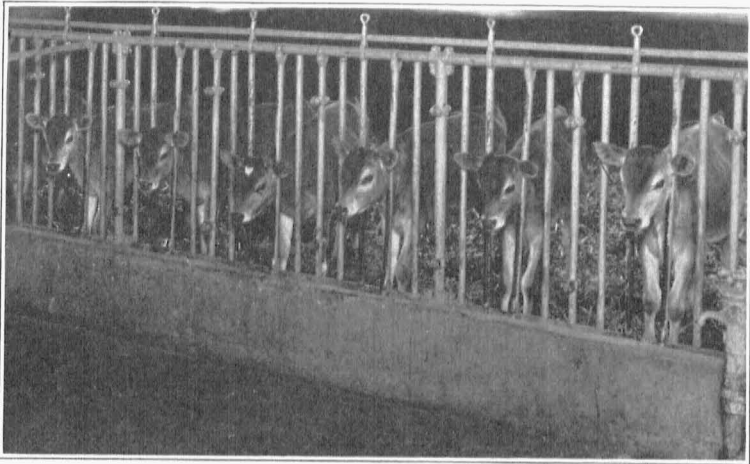


UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

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Raising the Dairy Calf

H. A. HERMAN



Strong, healthy calves sired by well bred bulls, and from good dams, are important factors in improving the dairy herd.

COLUMBIA, MISSOURI

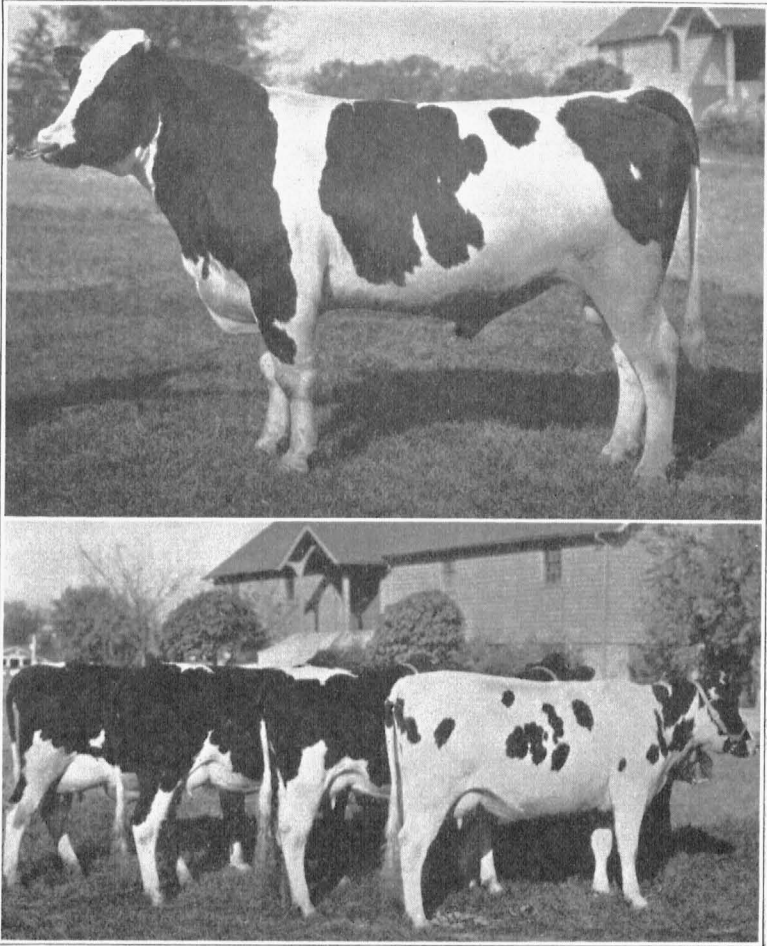


Fig. 1.—A good purebred sire and his first offspring. This bull sired a total of 14 tested daughters, averaging 14,272 lbs. milk containing 501 lbs. of butterfat, at the average age of three years.

Raising the Dairy Calf

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Economical improvement of the dairy herd is possible only where discarded cows are replaced by well grown heifers of improved breeding. It is estimated that the average period of usefulness for an individual cow in the herd is about five years. In herds where rigid culling of the low producers is practiced, and when diseases such as Bang's disease and mastitis are present, the average length of time a cow is in the herd may be much shorter. As a rule, 20 to 30 per cent of the milking herd must be replaced each year. This requires raising at least two to three heifers each year for every ten cows in the herd if the herd is to be maintained at its original number without outside purchases.

In 1936 there were 1,017,000 milk cows of producing age on Missouri farms; therefore, approximately 250,000 dairy heifers should be raised annually in Missouri in order to maintain the present dairy cow population.

The success of the dairy farmer depends to a considerable extent upon the careful raising of calves. Most farmers begin with the best cows they can get close at home, which is usually the best plan to follow. The development of a first class herd from these cows will depend largely upon four factors:

1. The careful selection of individual cows from the standpoint of production records and desirable conformation.
2. The continued use of a good purebred sire.
3. The careful raising of the heifer calves from the best cows.
4. Control of disease.

ADVANTAGES OF RAISING HEIFERS

The breeder who plans to maintain his milking herd through the purchase of cows will find this system expensive. Unless he is willing to cull closely and pay top prices for replacements he will find it difficult to improve or even maintain his herd average. It is commonly observed that herds which have maintained their numbers by purchase are generally no more productive today than they were five or ten years ago. Securing animals from various sources for herd replacement often introduces diseases such as Bang's disease, mastitis, tuberculosis, and Johne's disease, and is one of the most serious disadvantages of maintaining a herd through purchases.

Dairymen in the vicinity of large cities, where wholemilk is sold and feed prices are high, often find it too expensive to raise heifers, and usually maintain grade herds, disposing of a cow just as soon as she declines in production or becomes a victim of disease. Incidentally,

these dairymen are purchasers of many well bred heifers raised by the farmer-dairyman located further away from the cities. Farmers who sell cream and have skimmilk available, and breeders of purebreds seldom question the advisability of raising heifers.

The man who raises calves also has his difficulties. From birth to two years of age is a nonproductive period with no returns on the investment. There is some danger of losing calves by death and disease after the investment in raising them; some may prove to be non-breeders; and some will prove to be inferior producers and therefore must be sold for beef. Nevertheless, the plan of raising heifers has outstanding advantages, as it generally produces good cows cheaper than they can be purchased; it is the most desirable safeguard against disease; and makes possible improvement of the herd through the use of good purebred sires.

Calves to be Raised

Careful Selection of Calves Necessary—There is little or no difference in the cost of raising a well bred and a poorly bred calf. Under Missouri conditions it costs, on the average, from \$50 to \$80 to raise a heifer to producing age. The inferior calf is a liability from the day of its birth, and too many dairymen make the mistake of trying to raise all the heifers. Obviously only those heifers out of the best cows and sired by a good purebred sire should be raised. While all calves, both grade and purebred, which are sired by purebred bulls are not 100 per cent desirable, the majority will be worthwhile producers if the sire is carefully and intelligently selected.

The Influence of a Good Sire—The sire is the most important single influence affecting the general level of production of the heifer crop. The ability of a good sire to transmit high producing characteristics to his offspring makes it possible to vastly improve the produc-

TABLE 1.—INFLUENCE OF PUREBRED SIRES UPON THE PRODUCTION OF THEIR GRADE DAUGHTERS.*

| Breed of Purebred Sire | Scrub Dams | | First Generation Daughters | | Second Generation Daughters | |
|---|------------|----------|----------------------------|----------|-----------------------------|----------|
| | Milk lbs. | Fat lbs. | Milk lbs. | Fat lbs. | Milk lbs. | Fat lbs. |
| Guernsey..... | 4,480 | 202 | 5,729 | 253 | 7,155 | 355 |
| Holstein..... | 3,631 | 176 | 6,649 | 278 | 10,218 | 395 |
| Jersey..... | 4,047 | 194 | 5,015 | 270 | 6,539 | 331 |
| Average..... | 4,110 | 192 | 5,815 | 267 | 8,056 | 363 |
| Average increase of daughters over original scrub dams..... | -- | -- | 1,705 | 75 | 3,946 | 171 |
| Average percentage increase of daughters over original scrub dam..... | -- | -- | 41% | 39% | 96% | 89% |

*From Iowa Exp. Sta. Bul. 251.

tion of the herd. The influence of a good purebred sire, even when mated to very inferior cows, is well demonstrated by an experiment in which grade cows were mated to purebred sires. The results are shown in Table 1.

From the above figures it may be concluded that on the average the use of good purebred sires on scrub cows for one generation will increase the productivity about 40 per cent. The second cross with good purebred sires approximately doubled the production of the granddaughters over their scrub granddams.

Increased production is the initial step in economy of production and practically always leads to greater returns per cow above feed costs.

Care of the Cow Before Freshening

The program of successful calf raising begins with the pregnant cow. Cows should be allowed a dry period of approximately six weeks. Those given a rest are in better flesh, produce more and higher testing milk, and are usually more persistent milkers than those milked up to within a few days of calving.

Cows producing 20 pounds or less milk daily may be satisfactorily dried off by the simple process of reducing the feed and ceasing all further milking. For heavier producers the common plan of skipping milkings may be followed, at least until the production falls to below 20 pounds daily.

The dry cow should be fed liberally on a slightly laxative ration. Plenty of legume hay and corn stover or silage, or good pasture when available, and from 3 to 7 pounds of a rather light, bulky grain mix should put the cow in good condition for calving. A typical grain mix follows:

| | |
|--|----------|
| Ground corn, corn and cob meal, ground barley, or hominy | 300 lbs. |
| Ground or crimped oats | 300 lbs. |
| Wheat bran | 300 lbs. |
| Linseed or soybean oil meal | 100 lbs. |
| Salt | 10 lbs. |
| Steamed bone meal | 10 lbs. |

Calving Quarters

The cow should freshen in quarters apart from the herd, in a roomy box stall or a separate pen. Aside from insuring the cow freedom and protection during calving, this practice is important in controlling Bang's disease.

The stall should first be scrubbed with hot water and then disinfected. A 13-ounce can of lye to 15 gallons of either hot or cold water makes an excellent disinfectant for this purpose. Any cresol compound or other standard disinfectant may also be used. After the stall is dry

it should be lightly sprinkled with hydrate lime or gypsum, and bedded with fresh clean straw or shavings to insure sanitary surroundings for the newborn calf. During the winter months cows close to calving should be turned outdoors for a few hours daily to insure plenty of exercise. Cows on pasture usually get sufficient exercise.

During the summer months there is no better place for the cow to calve than outdoors in a separate lot or pasture apart from the herd. From the standpoint of sanitation for the newborn calf, the surroundings provided in a good pasture are nearly ideal. However, where the herd is infected with Bang's disease, the difficulty of disinfecting and cleaning up pastures makes this practice questionable even though a separate calving pasture is maintained. Cows should never be permitted to calve in the same pasture where the main herd is kept.

Care of the Cow at Calving Time

A calving ration of 2 parts wheat bran, 2 parts ground oats, and 1 part linseed oil meal, fed at the rate of 4 to 6 pounds daily, is recommended for the last few days before and just after calving. A wet bran mash is used by some breeders with much success and is recommended where the cow is hot and feverish. Care must be taken that the cow has plenty of fresh, clean water available before and after calving.

Immediate calving is indicated by a relaxation of the muscles, giving a somewhat sunken appearance on either side of the tail head, accompanied by considerable swelling of the vulva. At this time the cow is usually nervous and restless and should be left alone except for occasional observations to make certain that all is well. While it is not always necessary for an attendant to be present at the time of calving, the experienced breeder likes to be near enough to lend assistance if necessary.

The calf is normally delivered with the front feet appearing first, followed immediately by the nose. Frequently abnormal presentations occur, such as delivery with the head turned back, hind end first, or lying on the back. These conditions must be corrected before delivery can be made and the services of a veterinarian are often necessary. In difficult parturition it is often necessary to apply force to assist in removing the calf. This is usually accomplished by means of ropes and pulleys and should always be done under the supervision of a veterinarian or an experienced herdsman. In no instance should pressure or "pull" be exerted when the cow is not laboring.

Care of the Newborn Calf

Cows that calve normally usually get up immediately and begin licking the calf, which is Nature's way of starting respiration and stimulating circulation of the blood. The cow should be permitted to

lick her calf dry but if she fails to do so, it may be briskly rubbed with a cloth until dry. This is very important during the winter months as it hastens drying and prevents chilling. In cold weather the newborn calf may be blanketed with a burlap bag until it is warm and dry. Occasionally the afterbirth or foetal membranes may stick to the calf's nose and should be removed immediately to prevent smothering. It is also wise to run the finger around the newborn calf's mouth to remove all mucous.

The navel cord of the calf should be disinfected with tincture of iodine as quickly as possible after birth to prevent disease-producing germs gaining entrance into the body by this route. The genitals and rear parts of the cow, particularly the udder and teats, should be thoroughly washed and the teats sterilized by wiping them with a cloth dipped in a mild chlorine solution before the calf nurses. This practice also aids in preventing contamination and spread of scours.

Strong, well developed calves will be on their feet and nursing within an hour after birth. Weak calves which are unable to stand should be assisted to their feet and held up to the udder to nurse. In most such instances the teat must be inserted in the calf's mouth and milk stripped into the mouth to encourage sucking. It is highly important that the calf receive the colostrum or first milk of the mother as this acts as a laxative and aids in starting the digestive system working properly. Colostrum also supplies the constituents highly necessary in blood forming processes in the newborn calf and furnishes the antibodies necessary for preventing disease until such time as the calf has established its own immunity. Studies at the Missouri Station show that 32 per cent of dairy calves die unless they receive colostrum.

It is a good practice to leave the calf with its dam during the first two or three days of its life. After this time the normal vigorous calf may be removed from its dam, taught to drink milk from a bucket, and raised by the method most economical and practical under conditions prevailing on each particular farm.

TABLE 2.—AVERAGE BIRTH WEIGHTS OF JERSEY, HOLSTEIN, GUERNSEY, AYRSHIRE AND BROWN SWISS CALVES.*

| Breed | Birth Weight (lbs.) | |
|-------------------|---------------------|---------|
| | Males | Females |
| Jersey..... | 60 | 53 |
| Holstein..... | 95 | 90 |
| Guernsey..... | 71 | 65 |
| Ayrshire..... | 80 | 72 |
| Brown Swiss†..... | 85 | 80 |

*From Mo. Experiment Station Bulletin 336.

†Weights estimated.

METHODS OF RAISING DAIRY CALVES

All investigations and experience indicate that a calf must have chiefly milk the first few weeks of its life, as there is no acceptable substitute for wholemilk during the first two weeks after birth. Dairy-men selling fluid milk often find it difficult to raise calves economically as wholemilk is too expensive to feed after the first two or three weeks. Experiments have shown, however, that skimmilk is an excellent calf feed and may be substituted for whole milk after the third week with excellent results.

TABLE 3.—THE COMPOSITION OF WHOLEMILK, SKIMMILK, WHEY, AND COLOSTRUM.

| Constituent | Percentage of Constituent in | | | |
|-----------------------------|------------------------------|----------|------|-----------|
| | Wholemilk | Skimmilk | Whey | Colostrum |
| Water..... | 86.8 | 90.40 | 93.4 | 74.5 |
| Fat..... | 3.7 | 0.10 | 0.35 | 3.6 |
| Protein..... | 3.5 | 3.7 | 0.85 | 17.6 |
| Sugar or carbohydrates..... | 4.9 | 5.0 | 4.8 | 2.7 |
| Ash or mineral..... | 0.7 | 0.8 | 0.6 | 1.6 |

Where wholemilk is sold, dry skimmilk powder may be utilized by mixing with warm water and feeding in the usual manner. Some breeders utilize skimmilk powder as a major constituent of a dry grain mix with pleasing results in growth and a complete elimination of the feeding pails. In some cases calf meals or some of the proprietary meals may be used in conjunction with the skimmilk feeding. Calf meals, as a rule, can be satisfactorily used to replace only a part of the milk normally fed. The various systems for raising dairy calves will be discussed completely on the basis of problems confronted under the various plans of marketing milk from the herd.

Precautions—Early Feeding and Care

Irrespective of the plan followed in raising calves, they should be left with the dam from one to four days. Some feeders favor earlier separation as a safeguard against the calf gorging itself and also becoming accustomed to sucking, thereby making bucket feeding more difficult.

Teaching the Calf to Drink—After separation from the dam the calf should be taught to drink from a pail (Fig. 2). It is usually advisable to withhold feed for 12 to 18 hours before attempting to teach the calf to drink so it will be hungry and will take the milk more readily. By allowing the calf to suck several fingers of one hand held in the milk, it can usually be broken to drink milk from the pail on one or two lessons. Only fresh, warm milk should be offered.

The calf should be taught to drink milk slowly, and the bucket should be held up or placed on a rack about one foot from the ground while the calf is being fed. This practice will help to overcome some of the criticisms advanced against bucket feeding. The calf in nursing takes the milk slowly and mixes it with saliva. If the calf is permitted to gulp milk, or drinks rapidly, thus extending the esophagus, experiments show that some of the milk "spills" over into the first stomach or rumen rather than going into the true or fourth stomach as intended, and since the milk cannot escape, undesirable fermentations take place. The result is usually an unthrifty, "pot-bellied" calf.

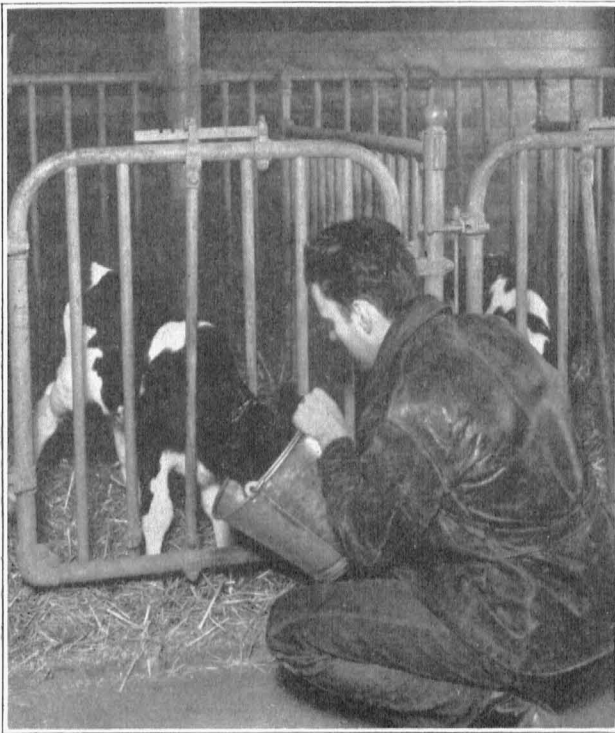


Fig. 2.—Teaching the calf to drink from a bucket. Normal, thrifty calves can be raised on skim milk as the principal feed.

The digestive system of the young calf is very delicate and the stomach is limited in capacity. Under natural conditions the newborn calf will nurse several times a day, but overfeeding is a more common cause of calf ailments than underfeeding. Regularity, cleanliness, and exactness are highly necessary in successful calf raising. The following points should be carefully watched:

Amount of Wholemilk to Feed—Young calves must not be overfed since indigestion and scours invariably follow. The amount of milk fed daily should not vary because erratic feeding usually leads to scours and an unthrifty calf. As a rule the daily allowance of wholemilk, which should be in accordance with the weight of the calf, will equal 8 to 10 per cent of the body weight for the first week. However, one pound of wholemilk per day for each 10 pounds of body weight, is

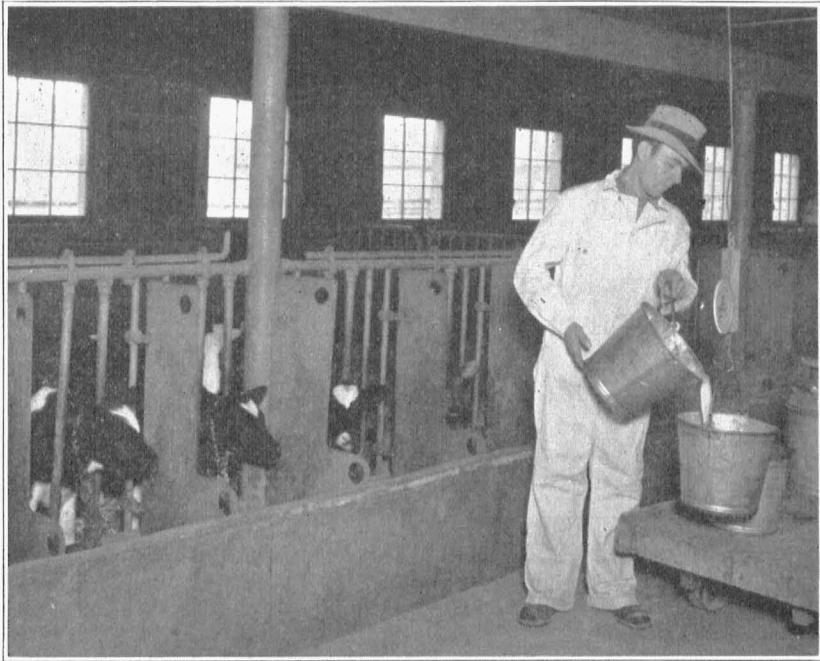


Fig. 3.—Weighing the milk for calf feeding. Varying amounts should be avoided.

a safe rule to follow. A pair of scales takes the guess out of feeding—no one can accurately estimate the weight of milk in a pail (Fig. 3). Table 2 gives the average birth weights of calves of the dairy breeds.

Feed at Regular Intervals—Calves should be fed from three to four times a day until they are about a week old. A calf weighing 60 pounds at birth should be fed 2 pounds of wholemilk at a feeding three times daily for the first week. Older calves may be fed twice a day, dividing the milk equally between the two feedings. Calves soon become accustomed to regular feeding hours and should be fed at the same time each day.

Feed Sweet, Warm Milk—The milk for feeding purposes should be at a temperature of 95 to 100 degrees Fahrenheit. A thermometer

should be used to determine the temperature of the milk as the use of the finger for this purpose is very deceiving. (Fig. 4) Only sweet, clean milk should be used as sour milk may induce scours in young calves and should be avoided.

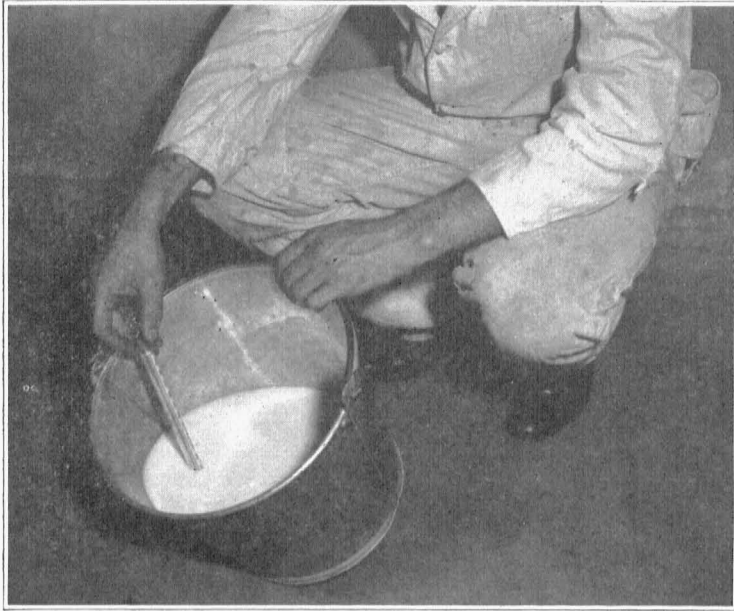


Fig. 4.—Use a dairy thermometer to determine the temperature of the milk fed. Milk should be between 95 and 100 degrees Fahrenheit. The finger is a poor measure to use in testing the temperature of the milk to be fed.

Clean Feeding Pails—Clean feeding pails and clean milk are essential in growing thrifty calves. Dirty feeding pails and contaminated milk are the most common causes of calf scours. The calf feeding pails should be thoroughly washed and sterilized after each feeding just as though they were to be used in the production of high quality milk. Discarded feed should be removed from the feed troughs daily. Attention to these small details is the best way to prevent disease.

Clean Calf Pens—The calf pens must be clean, dry, and sanitary. Dirty calf pens and diseases such as scours are usually found together. Special isolation quarters should be maintained for all animals showing evidence of sickness. Plenty of sunshine and proper ventilation are also essential. The calves must be protected from drafts and dampness. If possible, the calf pens should be on the south or most sheltered wing of the barn.

Watch Individual Differences—Calves differ widely in their response to treatment and must have some individual attention. Small calves in particular must have careful attention until they are growing nicely and are accustomed to the feeds offered. It is desirable to quarter the youngest calves in individual pens so that they may be watched more carefully for signs of sickness or loss of appetite.

PLAN I. RAISING THE CALF WHERE SKIMMILK IS AVAILABLE

The Skimmilk Calf

Skimmilk, when supplemented with a grain ration and plenty of good roughage, is the best feed for the calf up to six months of age. The change from wholemilk to skimmilk should usually be started when the calf is between two and three weeks old, depending upon the development and health of the individual.

The change from wholemilk to skimmilk should be gradual. One pound of skimmilk may replace an equal amount of wholemilk, the substitution being made at the rate of about 1 pound per day. As a rule the calf will be entirely on the skimmilk ration by the time it is about one month of age. Thereafter the amount of skimmilk should be increased gradually until the calf is receiving about 10 to 14 pounds at two months of age; 12 to 16 pounds at three months of age; and most calves will take 16 pounds before they reach the age of four months, after which time the amount of milk should not be increased. The chief difference between skimmilk and wholemilk is in the butterfat and the vitamin A content. Grain feeds supply the heat and energy furnished by the butterfat, and green feeds supply additional vitamins.

Feeding Grain and Roughage

A good quality leafy, green hay (preferably a legume or mixed hay) should be kept before the calf at all times. Dairy calves will begin to eat a little hay at the age of 2 to 3 weeks and will be eating about $\frac{1}{2}$ to 1 pound at two months; 1 to $1\frac{1}{2}$ pounds at three months; 2 to 3 pounds at four to five months; and 4 to 5 pounds by the time they are six months of age. Silage is not recommended for calves until they are at least three months of age.

The dairy calf begins to eat a little grain at 10 days to two weeks of age. During the second month the grain consumption will average $\frac{1}{2}$ to 1 pound; during the third month 1 to $1\frac{1}{2}$ pounds; during the fourth month 2 to $2\frac{1}{2}$ pounds; during the fifth month $2\frac{1}{2}$ to 3 pounds; and at the age of six months 3 to 4 pounds daily. The grain mix for the growing calf may be made up of homegrown grains supplemented with linseed or cottonseed meal. The following grain mixtures are recommended:

| | | | |
|-----------------------|----------|----------------------------|----------|
| I | | II | |
| Ground corn..... | 500 lbs. | Ground corn or barley..... | 300 lbs. |
| Ground oats..... | 250 lbs. | Crushed oats..... | 300 lbs. |
| Wheat bran..... | 200 lbs. | Wheat bran..... | 50 lbs. |
| Linseed oil meal..... | 50 lbs. | Linseed oil meal..... | 50 lbs. |
| Salt..... | 10 lbs. | Salt..... | 8 lbs. |
| III | | IV | |
| Ground corn..... | 400 lbs. | Ground corn..... | 300 lbs. |
| Ground oats..... | 300 lbs. | Ground oats..... | 300 lbs. |
| Wheat bran..... | 200 lbs. | Wheat bran..... | 300 lbs. |
| Linseed oil meal..... | 100 lbs. | Linseed oil meal..... | 100 lbs. |
| Salt..... | 10 lbs. | Salt..... | 10 lbs. |

Calves should not be overfed on grain and should be given just what they will readily clean up.

Salt—Calves should have free access to salt. In addition about 1 per cent salt should be included in the grain mix.

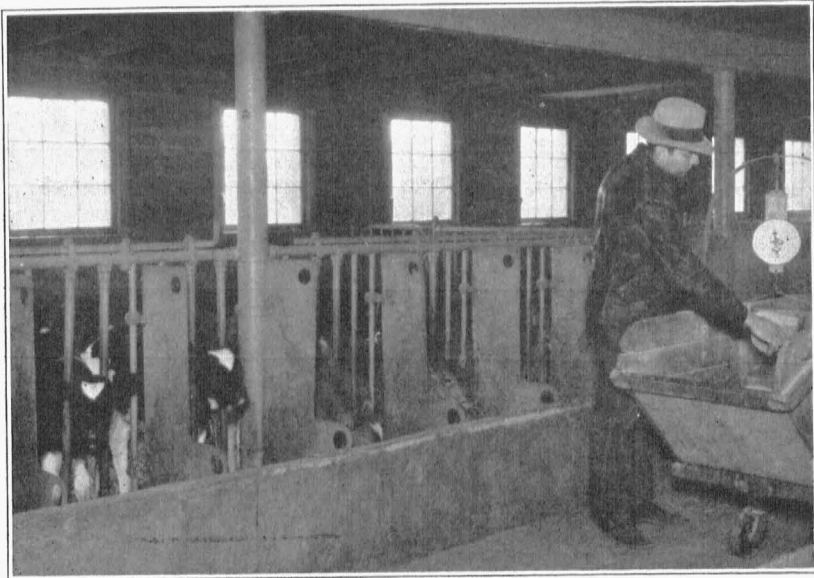


Fig. 5.—Weighing the grain feed for each calf.

Minerals—The growing calf, particularly where skim milk and legume hays are fed, seldom suffers from a shortage of minerals. As a precaution, equal parts of salt and steamed bone meal or equal parts of salt and finely ground limestone should be kept before the calves.

Water—Calves should have plenty of fresh, clean water after they are three weeks of age. Failure to provide water may result in less efficient growth of the calf.

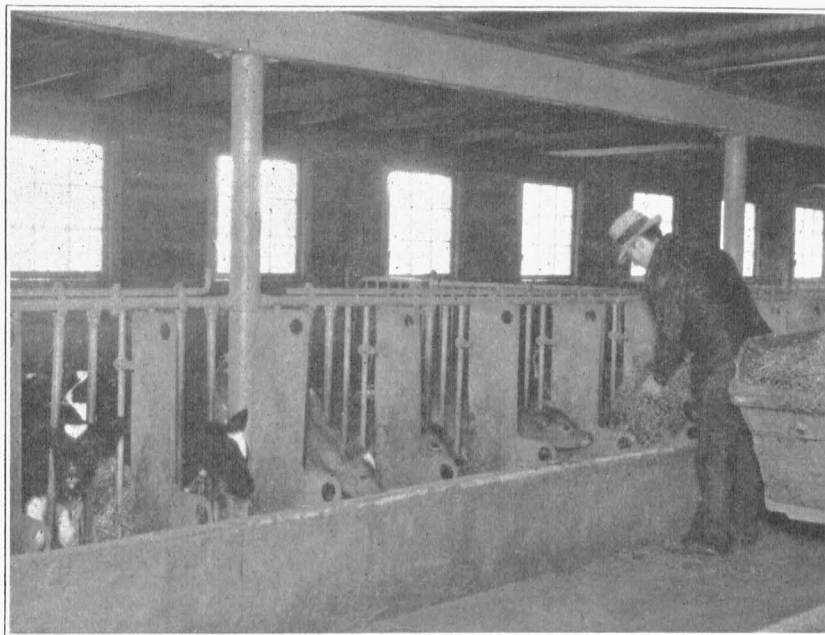


Fig. 6.—Feeding hay to dairy calves. Plenty of leafy, green hay should be provided.

TABLE 4.—DAILY FEEDING SCHEDULE FOR THE SKIMMILK CALF.
(Birth to 6 months of age)

| Age of Calf | Whole Milk (lbs.) | Skim Milk (lbs.) | Grain (lbs.) | Legume Hay (lbs.)** | Silage (lbs.) |
|--|-------------------|------------------|--------------|---------------------|---------------|
| (Ayrshire, Guernsey and Jersey Breeds) | | | | | |
| Birth to 48 hours..... | with dam | | | | |
| 2 to 7 days..... | 5 to 7 | | | | |
| 7 to 15 days..... | 6 to 8 | | | | |
| 15 to 22 days*..... | 8 to 1* | 1 to 8* | 1/16 | 1/16 | |
| 4 to 5 weeks..... | -- | 8 to 10 | 1/4 | 1/4 | |
| 5 to 6 weeks..... | -- | 9 to 11 | 1/3 | 1/3 | |
| 6 to 8 weeks..... | -- | 10 to 12 | 2/3 | 2/3 | |
| 8 to 12 weeks..... | -- | 12 to 14 | 1 | 1 | |
| 12 to 16 weeks..... | -- | 14 to 16 | 1 1/2 | 1 1/2 | |
| 16 to 24 weeks..... | -- | 16 | 2 1/2 | 2 1/2 | 1/2 to 2 |
| (Holstein and Brown Swiss Breeds) | | | | | |
| Birth to 48 hours..... | with dam | | | | |
| 2 to 7 days..... | 7 to 9 | | | | |
| 7 to 15 days..... | 9 to 11 | | | | |
| 15 to 22 days*..... | 10 to 1* | 1 to 10 | 1/16 | 1/16 | |
| 4 to 5 weeks..... | -- | 10 to 12 | 1/4 | 1/4 | |
| 5 to 6 weeks..... | -- | 12 to 14 | 1/2 | 1/2 | |
| 6 to 8 weeks..... | -- | 14 to 16 | 3/4 | 3/4 | |
| 8 to 12 weeks..... | -- | 16 to 18 | 1 | 1 | |
| 12 to 16 weeks..... | -- | 18 to 20 | 1 1/2 | 1 1/2 | 1 to 2 |
| 16 to 24 weeks..... | -- | 20 | 2 1/2 | 2 1/2 | 2 to 3 |

*Transition period—skimmilk substituted for wholemilk at rate of 1 pound per day until change is complete and calf is receiving skimmilk by the time it is 3 to 4 weeks of age. Reconstructed skimmilk may be substituted for ordinary skimmilk at this point in the feeding schedule.

**Calves should have free access to plenty of good quality, leafy green hay. The approximate amount of hay consumed daily by a calf of this age is indicated.

Raising the Dairy Calf Where Wholemilk is Sold

On farms where wholemilk is sold it is usually impractical to provide skim milk for calf feeding purposes. Calves may be raised successfully where wholemilk is sold by the use of liquid skim milk substitutes. It must be kept in mind that the young calf must have milk in its diet during the first few weeks of life. Ignoring this fact is usually responsible for the somewhat unthrifty, small, undernourished calves often found in wholemilk districts. The feeding of inadequate milk during the first few weeks of life, or eliminating milk before the calf is able to digest substitute feeds, are the two chief mistakes to avoid in feeding calves where wholemilk is sold.

Several methods of feeding have been found successful where liquid skim milk is not available. Skim milk powder, powdered buttermilk, semi-solid buttermilk and calf meals or gruels all offer possibilities. The dairyman should consider the cost and practicability of each method and use the plan best suited to his conditions.

PLAN II. RECONSTRUCTED SKIMMILK

As pointed out (Table 5), where powdered skim milk is not prohibitive in price it may satisfactorily replace liquid skim milk by adding 1 pound of skim milk powder to 9 pounds of warm water. The result is 10 pounds of skim milk of usual composition and feeding value. Reconstructed skim milk is fed exactly the same way as ordinary skim milk. Care should be taken to see that remade skim milk is at body temperature (95 to 100 degrees F.) when fed. Grain and roughages are fed according to suggestions given in Table 4.

Dairyman often raise the question of the economy of raising calves on skim milk powder. Under market conditions it is often more economical to sell wholemilk and buy skim milk powder. In other cases, particularly in the sale of surplus milk as delivered to wholemilk markets in bulk, the buying of skim milk powder for feeding purposes may be a losing proposition. The economy of feeding skim milk powder depends upon the comparative net returns the dairyman receives for his product, which is marketed as fluid milk, as compared with selling cream or butterfat and retaining the skim milk on the farm for feeding purposes. Since most wholemilk is sold on the basis of a 3.5 per cent fat test, the returns for fat sold in the form of cream on a butterfat basis as compared to the price for wholemilk will show the price one can afford to pay for skim milk powder. Cream is usually separated to contain from 30 to 40 per cent butterfat and on this basis each 100 pounds of 3.5 per cent milk yields about 85 to 90 pounds of skim milk containing 9.5 per cent dry matter, thus supplying the equivalent of

about 8.30 pounds of dried skimmilk. If liquid milk testing 3.5 per cent will bring \$1.50 per hundred pounds net, and butterfat is worth 30 cents per pound, the producer receives 45 cents for the skimmilk sold in 100 pounds of wholemilk. If skimmilk is needed for calf feeding the dairyman cannot afford to pay more than \$5.42 per hundred pounds for dried skimmilk powder. At this figure the dairyman is just breaking even financially. In many cases it would be more profitable to separate surplus milk.

Table 5 shows the maximum price the dairyman can afford to pay for one hundred pounds of dried skimmilk for calf feeding purposes at various wholemilk and corresponding butterfat prices.

TABLE 5.—A COMPARISON BETWEEN THE PRICE OF WHOLEMILK AND BUTTERFAT AND THE VALUE OF SKIMMILK POWDER FOR CALF FEEDING PURPOSES AT VARIOUS PRICE LEVELS.

| Net Price to the Producer for 3 3/4% Milk | Maximum Price to Pay for 100 lbs. of Skimmilk Powder When the Price per Pound of Butterfat is: | | | | | | | |
|---|--|--------|--------|--------|--------|--------|--------|--------|
| | 25c | 30c | 35c | 40c | 45c | 50c | 55c | 60c |
| \$1.00 per hundred..... | \$1.50 | | | | | | | |
| 1.25 per hundred..... | 3.31 | \$2.40 | \$0.30 | | | | | |
| 1.50 per hundred..... | 7.53 | 5.42 | 3.31 | \$1.20 | | | | |
| 1.75 per hundred..... | 10.54 | 8.43 | 6.32 | 4.21 | \$2.10 | | | |
| 2.00 per hundred..... | 13.55 | 11.44 | 9.33 | 7.22 | 5.12 | \$3.01 | \$0.90 | |
| 2.25 per hundred..... | 16.56 | 14.45 | 12.34 | 10.24 | 8.13 | 6.02 | 3.91 | \$1.80 |
| 2.50 per hundred..... | 19.57 | 17.46 | 15.36 | 13.25 | 11.14 | 9.03 | 6.92 | 4.81 |
| 2.75 per hundred..... | 22.59 | 20.48 | 18.37 | 16.26 | 14.15 | 12.04 | 9.93 | 7.83 |
| 3.00 per hundred..... | 25.60 | 23.49 | 21.38 | 19.27 | 17.16 | 15.06 | 12.95 | 10.84 |

PLAN III. FEEDING A DRY CONCENTRATE AND LIMITED WHOLEMILK

Dry Concentrate Containing Skimmilk Powder—Calves may be raised successfully by feeding wholemilk for a short time and gradually switching the calf to a dry grain mixture containing about 20 per cent dried skimmilk powder. Much labor is saved by feeding the dry mixture. The necessity of having hot water at feeding time is also dispensed with, there are no pails to wash after the first two months, and the danger of spreading digestive troubles is lessened. Under this plan the calf is fed wholemilk for 6 to 7 weeks. From the third week on the calf is induced to eat just as much hay and concentrate mixture as possible and the amount of wholemilk is cut down gradually. A dry grain concentrate, containing skimmilk powder, and other feeding stuffs, readily obtainable by the dairyman, is suggested as follows:

| | |
|-----------------------------------|-----------------|
| Ground yellow corn..... | 30 lbs. |
| Ground oats (or rolled oats)..... | 30 lbs. |
| Skimmilk powder..... | 20 lbs. |
| Wheat bran..... | 10 lbs. |
| Linseed oil meal..... | 10 lbs. |
| Total..... | 100 lbs. |

With this plan the feeding schedule is as shown in Table 6.

TABLE 6.—DAILY FEEDING SCHEDULE—DRY CONCENTRATE AND LIMITED WHOLEMILK

| Age of Calf | Wholemilk (lbs.) | Concentrate* (lbs.) | Hay |
|---------------------------------------|------------------|--|-------------|
| (Ayrshire, Gurensy and Jersey Breeds) | | | |
| Birth to 4 day..... | with dam | | |
| 2nd to 7th day..... | 4-6 | | |
| 1st to 2nd week..... | 5-7 | 1/16 | Free choice |
| 2nd to 3rd week..... | 6-8 | 1/16 | Free choice |
| 3rd to 4th week..... | 7-9 | 1/4 | Free choice |
| 4th to 5th week..... | 6-8 | 1/2 | Free choice |
| 5th to 6th week..... | 4-6 | 3/4-1 | Free choice |
| 7th to 8th week..... | 4-0 | 1 1/4-2 | Free choice |
| 8th to 12th week..... | None | Increase steadily to 4 lbs.... | Free choice |
| 12 to 16th week..... | None | 4-5 | Free choice |
| After 16th week..... | --- | Change to regular grain mixture for heifers..... | |

For Holsteins and Brown Swiss the amounts specified above should be increased approximately $\frac{1}{4}$ to $\frac{1}{3}$. At best these amounts are relative and calves will differ considerably in the amount of food consumed. Each calf must be treated as a separate individual and care used not to overfeed the slower growing calves, or to underfeed the faster growing more hungry calves.

The New Jersey Dry-Fed Calf Mixture—A successful and popular system of raising calves, where wholemilk is sold, has been suggested as a result of feeding trials at the New Jersey Station. By this plan the calves are fed wholemilk for three weeks, the wholemilk being gradually replaced by warm water, and are induced to eat a dry grain mixture and hay just as early as possible.

The dry-fed ration consists of the following ingredients:

| | |
|---------------------------|------------------------------------|
| 100 lbs. yellow corn meal | 50 lbs. soluble blood flour |
| 150 lbs. ground oats | 4 lbs. feeding steamed bone meal |
| 50 lbs. wheat bran | 4 lbs. finely pulverized limestone |
| 50 lbs. linseed oil meal | 4 lbs. salt |

The feeding program is somewhat as follows:

- (1) *Birth to Three Days*—Suckle dam.
- (2) *Three Days to Three Weeks*—Wholemilk, not over 3 quarts per day. Start calf eating dry calf ration and hay.
- (3) *Three to Four Weeks*—Substitute 1 pound of warm water for each pound of wholemilk so that by the end of 30 days the calf will be living on the dry-fed mixture, legume hay and fresh water.
- (4) *One to Six Months*—At 30 days of age the calf should be eating nearly 1 pound of the dry grain mixture and hay free choice (about $\frac{1}{3}$ to $\frac{1}{2}$ pound daily). After the first month the dry grain mixture is gradually increased so that at the end of the fifth month the calf is consuming

5 to 6 pounds daily. Six pounds daily is the maximum to be fed regardless of breed. The calf will get the balance of the required nutrients from the hay which should be fed free choice and in liberal quantities.

- (5) *After the Sixth Month*—Discontinue the dry calf mixture and substitute a grain mixture for growing calves (see page 13). Silage may also be added to the ration.

Calf Meal Pellets—Commercial feed companies have in recent years placed upon the market “calf pellets” to be used in place of dry calf meals. In using calf pellets the same general plan is followed as in raising calves on a dry calf meal. It is claimed that calves like the pellets better than dry calf meal and therefore learn to eat them sooner and thus make better gains. This matter has not been sufficiently investigated by experiment stations to draw definite conclusions as to whether or not the pelleting is worth the extra expense. Where calf pellets are used the recommendations of the manufacturer should be followed in raising calves.

PLAN IV. THE USE OF CALF MEALS

When skimmilk is not available the period of wholemilk feeding should usually be extended until the calf is about 4 weeks of age. The calf meal mix is then gradually substituted for the wholemilk so the calf is entirely on the calf meal ration by the time it is 6 to 7 weeks of age. There are available on the market a number of commercial mixed calf meals, or the farmer may mix his own. A good calf meal should contain 25 to 30 per cent crude protein, 3.25 to 4 per cent fat, and not over 4 per cent fiber. Some protein from an animal source should be included. The following calf meals have given very satisfactory results:

| I (Indiana) | II (U. S. D. A.) |
|----------------------------------|----------------------------------|
| Corn meal or hominy.....100 lbs. | Corn meal or hominy.....100 lbs. |
| Linseed meal.....100 lbs. | Linseed meal..... 30 lbs. |
| Red dog flour.....100 lbs. | Rolled oats..... 30 lbs. |
| Soluble blood flour.....100 lbs. | Soluble blood flour..... 20 lbs. |
| | Skimmilk powder..... 20 lbs. |
| | Salt..... 1 lb. |

The calf meals are mixed with water in the proportion of 1 pound of the dry calf meal to 6 or 8 pounds of water, and the resulting gruel is fed in approximately the same quantities as skimmilk and with the same supplementary hay and grain feeds.

The general feeding schedule is as follows:

| | |
|-------------------------|---------------------------------------|
| Birth to 14 days of age | Wholemilk. |
| 14 to 28 days | 3 parts wholemilk, 1 part gruel. |
| 28 to 35 days | Wholemilk and gruel, equal parts. |
| 35 to 42 days | 1 part wholemilk, 3 parts gruel. |
| 42 to 180 days | Gruel with usual grain feeds and hay. |

Milk substitutes are never as satisfactory as either whole or skim-milk during the first few weeks of a calf's life and milk should be very high in price to justify their use at this time.

Calves raised by the calf meal plan are not usually as thrifty looking and in some cases are slightly smaller in size at six months of age than skimmilk calves, but at one year of age the calves are approximately normal in growth and development and under good feeding conditions cannot be discerned from the skimmilk fed calves.

Often the troubles encountered with calf meals or gruels may be traced to the use of low quality soluble blood flour. Only a high quality product should be used. Dried blood is not as satisfactory as soluble blood flour. The digestibility of soluble blood flour decreases as it is heated to unusually high temperatures. A soluble blood flour prepared at temperatures below 225 degrees F. is most desirable in this respect.

PLAN V. RAISING THE CALF ON WHEY

Good fresh sweet whey can be fed to calves with fair satisfaction if (1) the calf receives wholemilk long enough to get a good start (at least one month); and (2) if plenty of animal protein is included as it is recognized that whey is low in proteins. The following mixture is suggested for feeding with whey:

| | |
|-----------------------|---------|
| Ground yellow corn | 60 lbs. |
| Ground or rolled oats | 10 lbs. |
| Wheat bran | 10 lbs. |
| Linseed oil meal | 10 lbs. |
| Skimmilk powder | 10 lbs. |

This grain mixture should be rubbed on the calf's muzzle and a small amount kept in the feed box so as to induce maximum consumption while the calf is young.

Whey, secured from creameries or cheese factories for feeding purposes, should always be pasteurized to prevent the introduction of disease into the dairy herd. This precaution, unfortunately, is often overlooked.

PLAN VI. THE USE OF NURSE COWS

Some dairymen, particularly those engaged in the raising of high class purebreds, prefer to use nurse cows to furnish wholemilk during the first few weeks of the calf's life, which generally results in sleeker, healthier calves. Trouble with scours, often caused by the calf gulping milk too fast, "pot-bellied" calves, and contaminated feed pails are eliminated with this plan. Many who use the nurse cow plan claim there is less work involved than in bucket feeding.

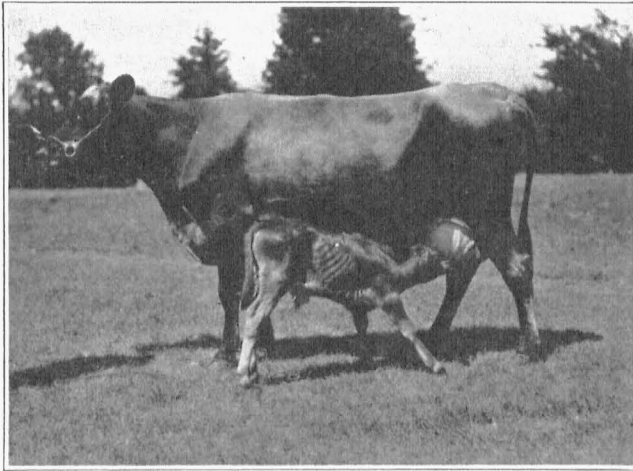


Fig. 7.—Raise only calves sired by well bred bulls and out of the best cows in the herd.

One nurse cow can handle two to four calves at a time. Each calf should get 8 to 10 pounds of milk per day, and until they are 50 to 60 days of age they should be allowed to suckle two or three times daily. After the calf is two months old it should be with the nurse cow only once a day until weaned.

By the time the calf is two weeks old it should have access to hay and a dry grain mixture similar to the following:

| | |
|----------------------------|---------|
| Yellow corn meal..... | 20 lbs. |
| Ground or rolled oats..... | 20 lbs. |
| Wheat bran..... | 20 lbs. |
| Linseed oil meal..... | 20 lbs. |
| Skimmilk powder..... | 20 lbs. |

Salt, or a mixture of equal parts of salt and steamed bone meal should be kept before the calves at all times. Fresh water should also be provided after the calf is a few weeks old.

Cows which are hard milkers, or old, and suffering from broken down udders often make very satisfactory nurse cows. The dairy breed associations have provisions for eliminating the production of cows used as nurse cows from yearly herd averages, which removes objections from the standpoint of breeders interested in establishing outstanding averages.

GENERAL MANAGEMENT OF CALVES

Quarters for Calves—The small calf can best be kept in a separate pen. A small pen 4 by 6 feet is sufficient for the first two weeks.

After the calves are a few weeks of age they may be placed in larger pens with other calves. Small calves should not be jostled and bumped around by larger calves so it is best, in large herds, to separate

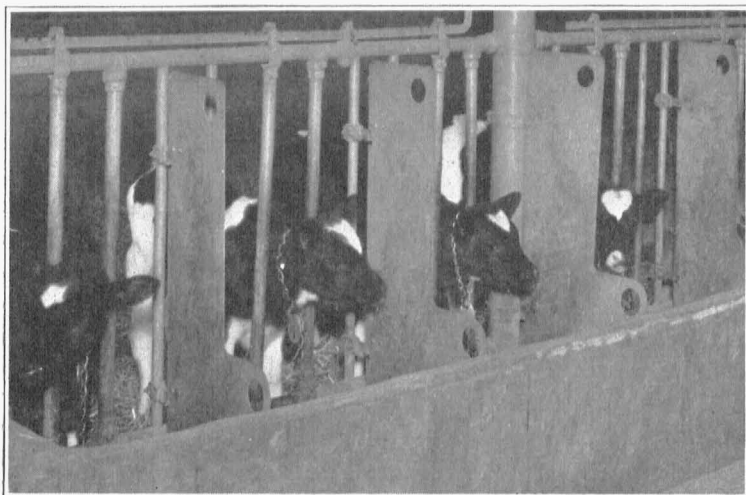


Fig. 8.—Calves in stanchions ready for feeding. Note the manger divisions which prevent the stealing of feed and discourage calves from sucking each other's muzzles and ears.

the calves into pens according to their age. Handling of heifers by this plan saves considerable labor and conserves bedding. Stanchions should be fixed on one side of the pen and used at feeding time so as to prevent calves stealing each other's feed. The feeding of grain, just after the milk has been fed, while the calves are still fastened in the stanchion, will materially aid in preventing the sucking habit. Heifers occasionally are brought into milk too early, misshapen udders occur, and spoiled quarters often result from the sucking habit. Some dairy-

men prefer to keep the calves separate until they are old enough to be entirely dependent on pasture and the regular ration as provided for older cattle. Where space and funds permit this practice is worth while and reduces the spread of disease, results in calves getting more attention, and shows them off to a better advantage.

Stalls and stanchions for calves may be made of steel or lumber. A satisfactory stall arrangement for calves can be built in most barns by the use of cheap lumber. In more elaborate set-ups, steel construction is very practical and convenient. Calf stanchions are usually 36 to 40 inches in height and have a 4-inch space for the calf's neck.

In building calf pens, care must be used to make certain that the construction readily permits thorough cleaning and disinfection, two of the most important items in successful calf raising.

Exercise—Calves should be allowed plenty of freedom and exercise. When weather conditions permit, calves of all ages should receive the benefit of fresh air and sunshine.

Pasture—Pasture is not recommended for calves until they are several months of age. Succulent green grass causes scours in young calves. Heifers from 6 to 12 months of age should not be raised on pasture unless a grain ration is also provided.

Dehorning

Dairy cattle not intended for show may well be dehorned. As a rule calves should be dehorned when one to two weeks old. The most satisfactory way is to use caustic potash for the purpose, as it kills the growing horn, and cattle breeders who prefer to have their cattle dehorned find it less trouble to prevent the growth of horns than to remove them later.

To prevent the growth of horns, first clip the hair from a small area around the horn button. Next, encircle the clipped area with vaseline or axle grease to confine the action of the caustic potash to the area of the horn. The final step is to rub the horn button with a stick of moist caustic potash until the skin is ruptured and begins to bleed slightly.

Excessive amounts of potash should not be used as the horns of young calves are easily killed. The caustic should not be too moist, for if it runs over on the surrounding skin or into the eyes, much unnecessary pain is caused. Immediately after treatment, calves should be protected from rains, to prevent the caustic from spreading.

Heifer calves a month or more of age may be successfully treated by the caustic potash method, by burning a raw ring in the skin from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch wide about the base of the horny growth. Clipping hair around the base of the horn will facilitate the operation.

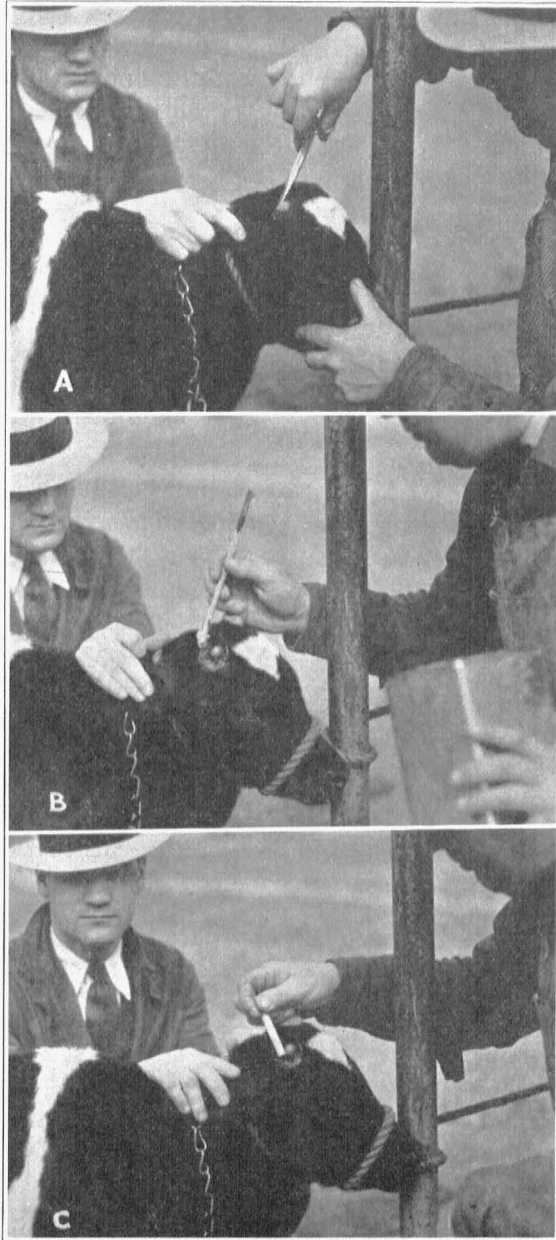


FIG. 9.—STEPS IN DEHORNING THE DAIRY CALF.

- A. Clip the hair away from the small horn or "button."
- B. Apply grease around the horn to prevent the caustic from spreading.
- C. Apply the caustic directly to the base of the horn.

Removing Extra Teats—Rudimentary or extra teats often appear on the udders of heifers. They generally secrete no milk but are unsightly and detract from the appearance of the cow's udder. Occasionally rudimentary teats appear as a part of the main teat, and are of considerable annoyance in milking. Such teats are hard to remove and at best require a surgical operation within the scope of only a good veterinarian. The usual type of rudimentary teat is easily removed, however, by any one of several methods. A simple but effective method is to tie a piece of thread or a rubber band tightly around the base of the teat, and within a week or two the extra teat will drop off, leaving a healed wound. The use of scissors is also generally recommended and gives good results. It is best to throw the heifer, apply iodine or any good disinfectant to the teat and cut it off quickly with sharp scissors. The operation is not painful and excessive bleeding seldom occurs. Where bleeding of any consequence occurs the exposed vessels should be cauterized. Care must be used to avoid infection from the scissors. Painting the wound with iodine solution after removal of the teat is recommended.

Marking Calves for Identification

It is important that each calf be plainly marked to permit easy identification. This is very necessary in purebred herds and should be done in all herds of considerable size, even if made up of grades. Some of the most common marking systems are—leather strap or small chain around the neck, with brass identification tag attached; ear tag of various forms; halters with number plates attached; tattoo marks in the ears; and diagrams of the markings. In some herds photographs are used as a means of identification, with excellent results. In purebred herds it is a good idea to diagram or photograph each calf quite early and make out the necessary registration application and hold this on file until time for registration. In the case of Guernseys where it is the usual custom to file a birth report before the animal is 30 days of age, the diagram of the animal should be made in duplicate and one copy sent to the breed association as a part of the birth report and the other kept as a means of identifying the animal in the herd.

Free-Martins

Many twins in cattle consist of a male and a female; in such cases the female is called a free-martin and in about 90 per cent of the cases is sterile. Occasionally these females breed, but at best it is about a 9 to 1 chance, and it is not worth the expense to raise them except in the case of an animal with very unusual blood lines.

There are many mistaken ideas as to the breeding ability of cattle twins. With opposite sexed twins even though the female is sterile,

the male is not affected and will breed. Twin bulls or twin heifers will breed the same as any singly born calf.

Some Common Ailments of Dairy Calves

Calves, particularly during the first few weeks of life, are subject to a few common ailments. In some cases diseases causing a high mortality are encountered and often the calves surviving are subject to general unthriftiness and poor growth.

Prevention is the best treatment of calf trouble. The general health and well-being of calves depends largely upon the feeding, care, and management and sanitation measures employed. When disease does make its appearance general "cure-alls" should be avoided. If the herdsman cannot detect or treat the trouble a competent veterinarian should be called. It is well to keep in mind that many diseases are rapidly spread and any appearance of sickness in the calf herd should be dealt with promptly. Sick calves should be isolated at once and the proper treatment rendered.

Common Scours—The causes of common scours are many, but usually they are confined to factors causing indigestion. Symptoms of this disease are a looseness of the bowels and foul smelling feces. Over-feeding, drinking milk too fast, separator foam on milk, cold milk, sour milk, dirty feeding pails or troughs, sudden changes of feed, feeding freshly cut or too much legume hay, fresh green grass and moldy, heated or damaged feeds are among the causes of common scours. This form of scours is usually corrected by proper feeding and management and should not be confused with dysentery or "infectious white scours."

The calf should immediately be isolated from the remainder of the herd. Treatment consists of (*a*) reducing the amount of feed immediately, also any faults with the milk such as too cold, sour, dirty, or from garget affected cows should be corrected; (*b*) give the calf about a half teacup of mineral oil to which has been added $\frac{1}{2}$ to 1 tablespoonful of a mixture consisting of two parts bismuth-subnitrate and one part salol. One to four tablespoonfuls of castor oil given in the milk may also be used, but the bismuth-subnitrate and mineral oil is preferable. If the calf does not improve, as in case of a severe attack, the bismuth-subnitrate-salol-oil mixture should be repeated every 6 to 12 hours, the amount given varying with the age and size of the calf. In severe cases, raw eggs broken into the milk are helpful; (*c*) the calf should be brought back on feed slowly, feeding one-half the usual amount of milk after the oil treatment, and gradually increasing the allowance of milk as the calf progresses. (*d*) All pails and utensils utilized in feeding must be sterilized. The addition of $\frac{1}{2}$ to 1 ounce of limewater per pint of milk fed is often helpful during the time the calf is recovering.

Colds—Colds are frequent among calves and though they may not cause death, the growth of the calf is usually retarded. Well ventilated, dry barns, plenty of bedding and avoidance of drafts will prevent colds.

Lice—Lice are found on calves and young stock during the winter months in particular and may become so abundant as to cause discomfort and loss of condition. During cold weather lice may be controlled by dusting powdered sabadilla seed along the backs of the animals. Blanketing the animal for a few hours following treatment and combing out the hair, preferably out-of-doors, makes this treatment more effective. A mixture of 1 part sodium fluoride and 5 parts flour may be used in the same way. In mild weather infested cattle may be washed or dipped, using one of the many commercial coal-tar compounds as recommended by the manufacturer.

Ringworm—This disease is quite common in young calves. It is caused by a parasite which burrows in circular areas under the skin, giving the affected areas a crust-like appearance. The crusts usually appear about the eyes and neck of young calves. The affected animals should be isolated and the stalls they occupied should be thoroughly cleaned and disinfected. The "crust" areas should be washed with soap and water. After the areas are dry they should be painted with tincture of iodine. For stubborn cases, equal parts of tincture of iodine and tincture of iron are helpful.

Warts—Warts appear on the surface of the skin in a rough, horny-like growth, and may be single or multiple. Rubbing the horny projection of each wart with castor oil daily will hasten their disappearance. Where warts are present in large numbers, surgical measures are advisable.

FEEDING AND MANAGEMENT OF YOUNG DAIRY STOCK

Heifers over six months of age are comparatively easy to care for but should not be neglected. At this age the heifer is growing rapidly and responds to good care and management by very economical gains in body size during this period. Studies at the Missouri Agricultural Experiment Station (Bulletins 336 and 338) show very clearly that neglecting the feeding of calves between 6 and 12 months of age results in an increased growing cost. Heifers should not be kept fat but rather growing rapidly so as to be sufficiently developed to be bred for freshening at the normal age for the breed.

From 6 months to 1 year of age the heifer may be fed mostly on roughages, including pasture, with a moderate amount of grain. During the summer months green pastures furnish excellent and well balanced feed for growth. Unless the pasture is unusually good, however, a

little grain feed is recommended, and this is most important for extremely young calves, 6 to 9 months of age. Early in the spring, during hot, dry weather, and during the fall months when pastures are short, hay and silage in addition to grain should also be provided. Heifers

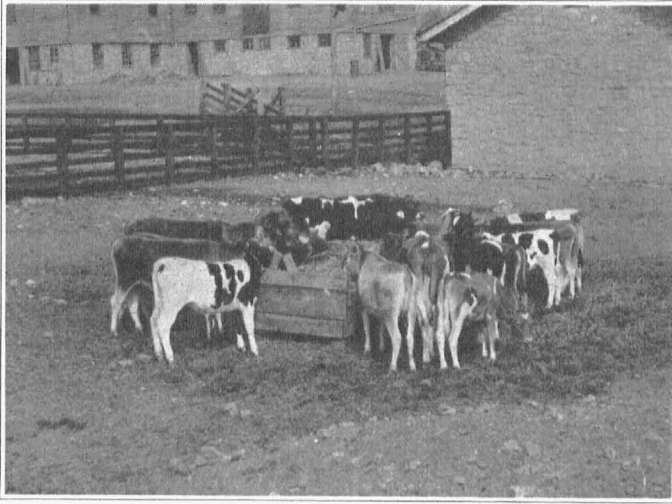


Fig. 10.—Heifers over six months old may be raised principally on good quality roughages.

from 6 to 12 months of age will eat from 5 to 10 pounds of hay daily and from 5 to 15 pounds of silage, the silage replacing some of the hay. Legume hays such as alfalfa, clover, soybean and cowpea, or a mixture of these hays and non-legumes, is excellent for growing heifers. This form of roughage is rich in minerals and vitamins necessary for growth. Roughages may very satisfactorily be fed free choice and just enough grain supplied to keep the heifers growing well. Where plenty of legume roughages and silage are available a grain mix consisting mostly of corn and oats is desirable. Suggested mixtures are:

| I | II |
|--------------------------|-------------------------------|
| Ground corn.....300 lbs. | Ground corn.....400 lbs. |
| Ground oats.....200 lbs. | Ground oats.....200 lbs. |
| Wheat bran.....100 lbs. | Wheat bran.....100 lbs. |
| | Linseed oil meal.....100 lbs. |

Where only non-legume roughages such as corn stover, timothy hay, straw, etc., are available, a grain mixture higher in protein than the above should be fed. In such cases one of the following rations will be satisfactory:

| I | II |
|-------------------------------|-------------------------------|
| Ground corn.....100 lbs. | Ground corn.....200 lbs. |
| Ground oats.....100 lbs. | Ground oats.....200 lbs. |
| Wheat bran.....100 lbs. | Wheat bran.....100 lbs. |
| Steamed bone meal..... 3 lbs. | Linseed oil meal.....100 lbs. |
| | Steamed bone meal..... 6 lbs. |

Alfalfa and Skimmilk—Heifers may be raised satisfactorily to the age of approximately 2 years on a ration of skimmilk and good quality alfalfa hay. In experiments now in progress at the Missouri College of Agriculture, it has been found that heifers fed skimmilk and leafy green alfalfa hay to 9 months of age and then continued on the alfalfa alone are approximately 96 per cent as large in body framework as the normal heifer at 18 months of age. In body weight the heifers are about 11 per cent below normal, indicating a lack of energy in the alfalfa ration. The heifers are very thrifty and healthy in appearance, however, and when fed the usual ration supplied cattle of near freshening and milking age will add sufficient weight to closely approximate normal.

The amount of hay consumed per pound of body gain has been approximately equal to the amount of grain and hay combined consumed by calves fed the usual way. The cost of growing the heifers has been reduced considerably, however, through the substitution of roughage for the grain. This plan offers considerable promise for the breeder who has an abundance of skimmilk and legume hay.

Water and Salt—Growing heifers require plenty of water and salt. Salt may be fed as a part of the grain ration and in addition should be available at all times in the pasture or exercise lot.

Age for Breeding Heifers—The age at which heifers are bred depends upon their growth and development. Jerseys and Guernseys mature somewhat earlier than Holsteins, Ayrshires and Brown Swiss, and should usually be bred at 15 to 18 months of age. Holstein, Brown Swiss and Ayrshire heifers should usually be bred at 17 to 20 months of age. Delay of breeding past the recommended age where a heifer has attained normal development and growth is not usually justified by a sufficient increase in production to warrant the practice. On the other hand, a small weak heifer should not be bred until she has attained approximately normal size. The strain of lactation after a small, weak heifer has freshened usually retards growth to a considerable extent.