stone-breaker. As soon as prices began to fall, and the exodus to the towns began, those who went away sent reports to their friends of the better pay and altogether superior conditions under which they lived in the manufacturing districts. The result was a still greater exodus from the country, until at last the condition of things existing at the present day was brought about.

But the most exasperating part of the whole business is that we now hear the cry of the "unemployed" rising louder and louder day after day. The decay of manufactures, coupled with the exodus from the country of so many labourers, has made the distress so acute in the towns, that we are actually beginning to see schemes put forward for taking some of these unemployed "back to the land." But the mischief is done. To make a thoroughly useful farm hand it is necessary that the training should begin in boyhood, and it would take at least a generation, even if things went the right way, before the country was again properly supplied with skilled farm labour.

Meanwhile, we must take things as we find them, and

therefore it will be best to overestimate the amount of labour required. For the dairy you will require a milker for each six cows. It will be generally necessary to get the milking done quickly, and therefore the number of cows to each milker cannot be more than this, but, of course, the milkers will be used on other work afterwards. A butter or cheese maker will be required in the dairy, whose whole time must be given to these operations. One of the milkers is usually the cowman, and when many cattle are kept it will take all his time attending to them, keeping their stalls clean, feeding, and so on.

As regards the arable land, if it be fairly light soil, one pair of horses will be required for every hundred acres or fraction of it; each of which, with a plough, will require a man and a boy. If milk is sold, either to private customers or a factory, this will require a pony and a light cart, with a boy to drive. In hay-time it will be necessary to have some large hay-wagons, a mower, a rake, and perhaps a tosser. (I have already discussed this under haying.) A good roller and a liquid-manure cart will also be required.

In the food-house there must be a chaff-cutter, root-cutter, and cake-breaker. In the dairy a separator, refrigerator, and implements for butter and cheese. (catalogues from any good dairy supply company will give all the necessary information as to these.) On no account omit the refrigerator. In many dairies this machine is not to be found. The value of it is not immediately apparent, and therefore it is not always grasped; but there is little doubt that it is one of the greatest boons to the dairyman whose milk is expected to stand a long railway journey. If milk be cooled as soon as possible after milking, it will keep fresh for a

considerably longer time than that which has not been so treated.

In giving this very short description of the labour and machinery required on a dairy-farm, I am fully aware of its deficiencies. I may be told at once that my account is too vague. My only answer must be that the whole question cannot be treated other than vaguely, and I have merely given a few details of some of the items to be taken into consideration in estimating the quantity of capital necessary for the proper working of a dairy farm. I know full well that many will consider my estimate of labour too low. I shall be told that there must be a foreman, a head cowman, and so on. But I am also aware that there is a great deal too much of this unnecessary expenditure nowadays, and it is due to the fact that farming has been taken up so much by those who need not rely on it for a living. How often we see the description "pleasure farm"! No; I firmly believe that a rigid economy in every branch is absolutely necessary to the success of the undertaking.

I can cite as a fair instance of what may be done the case of a farm of about 100 acres which I once held, and which I worked with the help of only one man. In hay-time only were we obliged to get the help of an extra hand. There was very little arable, and I found that what there was could be attended to at times when the horses were not occupied elsewhere. Of course, I helped whenever a second pair of hands was wanted, with milking and in hay-time, but yet I know that unless the man had been a very good one it could not have been done. He understood the care of cattle, sheep, and all stock thoroughly; could plough well, and make and thatch a rick. However, such men are not easily found nowadays,

and when they are found they are worth a good wage. Also, if the owner does not work himself, he will require someone to take his place in the dairy; but I cannot conceive why anyone should take up farming as a business, with the intention of making it pay, unless he not only understands every operation thoroughly himself, but intends to use his knowledge in practice. There is too much of the idea about that farming is a pursuit which "any fool" can tackle. Why, to me it seems worthy of being classed among the "learned" professions. Think of what a farmer must know in order to be a success! He must first of all know a good beast from a bad one; he must understand the process of milk-production; must know something of bacteria and their effects; must be capable of making butter and the different sorts of cheeses; must understand the growth of crops and the principles of manuring; must be a mechanician, and able to take to pieces or mend his own machinery. Does it seem a small thing? I should say a whole lifetime would not be sufficient for the mastery of even its details.

EXPENSES.

Lastly, we have to consider the question of capital. Here again there must necessarily be a great difference of opinion. My advice is not to have much superfluous capital—too much of a reserve leads to too great security, and therefore a want of attention to saving in small matters—but at the same time to have enough, for nothing is so fatal as being cramped for money just when you want it, to grasp a good opportunity for buying stock cheap, for instance. Again, foods and manures are expensive, and if there is not a sufficient reserve for them they are

liable to be stinted, and thus the most is not made of either land or stock.

My own opinion regarding the amount of capital desirable—I know it may be thought low by good authorities, but it is the result of my own experience—is that from £5 to £7 an acre will be ample. This will give a sufficient margin to tide over the delay which must ensue until returns come in and for wages, &c.

I should have liked to say a word or two regarding the cost of various farm operations done as piece-work; but on second thoughts I have come to the conclusion that this varies so widely that such an estimate would be quite valueless. To give two examples: I have paid for mowing in various districts from 2s. 6d. to 10s. an acre, and for ploughing as high as 14s. an acre, which was preposterous. From these two instances it may readily be seen how useless it would be to try to tabulate the proper charges for work. They are entirely ruled by local supply and demand.

CHAPTER XVI.

INSTRUCTION.

To the novice who proposes to take up dairy-farming as a business, there are three ways open for obtaining the necessary instruction, but whichever of these he may decide to follow, he will soon learn that a fairly long apprenticeship is necessary. The barbarous ignorance on this point has led to much failure and disappointment, and has gained a bad name for farming as a profession. Many people are totally unfitted for life on a farm, many have not sufficient experience, and when things go the wrong way the blame is laid upon the business, not upon its owner.

The student, I have said, has three courses open to him. He (1) may go to one of the well-known agricultural colleges; (2) may live with an agent or a practical farmer for a few years; or (3) may take a course at any of the excellent Institutes to be found in almost any district.

(1) I cannot say that I am much in favour of this method. The process is very expensive, and the results are not proportionately great. To the absolute tyro in the business they will be useful up to a point, but once that point is reached a further process of practical work will be necessary to render him proficient.

(2) This is the plan which commends itself to me most—may I say I have tried them all? It is an enormous

advantage in this business, as in all others, to go straight to the fountain-head. If a man wishes to become an engineer he goes as an apprentice into the workshops. The same in the law or any other profession. I recommend the same plan to the student of farming. Live with an agent who works the home farm himself, or with some large tenant-farmer. Not only use your eyes to *see* all that is going on, but your *hands* to help in it. No amount of eye or ear work is equal to a tithe of hand work. I do not believe that anyone has a right to profess to understand farming unless he has been through the mill, like any day labourer, and done the work himself. It is only in this way that you run into the thousand and one difficulties that are constantly cropping up, but having met them once you will always be ready for them and able to grapple with them in future. There is also an invaluable test in the practical method of learning. To many the *idea* of farming has great charms. They think of green fields, pleasant brooks, leafy woods, and browsing herds. But put them down near the homestead, tell them to milk the cows, groom the horses, or feed the pigs, and immediately all is changed and they are grievously disappointed. They didn't know that farming meant work of this sort; besides, it will dirty the hands. And it is for this reason—especially nowadays, when so many are preparing for colonial life—that I would strongly urge, whatever else he may do in addition, that the intending farmer should go through a practical course on a farm.

Lastly, there is course No. 3. This I can also thoroughly recommend. The instruction is by no means expensive; it is the very best of its kind, and six months' good work in one of the Institutes, such as the Midland

at Kingston, or the Dairy Farmers' at Reading, should make anyone proficient in butter and cheese making.

DAIRY INSTITUTES.

I give below a few of the details concerning the courses of instruction and fees at three of the more representative of these institutions.

The Midland Agricultural and Dairy Institute.

Situated at Kingston, in the county of Nottingham, this Institute consists of fully-equipped buildings and appliances for giving theoretical and practical instruction in all branches of agriculture, dairying, and poultry farming. The Institute was established by the co-operation of the County Councils of Derbyshire, Leicestershire, Nottinghamshire, and the Lindsey Division of Lincolnshire. The buildings are new and extensive, and well adapted for dealing with large quantities of butter and cheese.

The object of the Institute is to provide a practical course of instruction in dairying, combined with the principles on which the practice depends. The treatment of milk in all its branches; butter-making, with the best methods of packing and marketing; all varieties of cheese-making, such as Cheddar, Stilton, &c., and foreign varieties, such as Camembert, Gruyère, Pont l'Évêque, come under demonstration.

There are several courses—the teacher's diploma course; the factory manager's course; a six weeks' course for farmers, their sons and daughters; and many special courses. After attendance on any of these and passing a satisfactory examination, certificates and diplomas are granted.

The fees for the dairy courses are :—For students without the area of the counties, £1 per week, or £12 for three months; £21 for six months, or £27 for nine months. For students within the area, half these fees.

Agricultural courses :—£5 per term of ten weeks to students in the area; £7 10s. per term for those without.

The fees for board and lodging are: For males, 15s. a week; for females, 12s. a week.

The British Dairy Institute.

This was established at Aylesbury in 1888 by the British Dairy Farmers' Association, and several hundred students were successfully trained there in different branches of dairy work. In order that students might have an opportunity of combining with the practical study of dairying a more complete scientific instruction, the Institute was moved, in 1896, to the new building adjoining the College at Reading, and placed under the management of a committee.

The Institute contains large milk-receiving, butter-making, and milk-testing rooms; four rooms for the manufacture of pressed and soft cheeses, and seven for the ripening and drying of these, besides reading, lecture, and common rooms. It is equipped with the best modern apparatus for the manufacture of dairy produce.

The instruction is both practical and theoretical, and is designed to meet the requirements of those who need elementary or advanced instruction, or who desire to perfect themselves in the manufacture of any special variety of dairy produce. The Institute is open all the year round, except during the Christmas vacation. Students may join at any time and for any period.

The fees are as follow:—Practical and theoretical instruction in butter-making and cheese-making (including hard-pressed, blue-veined, and soft cheese), £1 per week, £10 for three months, £18 for six months; practical and theoretical instruction in butter-making only, 10s. per week.

Arrangements are made for boarding and lodging students in Reading, and the charge varies between 15s. and 25s. a week.

The Lady Warwick College.

Situated near Studley Station, on the Midland Railway, this college was founded for women students. The scheme of work in dairying is intended to prepare students for the following examinations:—(a) The National Diploma of the Royal Agricultural Society; (b) The Diploma and Medal, or Teacher's Certificate, of the British Dairy Farmers' Association; (c) The Lady Warwick College Certificate and Diploma in Dairying. There are also short courses at special fees.

The fees are as follow:—

Resident Students.—Full training, with board and residence at the College, in dairying: Cubicle, £80 a year; study bedroom, £100 a year. Short courses for six weeks: Cubicle, £15; study bedroom, £18.

Non-resident Students.—Fees for each department, 25s. a week, or £13 6s. 8d. per term.

Communications should be addressed to

The Warden,
Lady Warwick College,
Studley Castle,
Warwickshire.

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In concluding this subject I cannot forbear saying a few words in praise of the calling of which it treats. It is so common to hear abuse heaped upon it even by those whose livelihood it is. Times are always bad, the weather is never what it should be, and money is always lost. My answer to all this is: When times are bad in farming, they are generally equally bad in trade; if every opportunity were taken of making the best use of the good weather while it lasted, we should not hear so much of its badness. It is quite usual to see work delayed during fine weather as if it would last for ever, and when a change comes the job is only half done. Lastly, concerning the question of profit, I do not remember meeting the man who had absolutely lost money except through his own fault. Tenant-farmers with small capitals bring up large families, put them out in trades or on farms, and because when they themselves retire they find their banking account no larger than it was, they complain that they have lost money. But what about the cost of bringing up the family? Could they have been so healthily or happily reared in towns, in small stuffy quarters? I say decidedly No.

Farming is a fine, wholesome, and absorbing occupation, and to him whose whole soul and interest lie in his work it offers sufficient, if not excessive, reward.

CHAPTER XVII.

VETERINARY ADVICE.

PRECAUTIONARY MEASURES.

ALTHOUGH it is doubtless most useful to know how to deal with disease when it occurs, yet it is almost more valuable to be able to prevent it from cropping up at all. Many of the commoner diseases, which are certainly dangerous when they break out, might be prevented more or less by taking proper precautions at the start. Certain cattle have a tendency to certain forms of disease, and therefore, before I say anything about the cure of these, I propose to make a few remarks by way of warning about what to avoid when buying a cow.

If it were possible always to know the life-history of an animal it would be a fairly easy matter to select only such as were likely to suit, and to avoid those which were not. But naturally a seller is not generally in a confidential mood, and therefore in buying in the open market grave risks have to be run of introducing into a herd diseases which could not have been discovered by inspection. Such are milk-fever and abortion, and since these two are among the most formidable that attack stock, the reasons which have led me to deprecate buying in market overt may easily be understood.

I would remind those who are obliged to resort to the

markets for their dairy stock that the following points must be kept in view. Having inspected the animal and become satisfied of her external appearance,

(1) Insist on seeing her calf if possible. If the calf be at foot it is reasonable to suppose not only that she will breed, but also that she is not subject to abortion, for it is almost certain that a cow which has once aborted will do so again.

(2) Examine the udder and strip the teats to discover whether they are all in working order, or if any of them is "blind." If such is the case, leave the cow alone, as a blind teat may be the result of inflammation or "garget" (see under this heading, further on), and liable to recur.

(3) Examine the horns for her age. The first ring shows three years, and each additional ring another year. If the horns seem to have been tampered with (rings are often removed with sand-paper), examine the teeth. A cow has thirty-two teeth, of which eight incisors—the centre teeth—are in the lower jaw. There is only a pad in the front of the upper jaw, no teeth. At twenty-one months she has two central permanent incisors; at two and a quarter years she gets two more, one on each side of central; at two and three-quarters she has six permanent incisors; and at three and a quarter years she should have the full number, eight permanent incisors.

(4) If the calf is not with her, but she is sold as in-calf, it is often possible to prove the truth of this statement—after the first five months of pregnancy—by pressing the abdomen on the right side, when the movement of the calf will generally give evidence of its existence.

These are the only precautions that can be taken, and they should never be omitted.

Abortion.

The ailment which occupies the second position of importance in the amount of damage which it inflicts is abortion. This is the premature birth of the calf, and is often known as "slipping the calf," and I cannot help thinking that in its earlier stages it is of commoner occurrence than is generally recognised. Where cattle are running out, it often occasions surprise when cows which were supposed to be in-calf turn to the bull again. In some of these cases I feel persuaded that the cow has slipped its calf unknown to the attendant.

Abortion may be caused in several ways. Probably the commonest reason is a blow either from man or beast. It is no unusual thing to see cattle horning one another; nor is it uncommon to find the man who is herding them driving them quickly through a gate or doorway so that they often receive a heavy blow against the posts.

Another cause is the use of impure water from ponds, especially where other cattle have aborted close by. This leads me to a third cause of danger, the known contagion which is so much dreaded. If a cow slips her calf in the field, the rest of the herd gather round stamping and snorting, with almost certainty that one or other presently does the same. It is denied that this is the result of contagion, and quite possibly it is due to the effect produced on the nervous system of the rest of the herd, but still the term "contagious" expresses the results quite clearly.

There is one more cause of the disease which has never received as much attention as its importance warrants. This has been called "mediate transmission." When a cow has slipped her calf, she comes in season again in a short while and is taken to the bull. Unless every precaution is taken there is the gravest danger that if the

bull be used for other cows afterwards he will transmit the disease to them. The result is not immediately apparent, but the following season the number of cases of the complaint occasions remark, although, through lapse of so many months, it never strikes the owner that the bull was the original cause. I would strongly advise not breeding again from a cow which has once aborted, as—apart from the fact that she will probably do so again—the danger to the rest of the herd is too great. If, however, it is necessary to breed from her, every precaution should be taken by injections of dilute carbolic, and the bull should be cleansed with the same. The following will do: Carbolic acid ½oz., water ½ gallon.

Treatment.—As soon as a case occurs, separate the animal attacked from the others. Remove all traces of the birth, and lime the spot heavily. Clean the animal by injections of dilute carbolic. Give ½oz. doses of carbolic in the bran mashes.

The following is a summary of the treatment recommended by the Board of Agriculture:—

1. Aborting cows should be isolated, and all objects which have come into contact with them burnt or disinfected.

2. Aborting animals should not be bred from. After aborting, a cow should have her vagina syringed with a solution of 1oz. of Izal to the gallon of water, to be continued until all discharge ceases.

3. All cows in the herd should have their hind parts sprayed with a solution of Izal, 1oz. to 4 pints of water. One syringeful will be sufficient for each cow, and this should be repeated three times a week.

4. The sheds should be limewashed every three months with a mixture of lime and carbolic.

5. Roofs or interiors which cannot be reached with the lime should be sprayed with a solution of 10z. of Izal to 10 pints of water.

Much interest has lately been aroused on the Continent in connection with the treatment of epizootic abortion by the subcutaneous injection of phenic acid. Very remarkable results have been obtained thereby. All that is necessary is to mix two-thirds of an ounce of phenic acid with 1 quart of boiling water. This solution is injected in doses of 20 cubic centimetres into the animal's neck near the lower part of the dewlap, every fortnight from the fifth to the seventh month of gestation, in the case of all in-calf cows. This simple process, which produces neither pain nor danger, has caused the complete disappearance of abortion in whole districts, even in those in which it had formerly accounted for 75 per cent. of the deaths.

Anthrax.

This is one of the most fatal diseases of stock of all kinds, and is communicable by them to man. The disease is due to the entrance into the blood of the anthrax bacillus or its spores. In order to prevent the spread of the disease it is absolutely essential that carcases of animals which have died of it should not be cut up, in order that none of the blood may be shed, and the spores contained in it allowed to spread.

The first evidence of the disease is generally the finding of a dead animal. Sometimes, however, premonitory symptoms may be noticed. An animal stands by itself in the field, dull and disinclined to move. It ceases to feed, and stands with head bent and blood trickling from the nostrils. There is occasional shivering and trembling

of the limbs, which passes rapidly over the body and then ceases. There is often a swelling in the throat, which is hot and tender, and gradually extends. Finally, the animal dies.

There seems to be little doubt that the disease can only be spread by germs or their spores, transmitted through food or water, and which may gain an entrance into the body by the mouth or a wound. But the germs can generally only find an escape from the body of a diseased animal by its carcase being cut up and blood shed. Therefore, where the disease is suspected, every precaution should be taken to prevent this, and the affected animal should be separated and allowed to die, not slaughtered. After death the nostrils and other openings should be plugged with cotton-wool saturated with carbolic acid in order to prevent blood oozing from the body. The Local Authority should also be informed, so that an examination may be held. If it is decided that the disease is anthrax, all animals which have been in contact with the dead beast should be isolated and watched for a period of seven days, which is the usual period of incubation of the disease.

The carcase of a dead animal should be buried deeply, away from any watercourse, or from any place frequented by cattle. It should be covered with quicklime; and any straw or manure connected with the dead animal should be burnt. It is supposed that one of the commonest causes of outbreaks of the disease is due to the habit of skinning dead animals. This is a very prevalent but very foolish habit, and is extremely dangerous to the labourer who undertakes it. If he happen to have any fresh cuts upon his hand, the germs may find ready entrance into his system. The safest

method of disposing of the carcase is to burn it; but as this is a matter of some difficulty, the only alternative is very careful and deep burial in quicklime.

Cow-pox.

This is evidenced by the appearance of a number of pustules upon the teat of the affected animal. It was the examination of these, and the discovery in connection with them that milkmaids were generally immune from small-pox, that led Jenner to use cow-lymph for vaccination. When the pustules appear and grow larger, the mere act of milking gives the cow intense pain, and the milk-siphon should be used until they disappear again.

Treatment.—Use antiseptics, such as the following: Carbolic acid, 1oz.; glycerine, 1oz.; water, 1 gallon. If the udder become inflamed, treat in the same manner as for "Garget." Keep the animal apart and disinfect the cow-house, and on no account let the attendant go near or milk other cows. Needless to say, the milk must not be used.

Diarrhœa.

This is probably more fatal to young cattle, and therefore more costly to their owners, than all other diseases put together; and yet I feel confident that the greater part of the loss might be prevented by taking proper care of the calf at birth. I believe that in the majority of cases the microbe to which diarrhœa is attributable enters through the navel soon after birth. The byre in which calving takes place is not always kept sufficiently clean, and the calf rolls about in the dirt, and presently the disease appears, generally in a few days.

Another very fertile cause of this disease is the habit

of feeding calves on stale skim-milk. Skim-milk, given fresh and with a small quantity of cod liver oil added to it, forms a good food, but it must be quite fresh. Formerly, when milk was set up for butter, it stood for thirty-six hours before it was used, and by that time it was too acid, and caused serious trouble to the digestive apparatus of the calf; but since the advent of the separator there is not the slightest excuse for this cause of disease—this is among the foremost of the great advantages of the separator—and the milk can now be fed warm and fresh immediately after creaming. Moreover, too, much milk should never be given at one time. If the suggestions here put forward were attended to carefully, diarrhœa would cease to claim its yearly list of victims, and the country generally would be the gainer.

Treatment.—Where diarrhœa has shown itself, an aperient should be administered at once, and for this purpose nothing is better than castor oil. A teaspoonful should be given night and morning the first day, and one dose again the following day, when the attack should disappear. It should be understood that the disease is highly contagious, and therefore all dirty litter should be at once removed, and any byre where it has occurred should be thoroughly disinfected with carbolic.

Garget, or Mammitis.

This is a common form of disease, often attributed to lying out on damp, cold ground, and sometimes to bad milking. It consists of inflammation of the udder, which becomes hot and hard. Unless it is taken in hand at once it may result in parts of the udder sloughing off, and even in mild forms there is often a loss of a teat.

Treatment.—Knead the udder and rub well into it a good

ointment of lard and belladonna : belladonna, 1ooz. ; hog's lard, 6oz. If gangrene appears use antiseptics, such as carbolic solution recommended for cow-pox. When the cow is recovering it may happen that one or more of the teats is blocked; in such case a milk-siphon should be procured and passed up the channel, when the milk will flow. The treatment must be kept up until the teat will do its work without the siphon.

Husk.

Husk, or hoose, is denoted by a hard, dry, and continuous hacking cough, generally present in herds of young cattle about a year old. It is due to the presence of parasites in the wind-pipe, and relief must be sought in the removal of these. It is usually calves in poor condition that suffer, and they should be housed and well fed as soon as the disease appears.

Treatment.—Various methods of destroying the parasites have been tried, but I fear with indifferent success. Fumigation probably offers the best remedy, but it is often difficult to effect thoroughly. The animal should be shut up in a closed chamber, and sulphur or turpentine burnt to produce the fumes, care being taken not to smother the patient. Injections of various substances into the trachea are often made. Doses of turpentine are sometimes effective, and one farmer found that a mixture of turpentine and camphor (two or three doses) was always a cure when administered at an early stage of the disease. The Irish Department of Agriculture recommends the following treatment : Give twice daily to each affected calf 1½ table-spoonfuls of a mixture composed of 1dr. of oil of cloves, 3oz. of spirits of turpentine, and 24oz. of linseed-oil.

Mammitis. *See* GARGET.

Mange.

This is a contagious skin disease caused by a mite (*Acarus*). It is generally found upon the neck and at the root of the tail, but may spread all over the body. The result is that the affected animal constantly bites or rubs itself against posts or trees, and thus the disease is spread. Where the complaint is allowed to continue unchecked, great discomfort is caused to the animal, with consequent loss of condition, and such debilitation of the system that other diseases are liable to be contracted.

Treatment.—Mange is something like ringworm in that it seems to disappear as soon as cattle are turned out to grass. But though ringworm actually does so, mange does not, and the parasite continues to live, and, on the stabling of the cattle in autumn, recurs. The mangy patches should be washed with soap and water. Dressings should then be applied similar to those recommended for ringworm. All affected animals should be kept to themselves, their litter burnt, and those parts of buildings in contact with them sprayed with a five per cent. solution of carbolic acid and water.

Milk-Fever.

Probably the most formidable of all the diseases which attack dairy stock. It is both difficult to prevent in the case of heavy milkers, and extremely difficult to cure when it occurs. The symptoms begin to appear soon after calving. The cow seems restless and excited, stamps and moans, turning her head from side to side. In a short time she falls to the ground and is unable to rise, and is generally dead or well again within forty-eight hours. The disease is said to be attributable to a specific microbe,

but I am convinced that a contributory cause is often present when a cow is milked soon after calving. The nervous system which ought to be employed in regulating the milk-supply is put out of gear, and instead of the blood being attracted to the udder it rushes to the head and inflammation of the brain sets in, accompanied by the characteristic symptoms of falling and unconsciousness.

No satisfactory explanation of milk-fever has yet been put forward, but after studying the matter closely for some years, and noticing the accompanying phenomena, I formed a theory of my own which seemed to me to explain perfectly all the features of this strange disease. The latest methods of treating this complaint very strongly confirm my original views of its causes and cure.

There is one feature of milk-fever which is at the same time fortunate and unfortunate: it is a very common complaint and causes a great deal of loss to farmers, and on the other hand its universal occurrence gives us plenty of opportunity of examining the course taken by the disease. Now, I was fortunate enough, during many years of farming experience with dairy cattle, never to have a case of milk-fever in my herd. Coupled with this fact, it was always my habit to insist that no cow's udder should be emptied—this was always left to the calf—until at least three days after calving. (Of course if the cow were an exceptionally heavy milker, and the udder showed signs of being painful, there would be no danger at all in merely easing it.) Therefore, considering the foregoing facts, I tried to put two and two together and see whether I could not form a sound working theory to account for the appearance of milk-fever, and to determine its prevention and cure.

Although I am quite aware that it is not absolutely

logical, I deduce from the two foregoing facts the belief that milk-fever is the direct result of nervous action, and has its seat in the udder. I believe the authorities are against this view, or were until quite lately. It has been stated that the nervous system does not extend into the udder, and therefore if milk-fever were a nervous disease it could not arise from complications in the udder. But though I cannot say how far this is true from my own knowledge, I believe I am justified in holding that the udder and the nervous system—whether actually mutually involved or not—are at least intimately connected.

Anyone who has had much to do with milking cattle knows what an instantaneous effect is produced upon the milk-flow by the entrance of a strange person or a dog into the cowhouse at milking-time. Again, a cow of a very nervous disposition will refuse to allow herself to be milked by a milker who is new to her. Is this retention of milk in the udder purely physical, or is it the work of the nerves? I think the ordinary observer will be satisfied that the last is the correct reason.

Now, assuming the nervous system to have a very powerful influence upon the udder, and, through the udder, upon the arteries supplying it, let us see what happens in a case of milk-fever. The external features are as follow: Soon after calving, the attendant, believing that the udder is over-distended, proceeds to milk the cow. Not many hours afterwards the cow appears to be in a dazed condition, ceases to feed or chew the cud, stamps and moans, and finally lies down and becomes comatose. Milk-fever or parturient apoplexy has supervened. Both these names suggest to us the faultiness of the old diagnosis. The complaint, in my humble opinion, is not a fever at all.

One of the earliest theories concerning the origin of milk-fever connected it with the absorption of toxins from the uterus. Later on it was claimed that the disease was due to the absorption of leucomaines from the udder, and the treatment consisted in injecting the udder with solutions of potassium iodide. The results of this treatment showed a great decrease of mortality, and induced the employment of a variety of substances as injections. Etherised air and oxygen were used with equally good results, and finally a Danish practitioner introduced plain atmospheric air as an injection, with the most successful results. Now, it seems to me that the lesson to be learnt from all this is that any gas or liquid which sufficiently distends the udder is capable of producing the desired result. Distension of the udder is the point to be aimed at.

If reference be made to the hypothesis with which I started it will be seen that the conclusion just arrived at fits it perfectly. I said that I believed milk-fever to be due to the emptying of the udder of the newly-calved cow, and now I conclude from an examination of the latest methods of treatment that a successful cure depends upon distension of the udder. The explanation seems to be as follows: The udder, as is well known, is supplied with a large quantity of blood in order that it may carry out its work of the manufacture of gland-cells efficiently. During the uninterrupted manufacture of milk the blood continues to be directed to the udder, but if the glands be suddenly emptied the blood flows away and tends towards the brain and the seat of the nervous system. The result is what appears to be apoplexy. But if the suggested remedy is promptly applied, and distension of the udder carried out, the blood leaves the brain and returns to its work in the neighbourhood of the udder.

Treatment.—Something may be done in the direction of prevention by keeping any cow which has a tendency to the disease in rather low condition previous to calving. A pound of Epsom salts may be given a fortnight and again a week before calving. She should be allowed plenty of exercise, and, after calving, her calf should be allowed to remain with her for the first three days.

If the disease should make its appearance the treatment should be sufficiently clear from what has already been said. Plain atmospheric air should be injected into the udder, which is easily managed with the apparatus specially devised for the purpose. The treatment is perfectly harmless, and out of nearly a thousand cases treated in Denmark about 96 per cent. recovered. This remedy has shown itself so efficacious that henceforward milk-fever should not appear so serious as it has hitherto.

Ringworm.

This is one of those common diseases which are not so much fatal as debilitating. After their first winter indoors it is no unusual thing to see all the young stock turned out in the spring more or less affected with ringworm. The disease is highly contagious, and is probably contracted from the cattle-house itself and passed from one animal to another.

It chiefly affects young animals, such as calves or yearlings, and those in poor condition. The disease is due to a fungus at the base of the hair, which causes it to fall off, with the result that bare patches are formed on the head and neck. This is not a difficult disease to cure; but the effectiveness of all remedies depends on the smothering of the fungus with some greasy substance. The parts attacked should be first well washed with soft

soap, or a solution of washing soda, and then a dressing of any of the following applied:—

(1)	Lard	5 parts.
	Iodine or sulphur	1 part.
(2)	Soft soap	5 parts.
	Sulphur	1 part.
(3)	Sulphuric acid	1 fl. dr.
	Glycerine	3 fl. dr.

Treatment.—The disease is easily contracted by man from the cattle, and therefore great care should be exercised. The complaint is very debilitating, but as a general rule it quickly disappears after the cattle are turned out in spring. Where young cattle run out all the winter it very seldom occurs at all.

One word more. A great many of the common diseases of stock are due to dirt, and to infected cattle-sheds. Pay particular attention to liming every house, walls and floor, at least twice a year, and whenever disease has been present use plenty of disinfectant in the form of carbolic. A very small outlay on the latter will come back a hundredfold in the shape of immunity from disease, and therefore from loss.

Tuberculosis.

There can be very little doubt that the subject of tuberculosis has assumed a very prominent position at the present day, and it is well that it should be so: for it would have been almost impossible to do anything to put a stop to its ravages, in man or in the lower animals, unless better methods of detection and control had been introduced. The following letter on the subject, from one of our most eminent medical authorities, deserves mention.

In writing to the General Purposes Committee of the Metropolitan Asylums Board, Sir William Broadbent says:—

"The International Congress on Tuberculosis, which has been held in Paris, has brought into prominence the importance of the prevention of consumption from a social point of view. It is recognised that the chief object of the campaign against tuberculosis is not simply the care and treatment and restoration to health of the individual attacked, but the protection of the community from a disease which costs the country tens of thousands of lives and millions of money every year.

"I am led by this further development in the combined international defence against tuberculosis to approach the Metropolitan Asylums Board once more, and urge upon its members the proposal that the Board should constitute itself the tuberculosis authority for the metropolis. I need not refer to the fact that consumption, an infectious disease, carries off more victims than all the other infective illnesses put together; that it is most common during the working period of life, and thus specially affects wage-earners and heads of families. . . . If it can be shown that the Board has it in its power to make a sensible impression upon the prevalence of this disease I am confident that the members will feel it to be their duty to exercise this power."

Sir William Broadbent then proceeds to make suggestions for dealing effectually with the disease, which will be noticed when I come to discuss its treatment. It may be remarked here that the foregoing letter merely treats of tuberculosis in reference to its effect upon the public health, whereas what concerns the farmer more immediately is its effect upon his live stock; but further

consideration of the subject teaches us that the two matters are so intimately connected that no great and radical change can be introduced in the health of the one without a corresponding alteration in the sanitary conditions of the other. Hence the reason why tuberculosis has attained its present position of importance in the public view.

Unfortunately, however, enormous as is the importance of the subject, its difficulties are equally great. These arise primarily from the nature of the bacillus which is the origin of the disease. Although very great advances have been made in the last quarter of a century in the discovery and treatment of bacterial infection, the tubercle bacillus, though well known to the bacteriologist, has so far evaded almost every attempt to attack it directly. It differs in two important particulars from other germs; it is extremely resistant to high temperatures, and it does not appear to produce spores. While the majority of virulent bacilli, such as those of typhoid and diphtheria, are destroyed at a temperature of about 140deg. Fahr., the tubercle bacillus is unaffected, and has been known to resist a temperature of 149deg. Fahr. continued for an hour. Again, the tubercle bacillus can retain its vitality for a very long time in the dry state, which therefore enables it to spread in every direction in the form of dust; and it is believed that its virulence is in no way affected by the acts of churning and cheese-making, and therefore both butter and cheese, which have been rather overlooked so far in the campaign against tuberculosis, may be possible media of the transmission of the disease.

Secondly, the tubercle bacillus does not seem to multiply in the form of spores, but by means of fission only. Dr. Klein has this to say of it:—"Amongst the species

of bacteria in which spore formation has not been observed, there is one group which seems to stand out prominently because, owing to its high resistance to inimical influences—drying and heat—it is credited with the possession of spores, namely, the group of acid-fast bacilli, notably the *Bacillus tuberculosis*. The most careful microscopic examination of the tubercle bacilli of sputum or of the tuberculous deposits or of artificial cultures fails to show spores such as occur in the real sporogenous bacilli." Now this peculiarity of the tubercle bacillus makes it much more difficult to attack. The spores of most bacilli are as easy to destroy as the bacilli themselves, and, consequently, in order to overcome tuberculosis it will be necessary either to find some anti-toxin, as has been done in the case of diphtheria, or to subject the bacillus itself to a very high degree of heat. The impossibility of the latter course, in the majority of cases, will be immediately apparent, and therefore it must be supposed that the only hope of relief from this terrible scourge lies in the discovery of some serum inoculation with which will ensure immunity.

But the side of the question which concerns the dairyman is its relation to his trade as a purveyor of milk. There can be little doubt that among the many media of transmission of tuberculosis none is more dangerous than milk from cows which are themselves diseased. The controversy still rages over the amount of disease in the cow which must be present before the milk is dangerous. It has been generally believed, hitherto, that only the milk from cows with tuberculous udders is unfit for human consumption; but this is by no means certain. Experiments in Germany have shown: (1) That the tubercle bacillus may be demonstrated in milk from tuberculous

cows when the udders do not show perceptible evidence of the disease; (2) that the bacillus of tuberculosis may be excreted from such an udder in sufficient numbers to produce infection in experimental animals, both by ingestion and by inoculation; (3) that in cows suffering from tuberculosis the udder may therefore become affected at any moment; (4) that the presence of the tubercle bacillus in the milk of tuberculous cows is not constant, but varies from day to day; (5) that cows secreting virulent milk may be affected with tuberculosis to a degree that can be detected only with the tuberculin test; (6) that the physical examination or general appearance of the animal cannot foretell the infectiveness of the milk; (7) that the milk of all cows which have reacted to the tuberculin test should be considered as suspicious, and should be subjected to sterilisation before using; and (8) that it would be better still that tuberculous cows should not be used for general dairy purposes.

These results are highly important, and their observance should go a long way towards diminishing the danger of infection from tuberculous milk. Very few people have any idea of the extent of this danger. It has been shown that in Copenhagen, under a very stringent inspection, over 17 per cent. of cows slaughtered showed evidence of tubercular disease. In Berlin, 15 per cent. were found to be tuberculous. A computation of the number of diseased cows in the United Kingdom puts them at 20 per cent., of which from 2 to 4 per cent. suffer from tubercular disease of the udder. Even if the total milk-yield of all these cows were only half what it is in reality, the amount of disease which it would be capable of conveying to human beings would be sufficiently appalling.

And what of the losses to farmers? I have so far only

dealt with the milking cattle, whereas other kinds, such as bullocks and heifers, are equally liable to the disease. If these be added to the cows it is probable, from a computation made by Bang, of Denmark, that at least 40 per cent. of our cattle are more or less affected with tuberculosis. Now, if we reckon the direct loss upon part of these cattle—rejected by the butcher on account of infection—upon those cows which have been condemned by the inspector as unfit for use, upon the impaired milking capacity of cows in the early stages of the disease, and upon the indirect results in the shape of abortion and non-breeding, we shall arrive at a very large yearly loss experienced by farmers. This loss has been very carefully worked out, and the total arrived at was in the neighbourhood of three million pounds per annum!

And now let us turn to the remedy for the present state of things. Several have been suggested: (1) Proper inspection, isolation of the diseased, and the rejection from the breeding-herd of any cows which give signs of disease; (2) disinfection of all premises which have held diseased cattle; (3) supervision of those attending on the cows, so that no diseased or unsound milkers may be allowed to attend upon them; and (4) the use of the tuberculin test. Most of these remedial measures have been proposed by Sir William Broadbent in the letter already referred to. He would separate the healthy from the unhealthy, would require immediate notification of any signs of disease, and would trust to educational influence and the introduction of open-air methods to effect the desired improvement. All these would be equally efficacious in the case of cattle. It should be remembered that tuberculosis is not hereditary. Although a marked tendency to the disease—from degenerate organs and

tissues—may be inherited, yet proper treatment in the way of plenty of fresh air and sunlight, and good food, would eventually overcome this tendency, and the disease need not appear.

And since the bacillus is conveyed through the air, there is very great danger that healthy cows may be contaminated when introduced into a dairy containing unhealthy ones, or in which one of the attendants has developed the disease. Therefore, even after these foci of infection have been excluded, it is well to disinfect the premises very carefully, to burn all dirt and dust, and to allow strong currents of pure air to pass through the building. How often we come across cowsheds, in which the cattle pass most of their time, where the light of the sun hardly penetrates, where the one or two windows which were intended to admit this light are thickly covered with cobwebs, heavy with the dust and germs of years. The air hardly circulates, and as milking proceeds the produce even from healthy cows quickly becomes contaminated with the bacteria which swarm in the building. Why this indifference to the condition of farm stock? Look at the horse stables, and mark the difference. Plenty of light, clean bedding, proper mangers of stone or tiles, and plenty of fresh air from door and window; yet the horse is used chiefly for man's pleasure, whilst the cow contributes an essential article of diet, and one which is equally capable of sustaining or destroying life.

There are two ways in which the tubercle bacillus may gain entrance into the body—either by the mouth or by the nostrils. It probably oftener enters by the former, and thus we find that, especially in young children, a tuberculous condition of the intestine occurs. But mere penetration into the human body will not alone cause

tuberculosis: it is necessary that the bacillus should propagate its species. This is not always possible, or cases of disease would be even commoner than at present. But as soon as conditions satisfactory to such propagation prevail, then the increase of the bacillus is rapid enough. The bacilli pass from one point to another, and centres of infection are set up in all parts of the body.

A very interesting statement appeared in the Twentieth Annual Report of the United States Bureau of Animal Industry, showing what is being done in America in the way of attacking tuberculosis. It deals with the results of herding healthy and unhealthy cattle together. On 27th January, 1903, seven healthy cattle and three tuberculous cows were confined in a byre in ten stalls. The stalls were separated by partitions 6ft. high. Five of the healthy cattle and the three tuberculous cows occupied different stalls each day in a rotation which exposed each of the healthy cattle equally to the tuberculous cows. A yearling bull in condition at the commencement of the experiment, and that occupied a permanent stall in the centre of the byre, was killed on 3rd August, and found infected with tuberculosis on the lungs and other parts. A six-year-old cow, similarly placed, and killed on the same date, was found to be extensively diseased, though all the tubercular nodules were of recent formation. Her calf, born on 25th June, and also killed, was quite free from the disease. Of the other five beasts killed on 3rd August, four had undoubtedly contracted the disease, the case of the fifth being doubtful. All the seven were tested at the commencement of the experiment, and found free from tuberculosis, but six months' exposure had done for them.

The rapidity with which the disease spread was truly

remarkable, and indicates what pains should be taken to prevent it from getting a foothold in a herd. Possibly the test was more severe than cattle would be called upon to encounter in ordinary farming, and the tuberculous cows, too, seem to have been in an advanced stage of the disease, but the fact of the beasts in the centre of the byre being infected is, nevertheless, a warning.

The report also treats of the tuberculosis of different animals, with a view to discovering whether the various forms are inter-communicable. It points out how, although the conditions of life of man, bird, and fish vary so greatly, each of these is subject to tuberculosis. The question then is, Can the bacillus of one animal attack a creature of a different species? The general tendency of the experiments confirms the opinion that human and bovine tuberculosis have very much in common; that cattle can be infected by human tuberculosis, and *vice versâ*. It seems, however, that a certain modification of the bacillus takes place when grown in cattle, and that it does not quite readily infect human beings.

Not only is it advisable to prevent unhealthy cows from contaminating healthy ones, but we should have some surer means of detecting the unhealthy than the naked eye. Luckily for us, the discoveries of Koch have placed at our disposal a diagnostic for the detection of tuberculosis in its earlier stages, which is known as tuberculin. Koch has used three forms of tuberculin, prepared in different ways, but only one of these is necessary for the purposes of the veterinary surgeon. The method of using tuberculin is to inject a certain quantity into the suspected animal and watch whether it "reacts." This is indicated by a marked rise in temperature. An interesting paper was read on this subject before the West of

Scotland Veterinary Medical Society by Mr. M'Laughlan Young, of Dundee. He says:—

"The *modus operandi* is very simple, the chief point being to have everything conducted under strictly antiseptic conditions. I make a weak solution of Jeyes' Fluid, and wash an area of about 2ft. round the dewlap of cows, or behind the shoulder in bulls. I use the ordinary hypodermic syringe, and inject 40 to 60 minims of tuberculin, according to the age or size of the animal. I make the injection in the evening, and the animals being undisturbed in the night, the reaction is more reliable.

"The first step before injection is to note the normal temperature. So frequently did I meet with animals whose temperature was 102deg. or over, that I had to accept this as the normal. In one case the temperature of a cow was 103deg. Before she was killed the temperature rose to over 106deg., and examination showed the lungs and pleura to be affected. This is curious, since the instructions of scientists provide that the temperature should be normal for the success of the experiment. Again, an aged cow, coming to calving, was tested, and gave no reaction. Some time later she gave birth to an extra fine bull calf, but died after calving. Examination of her lungs revealed a mass of tuberculous matter enclosed in a sac resembling encysted pleuro-pneumonia. I know the mass was tubercular, for I was enabled to demonstrate the bacilli under the microscope. This mass must have been in existence when I tested the animal. . . . I feel inclined to say that the flesh of such an animal would be perfectly safe to use as food, for, had any tubercular contamination been in the muscles or glands, the tuberculin would have revealed it. The calf I tested when it was three months old, and found it free.

"In all the cases where I have had the chance of verifying the result, tubercules were found when the fluid gave the elevated temperature, or nothing was seen when no reaction was obtained. That is my answer to the oft-asked question, Is tuberculin reliable? The instructions given for conducting the experiment say that, if affected, the temperature rises from 2deg. to 3deg. within twenty-four hours, and my experience has been that at the fifteenth or sixteenth hour the temperature is highest. So invariable have I found this that I now make my second visit at that time.

"The successful use of tuberculin is the strongest argument we can use to induce those in authority to place tuberculosis under the Contagious Diseases Act, as, when they refused, the reason given was dubiety in the diagnosis. Now, thanks to Professor Koch, we can diagnose with certainty 90 per cent. of cases."

The question of testing with tuberculin has come into still greater prominence to-day owing to the regulations framed by many of the South American States imposing this test upon all animals imported from abroad. These regulations have called forth much criticism from breeders here, for they are likely to have a very serious effect upon the trade in pure-bred stock. The objections are: (1) That testing is not necessary on arrival at their destination, if animals are tested before shipment; and (2) that the regulations often cause great and needless loss. All shippers, having these regulations in view, naturally submit their cattle to the test before sending them away, and, consequently, only ship those which do not react. But on arrival at their destination, after a long sea voyage, and being reduced in condition therefrom, they are again tested, and sometimes show a reaction and are killed, since

they cannot be re-imported into the British Isles. Now, the losses under these circumstances are often very great. There is no certainty that the foreign tuberculin is of proper quality, or that the test is well made. Therefore, it has been suggested that all animals should be submitted to a Government test before shipment, and that such a test should be considered sufficient in the country to which they are going.

If every possible precaution be taken in the way of isolation of unhealthy animals or their destruction, and the thorough disinfection of all contaminated premises, a great advance will be made in the suppression of tuberculosis. By the use of tuberculin the presence of the tubercle bacillus may generally be recognised with certainty. There is only one objection to its use—that after several injections even a diseased animal ceases to react. This constitutes a danger, for it is only necessary that the owner of an unhealthy cow should make several injections, in order that he may be able, if he be fraudulently inclined, to offer her as a cow which will not react to the test, and which is therefore presumably sound. However, the danger of this is very small in comparison to the advantage of having such a test for tuberculosis.

It has been stated that the disease is *not* on the increase, and if this be so we have much to be thankful for. But non-increase should be tantamount to decrease, so that the signs are very hopeful that by the introduction of better methods of dealing with the disease, by the compulsory use of the tuberculin test, and by the destruction of all cows, at any rate, which react, the disease may be very considerably diminished and eventually overcome. Tuberculin, fresh air, and sunlight should be capable of suppressing tuberculosis in farm stock.

Warts.

These are a very common form of excrescence on the teats of cows, and though not of much importance, yet they hinder proper milking, and are often broken off in the process, leaving a raw wound. The best way of dealing with them is to tie a piece of silk tightly round, when they will dry up in a few days and drop off.

The foregoing complaints are the commonest and among the most dangerous which attack dairy stock. It would be quite beyond the scope of this book to enter further into the question of veterinary treatment, but there are many works—notably Armatage's "Cattle Doctor"—from which full and reliable information may be obtained.

APPENDIX.

PIG-KEEPING.

As there is so much waste material in the form of butter-milk and whey on every dairy-farm, it seems advisable to add a word or two on the rearing and feeding of pigs. The first question to settle is which breed of pigs it is desirable to keep, and whether they should be pure-bred or not. Now there is not the slightest doubt that in all cases the boar used should be pure-bred. It is quite usual to find boars all about the country, large in size and healthy in appearance, but which lack the most desirable property of all—early maturity. It is in this direction that pure breeding has effected such good results. The same remark applies to the sow also. It is extremely desirable that she should be of an early-maturing breed, prolific and a good milker. If, in addition to these qualities, she has a good long pedigree behind her, she will almost certainly transmit them to her descendants.

As regards the breed to be kept, there is no absolutely best sort. There are almost as many varieties of pigs as of cattle: each has its admirers, and the type found in any particular district has been chosen for certain qualities which make its bacon acceptable in that district. The object of pig-keeping is the production of meat, either in the form of fresh pork or of bacon. There are three large divisions into which the various types fall: the Yorkshire,

the Berkshire and the Tamworth. Of these the most prevalent is the Yorkshire. There are again three divisions of Yorkshires—the Large, Middle, and Small—but the most valuable of these is the Middle White. It is either crossed with a boar of the same breed, or with a Berkshire, and produces pigs of about 1cwt. at six months old.

The Berkshire, also, is much in demand, as it is thought to produce bacon of a leaner stamp than the Yorkshire, which is inclined to run too much to fat. This is not thought objectionable in the North, but is disliked in the Southern counties. The Tamworth, a red pig, is very valuable for bacon. It is contended that Tamworth bacon is of that streaky nature so desirable for curing. But whichever breed be chosen it is as well to consider the peculiarities of the district and its markets, and to determine whether the destiny of the pig is to be fresh pork or bacon. In the case of the latter, a larger and therefore older animal will be wanted, and it should be of a sort which affords good deep sides and bellies. As we have already learnt so much from Denmark in other directions, it would be as well to note what is being done there in bacon curing. The Danish bacon now commands a ready sale in the London markets, owing to the fact that the native breed has been very much improved, in both quality and early maturity, through crossing with the Middle White Yorkshire.

The following points should govern the choice of the sow to be used for breeding. She should have the special characteristics of the particular breed, and in addition should be chosen from a prolific and early-maturing strain. She should have at least twelve teats; if more, so much the better. She should be long in the body, with

short legs, deep sides, and fine bone. Unless she have plenty of room it is hopeless to look for large litters. There is some difference of opinion as to the best age at which a sow should be bred from. Some recommend mating sows after six months of age, others three or four months later. There can be little doubt that the mature sow will have a better chance of producing large healthy litters and of rearing them. It has also been noticed that the produce of such sows is more easily fattened and requires less food for a given increase in weight. The boar used should be pure-bred, though not necessarily of the same breed as the sow. He should be of good quality, with fine bone and silky hair, long and deep, light in front, and quiet in disposition.

No particular form of buildings is necessary, but two things must be prevented—damp and draught. Both are inimical to the health of young pigs. A very good plan is to have the inner chamber boarded half-way up from the floor, with a double door, so that when the upper part is opened the air circulates freely near the roof without causing any inconvenience to the inmates. It is also a good plan to have a board floor against the inner wall where the sow and her brood can lie in dry quarters. There should also be a rail running round the floor, 3in. from the ground and the same distance from the wall; for when the sow has farrowed she seems instinctively to lie as near as possible to the wall, with the result that her young pigs are often crushed. The rail round the floor renders this impossible, and gives the young pigs an opportunity to escape from under her.

The usual period of gestation in the sow is four months, but there may be variations either way of several days. When she is due to farrow she should be given some short

litter, and will proceed to make it comfortable in her own way. She should not be allowed a large quantity of long straw, or her pigs may be smothered after birth. In most cases she will not require any attention; many sows resent it very much, and will eat their young if watched. However, it is as well to keep an eye on her for fear she should lie on her pigs, which have not sufficient strength to look after themselves. As soon as the litter is complete the sow should be given a good supply of warm bran mash, in order to encourage her milk. If the young pigs settle down to suck her and she seems complacent, all will probably go well; but it sometimes happens that the little teeth are too sharp, the sow's teats are hurt, and she refuses to suckle her young. When this occurs the teeth of the small pigs must be examined, and any that are sharp pinched off. Some sows are naturally good mothers and never have any accidents; others are quite careless and indifferent about their youngsters. The former sort and their offspring should always be kept for breeding.

The young pigs will require only their mother's milk for the first six weeks of their life. She should receive plenty of bran and barley-meal mixed with warm water, skim-milk, or whey. It has often been stated that whey is useless for pig-feeding, but this idea is quite erroneous, for it contains most of the sugar of the milk, which is highly fattening. The young pigs may be weaned at eight to ten weeks of age, but previous to this, say at six weeks of age, they should be taught to feed themselves out of a small trough. The sow should be allowed out at all times for exercise, and while she is away some sloppy food in the shape of sharps or barley-meal and milk should be put before the young pigs. They will

very soon get to work, and after the mother is removed will not receive any check in their growth. Young pigs have very small stomachs, and therefore require to be fed at least three times a day. At the same time no food should be left in the trough from meal to meal to become sour and so upset their digestion.

Very young pigs should be allowed to exercise with their mother until weaned: the grass is wholesome for them. They also require charcoal in some form, and will eat pieces of coal with relish. After weaning, those which are intended for pork should be pushed on as fast as possible. The earliest months of the pig's life are the most profitable to the feeder, and therefore no time should be lost. They should be kept warm, and should give an increase of very nearly 2lb. a day. Pigs intended for the bacon-curer will take more time and should not be fattened in the same way, the object being to obtain plenty of lean with the fat. There are no better foods for pigs than oatmeal, barley-meal, and sharps, and these should be mixed with warm skim- or butter-milk, or whey. Barley-meal in large quantities is too heating, and costiveness may result therefrom. Bran is often found difficult of digestion.

As I have already said, no food should be left in the troughs to become sour: nor should the troughs themselves be allowed to become foul. On this account iron troughs are more suitable than wooden ones, and can be washed out after the meal. The young pigs should be castrated soon after weaning, care being taken that the sty is kept scrupulously clean after the operation. No dressing of the wound is advisable, and it will very soon heal.

It is very often the practice to arrange that the sow shall farrow in spring, so that the young pigs have the

warm period of the year for their growth. The dam is then fattened off. There is no reason, however, why litters farrowed in October should not do well, if care be taken that they are kept properly warm. The pig-feeder should always have a succession of young porkers on hand, and this can only be secured by litters in both spring and autumn. Moreover, it is a mistake to kill off the young sow after her first litter. If she have proved herself prolific and a good mother, she should be continued as a breeder. She will not, of course, fetch a very big price at the end of her career, but she will be the mother of a large number of young sows who will inherit her valuable properties.

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