nor ferment. After the combs have been capped over, the super should immediately be removed and stored in the honey house as honey is stored over winter.

The best time to secure surplus pollen for feeding is in June and July, mostly during the honey flow.

After the bees have had their first flight in the spring, a frame of empty comb is removed from the hive and one of the pollen frames is inserted among the bees next to the brood nest. Other conditions being favorable, brood raising in this colony will go on uninterrupted as long as there is any pollen. Other things being equal, colonies that have had pollen through the whole spring period are much stronger in numbers when the honey flow comes than are those that have had no pollen, and will also gather a larger surplus of honey.

The University of Minnesota

AGRICULTURAL EXPERIMENT STATION

THIRTY-SECOND ANNUAL REPORT

PART II

Popular Discussions of Some of the Experimental Work in Animal Husbandry, Dairy Husbandry, Veterinary Medicine, Poultry Husbandry and Bee Culture, 1924

UNIVERSITY FARM, ST. PAUL
OCTOBER, 1924

THIRTY-SECOND ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATION, 1923-24

PART II

INTRODUCTION

The Minnesota Agricultural Experiment Station was created to serve the people by developing useful information through investigation and research. .Its task relative to any subject it investigates is not finished until a statement of the conclusions reached is placed before the people in understandable and usable form. As agriculture becomes more complex and the need for efficiency on the part of the farmer more and more evident, promptness in placing the results of research in their hands becomes increasingly important. A little more than a decade ago the extension service, composed of specialists and county agents, was organized. It has become a great agency for getting the work of the experiment station before the people. It is a service that is impatient with delay in the announcement of the results of research and it should be, for no time should be wasted in giving the people an opportunity to benefit by the findings of the experiment station. It has become the custom, whenever possible, to issue a statement as soon as an experiment closes. This is true particularly of feeding experiments, and the stockmen who come to University Farm on Cattle Feeders' Day and Swine Feeders' Day manifest their appreciation.

The foregoing statement explains, in large part, why Part II of the Thirty-second Annual Report of the Experiment Station presents a discussion of that part of the work under way in certain divisions on which more or less conclusive statements can be made at this time. The divisions contributing to Part II are Animal Husbandry, Dairy Husbandry, Veterinary Medicine, Poultry, and Bee Culture.

ANIMAL HUSBANDRY

FEEDING BABY BEEF

Premium prices at present are paid for the younger, lighter weight cattle of beef breeding and early finishing quality. Heavy cattle are rapidly passing out of the market demand. Three- and four-year-old cattle are now rarely found in the feed yards or on the market. Even heavy two-year-old cattle are sometimes looked upon with disfavor. The marketing of calves as baby beef has many advantages and the process is well adapted to conditions on many Minnesota Farms.

The trend in modern beef production is toward baby beef.

Feeding baby beef has at least four advantages over feeding heavy cattle. (1) It has been found that calves and yearlings will make from 25 to 50 per cent more meat from the grain consumed than the same animals would make if kept until two or three years old. (2) The turnover on the money invested in breeding cattle is much quicker when baby beeves are produced than when the calves are kept until two or three years of age. (3) The number of breeding cows kept can be increased if calves and yearlings are sold, as there will be no two- and three-year-old cattle to carry. (4) Open heifers often sell at a discount when more than two years old. Finished off as yearlings at 800 or 900 pounds, they will sell almost as well as steers.

The Cattle-Feeding Shed and Yards at University Farm

Many problems are involved in baby beef production and much is yet to be learned about it. The outstanding questions that have been raised about fattening beef calves are: At what age and weight is it best to market? What are suitable grain rations? What kind and amount of roughages will give the best results? What is the effect of silage and protein supplements, and of feeding ground and shelled corn? Can calves be successfully fed at self-feeders? These questions indicate that the practice of fattening baby beef calves, altho still

in its infancy, is growing in importance. So vital are they that experiments have been conducted for the last three years to find the answers for at least a part of them under Minnesota conditions.

One lot of baby beef calves was fed out in each of the last three winters. In 1921-22, 40 purebred Hereford calves, 10 high grade Herefords, and 10 calves of common breeding but showing some beef cattle ancestry, were fed. In the winter of 1922-23, 60 purebred Shorthorn calves were fed, and in 1923-24, 60 purebred and high grade Aberdeen-Angus calves. The calves were purchased from breeders throughout the state. When received at University Farm the calves ranged in weight from 350 to 500 pounds, and in age from 6 to 9 months. All were steers and dehorned. They were put on feed in November of each winter and fed until satisfactorily finished for market. The first lot was fed for 196 days, the second for 217 days, and the third for 224 days.

Hereford Baby Beeves

In the 1921-23 trial, these calves gained 2.63 pounds per head daily on a ration of shelled corn, ground oats, linseed meal, corn silage, and alfalfa hay, fed during the 196 days. They weighed 955 pounds at the close of the trial.

The calves were housed each winter in a cheaply constructed shed divided into six sections. Each section has an eight-foot door opening to the south into an exercising yard large enough to allow them to move about freely. Water and salt were kept before the calves inside the shed. Grain, hay, and silage were all fed inside. Pigs followed the calves each winter to pick up feed that would otherwise be wasted.

Various rations composed principally of farm-grown grains were used. Among the more important questions to be answered by these trials were: Does it pay to feed silage along with grain and hay to the fattening calf? Can a calf of common beef breeding be successfully and profitably fattened? Does it pay to grind shelled corn and

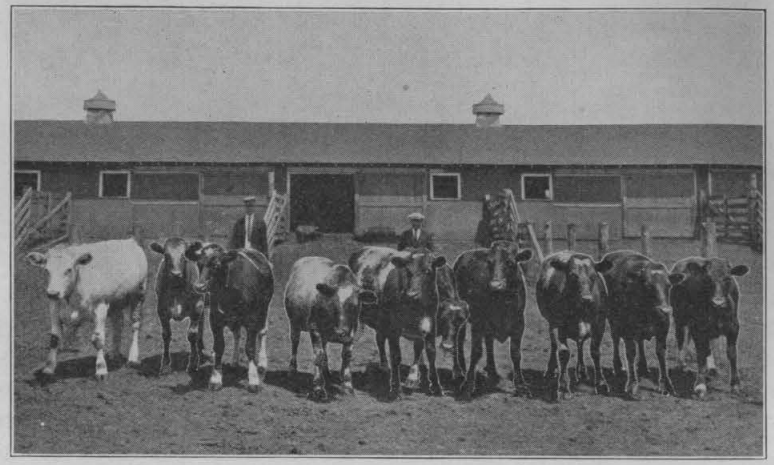
oats for the fattening calf? Can ground ear corn be successfully used in place of shelled corn and oats, or in place of shelled corn alone? Is it essential to feed a high-protein concentrate along with corn, corn silage, and a legume hay? Is a ration of grain and hay without either silage or linseed meal satisfactory? Is it economical to feed a limited grain ration during the early part of the feeding period? Can the self-feeder method be used satisfactorily in feeding grain to fattening calves? How long is it necessary to keep a calf on a full feed of grain to make him ready for market as baby beef?

At the conclusion of one of these trials ten scrubs were sold at $56 per head and ten good beef-bred calves at $86, a difference of $30 per head, or $300 for the lot, in favor of good breeding. It pays to use good bulls.

These experiments have shown:

1. That calves of beef breeding can be profitably fattened for the market as baby beef under Minnesota conditions even tho they are a little common in quality. The average margin on 180 calves fed in the three trials, after deducting feed costs, was $13.84 per head. The total gain over feed cost on the 180 calves was $2491.30.

2. At least 200 days on full feed of grain is required to put a desirable finish on beef calves 6 to 9 months of age and weighing 350 to 500 pounds at the beginning.



Shorthorn Baby Beeves

These calves in the 1922-23 feeding trial gained 2.34 pounds per head daily on a ration of corn and cob meal, linseed meal, corn silage, and clover hay. They were on feed 217 days. They weighed 993 pounds per head at the close of the trial.

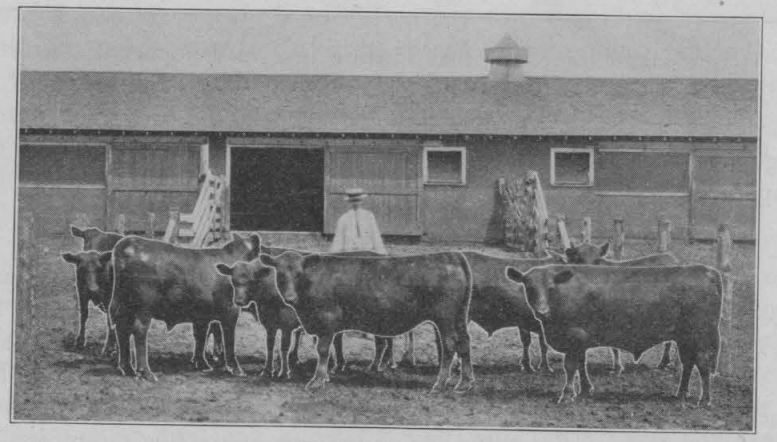
3. A full ration of ground ear corn with 2 pounds of oilmeal per head per day and all the silage and alfalfa hay the calves will eat has proved to be the most satisfactory ration.

4. Shelled corn or a mixture of 3 parts shelled corn, and 1 part oats may be used as the grain ration with good results. If oats is included, the proportion should be decreased toward the close of the feeding period.

5. It pays to feed silage provided a high-protein supplement such as linseed meal is fed with it.

6. When corn is cheap a ration of corn and a legume hay alone may be just as profitable as a ration of corn, hay, and linseed meal.

7. If linseed meal or other protein concentrate is not fed, it is especially important that a legume hay, such as alfalfa, clover, or soybean hay, be fed.



Ready for Market

During a 225-day feeding trial, in 1923-24, these ten Aberdeen-Angus baby beeves made an average gain of 2.26 pounds per head daily on a ration of shelled corn, linseed meal, corn silage, and alfalfa hay. The shelled corn was fed in a self-feeder. They weighed 955 pounds per head at the finish.

8. It does not pay to grind shelled corn and oats for fattening calves.

9. The self-feeder method of feeding corn to calves is satisfactory.

10. Ground barley may be used satisfactorily in place of corn, altho a little more barley may be required per 100 pounds gain, and less pork is made by hogs following barley-fed calves.

11. It is especially important that those who raise as well as fatten calves for market maintain good beef cows and use good purebred beef bulls, because it costs as much to raise and fatten scrub calves as high-grade beef calves, and the good calf is worth much more at weaning time and brings a much higher price when finished and marketed.

BETTER FEEDING MAKES BETTER HOGS

Between 50 and 60 million dollars worth of swine are sold from Minnesota each year. In recent years there has been a more rapid increase in this than in any other class of livestock. Approximately 3 million swine are produced annually. They have reached such a place of importance that producers can not afford to neglect approved methods of breeding and feeding.

Observations conducted on a South St. Paul market indicate that most of the hogs sold there are of acceptable type and breeding but many show the results of poor feeding.

In profitable production correct feeding must not be overlooked, for feed represents about seventy-five per cent of the cost of producing a pig of market weight.

It is evident, therefore, that feeding is a very important factor in making profits from the production of swine. To show the effect of good feeding and to determine which feeds give the best results, feeding trials have been made by the animal husbandry division of the experiment station. The results of some of these are given.

Are Wheat By-products Economical Substitutes for Corn?

Standard middlings, flour middlings, and red dog flour are common by-products of Minnesota flour mills. They are quite generally fed in varying amounts to hogs. Are they economical substitutes for corn as a part of the ration? What are the relative values of these different by-products in the ration for hogs? To answer these questions, which so often require a decision on the part of the hog raiser, feeding trials were conducted. Duplicate lots of pigs were fed. Care was taken to use the same quality of feeds in all cases. Two lots were fed on a basal ration of shelled yellow corn, tankage, and minerals. Two lots were fed on shelled yellow corn, tankage, minerals, and pure standard wheat middlings. Two lots received shelled yellow corn, tankage, minerals, and pure wheat-flour middlings. The other two lots received shelled yellow corn, tankage, minerals, and red dog flour. These rations were all fed on alfalfa pasture, as this was regarded as the most severe test of the value of substituting a mill feed for a part of the corn. The proportion of tankage to other feed was somewhat higher when the pigs were small. As they increased in weight the proportion of tankage was reduced in all cases. Not more than 10 per cent of the ration was tankage when corn and minerals only were fed with it. When mill by-products were substituted for corn, only

5 per cent of tankage was used at first. During the closing period the corn ration contained only 5 per cent of tankage and the rations containing mill by-products contained only 2 per cent of tankage.

It was found that the substitution of a wheat by-product for approximately one third of the corn and one half of the tankage in a corn and tankage ration, slightly increased the daily gains. This substitution materially reduced the amount of corn required to produce 100 pounds of gain, but required a slight increase in total amount of feed consumed per hundred pounds of gain. The use of a wheat by-product in the ration for growing pigs seemed to keep them in slightly better physical condition. At the prices prevailing during the summers of 1923 and 1924 the cost of gains was slightly cheaper when a wheat by-product was fed with corn and tankage on pasture than when it was not.

The results of these trials lead to the conclusion that in feeding growing pigs on pasture it will often pay to use a wheat by-product with corn and tankage to the extent of at least approximately one third of the ration. The relative prices of corn and the wheat by-product, of course, determine the possibility of a profitable substitution. When the wheat by-product does not cost more per pound than the corn is worth, the partial substitution can be made to advantage.

Is Rye a Good Hog Feed?

Normally, rye is of sufficient importance and value for human consumption that it is sold as a cash crop instead of being used as a stock feed. In times of wheat surplus, however, rye frequently becomes very low in price. At such times it is used extensively as a stock feed and principally in the feeding of hogs. Several trials of rye as a principal grain feed and in combination with other feeds have been made during the last two years to determine how it may be fed to best advantage. In all these tests it has been fed in the ground form and with a standard mineral mixture. Various combinations have been made and the rye has been fed both in the dry lot and on pasture. The results indicate that if rye is to be used successfully as a hog feed it must be used only as a part of the ration and that the feeds used with it must be carefully selected.

Three lots of pigs fed on a ration of rye, tankage, and minerals in a dry lot; and one on rye, tankage, and minerals on rape pasture, failed to reach an average weight of 200 pounds. These pigs were started at weights varying from 50 to 100 pounds. They gained at a normal rate for the first four to six weeks but then gradually declined in rate of gain until they came to a complete standstill. Further feeding resulted in loss of weight. Some of the pigs fed on these rations

scoured badly. All lost appetite and several died. At this stage efforts to induce gains by feeding butter, casein, and cod liver oil in order to make sure that all the necessary vitamins and proteins were present, failed to give any improvement. This would lead to the conclusion that rye, even in combination with minerals and pasture, can not safely be fed to growing pigs as the principal grain in a ration. A ration of equal parts by weight of barley and rye in combination with tankage and minerals gave quite satisfactory gains. In dry-lot feeding a daily gain of 0.94 pound was secured, the same ration on rape pasture giving a daily gain of 0.91 pound. The ration of equal parts corn and rye with tankage and minerals did not give satisfactory results in the dry-lot feeding but gave a gain of 1.19 pounds per day on rape pasture. A ration composed of rye, buttermilk, tankage, and minerals in dry-lot feeding gave a daily gain of 0.99 pound. Rations composed of rye, oats, tankage, and minerals; and rye, alfalfa, tankage, and minerals, were unsatisfactory.

In general, it may be said of these experiments that they indicate that rye is not a satisfactory pig feed. When it is very low in price and other feeds relatively high, it may be used only as a small part of the ration with possible economic gains.

Commercial Buttermilk Products for Growing Pigs

Many experiments have shown that tankage, skimmilk, and fresh creamery buttermilk, when used as supplements to the grain ration for growing pigs, increase the rate of gain, decrease the amount of grain required per hundred pounds gain, and usually decrease the cost per hundred pounds gain. Two commercial buttermilk products, semi-solid and dried buttermilk, have recently come on the market. These are sold in considerable quantities for use as supplements to the grain ration in swine feeding.

These products, if they can be economically used, have two points of value. (1) They will provide a milk product on farms where skimmilk or fresh buttermilk is not available; and (2) they provide a milk product in a form in which it can be kept for a considerable period of time. These two products have been compared with tankage and fresh creamery buttermilk in feeding pigs weighing 75 pounds at the beginning of the experiment. The pigs were carried until they averaged 175 pounds in weight.

In these trials, in which 80 pigs in all were fed, both the semi-solid and the dried buttermilk proved equal to fresh creamery buttermilk in promoting daily gains. They were slightly superior to tankage. The cost of gains, however, was higher with the commercial forms than with the tankage or fresh buttermilk at the relative prices prevailing. Creamery buttermilk at 35 cents per hundred pounds and tankage at $60 per ton proved much more economical supplements than semi-solid buttermilk at 3½ cents per pound and dried buttermilk at 7½ cents per pound. In these experiments the feed cost of 100 pounds of gain was the lowest, $5.53, when tankage was the supplement used. The cost was $5.73 when fresh creamery buttermilk was used. When dried buttermilk was the protein supplement, the feed cost was $6.98 per hundred pounds of gain, and when semi-solid buttermilk was used it was $8.07 per hundred. While the cost of gains was much higher with the commercial forms of buttermilk, it is possible that where fresh buttermilk or skimmilk can not be supplied it may be economical to use these products for a few weeks in feeding small pigs just at weaning time, or in feeding pigs that are to be exhibited. Their extensive use can not be recommended, however, until they can be put on the market at lower relative prices than at present.

LITTLE PIGS NEED HIGH PROTEIN FEEDS

Much protein is required to build animal bodies of any kind. Young animals need more protein than mature animals. Because of the rapid increase in size and weight small pigs need relatively larger proportions of protein-rich feed than do more mature hogs or those being fattened for market.

If little pigs are to become big hogs they must have a good start.

For the first few weeks after they are farrowed, nursing pigs receive a liberal supply of protein from the milk of the sow. However, they soon learn to eat grain. It then becomes necessary to supplement the grain ration with a liberal allowance of protein-rich feeds. The protein allowance for young pigs should not only be sufficient in quantity but it must be of the right quality as well. If the little pig is well started on feed before weaning, his later development is more certain to be rapid and profitable. In feeding suckling pigs and pigs that have just been weaned, it is important to know just which protein

supplements or which combination of protein feeds will give the correct amounts and kinds of protein to produce satisfactory gains at the lowest cost.

Protein Supplements for Suckling Pigs

In studying the effect of the addition of protein to the ration of pigs before weaning, and to compare the relative value of skimmilk and tankage as protein supplements, 56 fall-farrowed pigs were fed in 1923. These pigs were 30 days of age and were still suckling when put on feed. Part of the pigs were fed on shelled corn, red dog flour, and skimmilk. These pigs gained 0.75 pound daily. To another lot, shelled corn, red dog flour, and tankage were fed. The pigs in this lot gained 0.55 pound daily. The third lot was fed shelled corn and red dog flour with no protein supplements of any kind. These pigs gained only 0.45 pound daily. The gains made by the respective lots show that it is advisable to feed a protein supplement with grain even while the pigs are suckling, and that skimmilk supplies a very satisfactory quality of protein.

The use of the protein supplement in the first month after weaning is much more important than while the pigs are suckling the sow.

The pigs were continued on the same rations for a month after weaning. The effect of the supplements was even more marked during this period. The lots receiving skimmilk and tankage continued to make good gains. Those receiving only corn and red dog flour failed to gain and became runty and unthrifty. Had the ration not been changed many of them would have died.

Protein Supplements for Weaned Pigs

Weaning time is always a trying time for pigs. This is because they are deprived of a most important source of protein—the mother's milk. **Unless protein supplements are supplied at weaning time the pigs are likely to grow slowly and to become runty and unprofitable.** To test the relative values of different supplements for pigs after weaning, 30 pigs, in three lots of 10 each, were fed from June 27 to August 15. They averaged approximately 40 pounds when put on feed. They were fed until they had doubled their weight. Two lots were fed in the dry lot. One lot had access to rape pasture. The dry feeds were fed in self-feeders. The skimmilk was fed twice daily in troughs.

Shelled corn, flour middlings, and skimmilk were fed to one lot. These pigs gained 0.93 pound per pig daily. Another lot was fed shelled corn, flour middlings, and tankage. These pigs gained 0.71 pound daily. The third lot was fed shelled corn, flour middlings, and tankage, and also had the run of a rape pasture. The pigs in this lot gained 0.89 pound daily. The value of pasture when tankage is fed as a protein supplement to pigs after weaning, is clearly shown. When neither skimmilk nor pasture can be provided, green clover, green alfalfa leaves, or ground alfalfa would most nearly replace them in the diet of young pigs. One or the other of these can be supplied on most farms.

RAISING FALL PIGS

A factor that has a pronounced effect on the cost of producing pork is the number of pigs farrowed by a sow in the course of the year.

It has been customary on most farms to attempt to raise only one litter. If the litter should be small, the cost of maintaining the brood sow throughout the year must be assessed against only a few pigs and the initial cost per pig is consequently high. If the litter should be large the initial cost is correspondingly lower. There is a possibility of still further reducing the initial cost per pig by producing two litters per year. An additional advantage would lie in distributing the sale of finished pigs more completely throughout the year, thus gaining the advantage of better prices for at least a part of the hogs produced. An argument against two litters per year is the difficulty of successfully feeding small pigs during the winter season. The feeding and care of fall pigs is a sufficiently important problem to merit close attention. With a view to giving some additional information on this subject, the animal husbandry division has been comparing the rate of gain, cost of gain, problems of care, and resultant profit, in raising fall-farrowed and spring-farrowed pigs. In all, 180 pigs have been fed from weaning time to a weight of approximately 200 pounds. Sixty of these were fall-farrowed and fed through the winter months. Sixty were spring farrowed and fed through the summer months in dry lots, and sixty were spring farrowed and fed through the summer on alfalfa pasture. They were fed in lots of 10 pigs each. Three different grain rations were used.

A greater variety of feeds must be fed to grow fall pigs satisfactorily, because green crops are not available. The fall-farrowed and winter-fed pigs make as rapid gains under good care and management

as the spring pigs. The amount of feed required to make 100 pounds of gain was practically the same. Cheaper gains may be made by fall pigs than by spring pigs when feed costs are lower in winter than in summer. This is often the case. As a rule the market will be better for the fall-farrowed pigs when ready to sell than for the spring-farrowed pigs. This will probably hold true until enough fall pigs are raised to fill the market demand at that season of the year.

It has been found that fall pigs are more difficult to raise than spring pigs, but that when properly handled and fed they were at least equally profitable.

DAIRY HUSBANDRY

SOYBEANS AS A HOME-GROWN PROTEIN FEED

Next to not feeding liberally enough, the most common mistake made in feeding dairy cows in Minnesota is failure to provide sufficient protein. The chief reason for this condition is that the usual farm-grown grains and forage are somewhat deficient in protein. Farmers can buy protein in the form of linseed meal or cottonseed meal or gluten meal, but these feeds are expensive and the tendency is to use such a limited amount that the ration is deficient and the milk production of the cow reduced. Alfalfa hay provides a home-grown ration with sufficient protein when oats, barley, and corn are fed, for cows producing up to about a pound and a quarter of fat daily. However, in the best herds the production of many cows is above this figure for a portion of their milking period and additional protein is needed. The common practice is to purchase linseed or cottonseed meal to supply the need.

Experimental work has been under way for two years to test soybeans as a source of protein. Ground soybeans have been compared with linseed meal as a source of protein in rations for cows producing liberal amounts of milk. The soybeans were ground and fed as part of the grain ration. This feed is quite palatable, has no bad effect on the animals, and replaces linseed meal pound for pound as a source of protein in the ration. The Southeast substation, at Waseca, has had satisfactory results from feeding soybeans in the bundle for the same purpose.

Results indicate that ground soybeans are practically equal to linseed meal pound for pound when used as a means of increasing the protein in a ration for dairy cows.

By the use of this crop it is possible to grow on the farm everything needed for a herd of high producing cows.

"SANDY" ICE CREAM

The ice cream business has become of great importance in recent years. In Minnesota the milk from about 15,000 dairy cows is used for ice cream making. Ice cream manufacturers have their troubles, and among them that of "sandy" ice cream has been one of the worst

in recent years. The cause of this trouble has been found by previous investigators to be the formation of crystals of milk sugar.

Experiments have been carried on by the Minnesota Experiment Station to determine the conditions under which sandiness appears. Tests were made in which a portion of the sugar was replaced by glucose, and in others large amounts of cane sugar were added. The effect of varying quantities of gelatin and rennet was also determined. None of these measures prevented the formation of the lactose crystals causing sandiness. Experiments were also made with varying concentrations of milk sugar and by holding the frozen cream at various temperatures. These experiments show that the two factors mainly responsible for the development of sandiness are the milk sugar concentration and the temperature at which the frozen product is stored.

A mixture containing 10.8 per cent serum solids, 14 per cent fat, and 15 per cent sugar, is in danger of becoming sandy in time. The maximum amount of milk sugar which may be present without the possibility of sandiness developing under favorable temperature is about 8.5 per cent, based on the ratio of the mixture.

A temperature of from 5 to 20 degrees F. is especially favorable to the development of sandiness and should be avoided.

WHY THE COMPOSITION OF BUTTER SHOULD BE STANDARDIZED

The standard composition of butter is 80 per cent fat and not over 16 per cent water. The market grade of butter is not raised by increasing the fat. Many butter factories, especially those operating on a large scale, control the composition of their product very carefully. If the smaller factories of the state, which include most of the co-operative creameries, are to meet successfully the competition of these large factories they must give this matter equal attention.

From the standpoint of marketing, uniformity is very important.

A study has been made of the composition of butter as manufactured by Minnesota creameries. It has for several years been the practice of the Dairy and Food Commission to hold scoring competitions to which Minnesota buttermakers are invited to send a tub of butter for scoring and criticism. Through co-operation with the commission samples for analysis were taken from each tub entered in the various

competitions held in the state from May, 1922, to March, 1923, a total of 2050 samples. In addition, 363 samples were taken at creameries by field men representing the Minnesota Co-operative Creameries Association; and 47 were secured from Minnesota butter as it appeared on the New York market.

Study of the analyses of these 2460 samples shows that there was a very considerable loss in Minnesota, owing to the failure to standardize the product. During the year that the study was made, 170 million pounds of butter was manufactured in the creameries of the state. Had the butter been standardized to 81.5 per cent of fat, which leaves a safe margin of 1.5 per cent above the standard, 7,110,000 pounds more butter could have been manufactured. At 36 cents a pound, the additional income would have been $2,500,000. A study of the figures for individual creameries shows that it is not uncommon for an inefficient operator to lose an amount equal to his entire salary, and sometimes much more, through failure properly to standardize his product.

The services of a competent operator are much better appreciated when his employer knows to what extent his skill and close attention to work are factors in the successful conduct of the business. Special efforts were made to bring the results of this study to the attention of the creamery operators of the state. The facts concerning the wide variation in the composition of butter as manufactured in Minnesota creameries were given wide publicity, together with information pointing out the importance of maintaining uniformity and how it may be accomplished. Addresses and demonstrations were made at twenty-six district meetings of creamery operators and at two state meetings in co-operation with the Minnesota Creamery Operators Association, by means of which the subject was brought to the attention of nearly every creamery operator in the state. A later survey of the composition of Minnesota butter as it was then coming on the market showed a very gratifying improvement.

IS THERE DANGER TO LIVESTOCK FROM MOLDY SILAGE?

The general use of silage in recent years has led to numerous inquiries concerning all phases of its preparation and use. One of the most common of these questions is the possible danger from feeding moldy silage to livestock, concerning which little positive evidence has been available. It is not unusual, however, for the owners of livestock and veterinarians who are called in a professional capacity, to attribute sickness of livestock of an obscure nature to poisoning from silage. As a rule the possible danger of mold in silage is emphasized in this

connection. Altho there appears to be conclusive evidence that in some cases silage has been the cause of sickness among livestock, in no case reported by those who have investigated these cases is there definite evidence that mold in the silage was the cause. The Illinois Experiment Station investigated silage which caused the death of horses after a few days feeding. Graham, who conducted the investigation, concluded that the trouble was botulism, which has no relation to mold.

As no definite evidence was available regarding the danger from moldy silage, the Divisions of Dairy Husbandry, Veterinary Medicine, and Plant Pathology conducted an experiment extending over two winters. In order to know what kinds of mold are found in silage, samples were obtained from 19 silos in different parts of the state and the species of mold present were determined. The molds included a variety of common and well known species. None of those found is known to produce poisonous products. Three cattle were fed moldy silage for 128 days. After the first few days no difficulty was experienced in getting the animals to eat the ration, in fact the moldy silage was eaten as readily as silage free from mold. The moldy silage fed was from the University silos and others, including some whose contents were suspected of causing sickness among cattle. No indication of sickness occurred at any time.

As a practical procedure the discarding of moldy silage is recommended, but the feeder need not hesitate to utilize silage which contains some mold, especially for cattle.

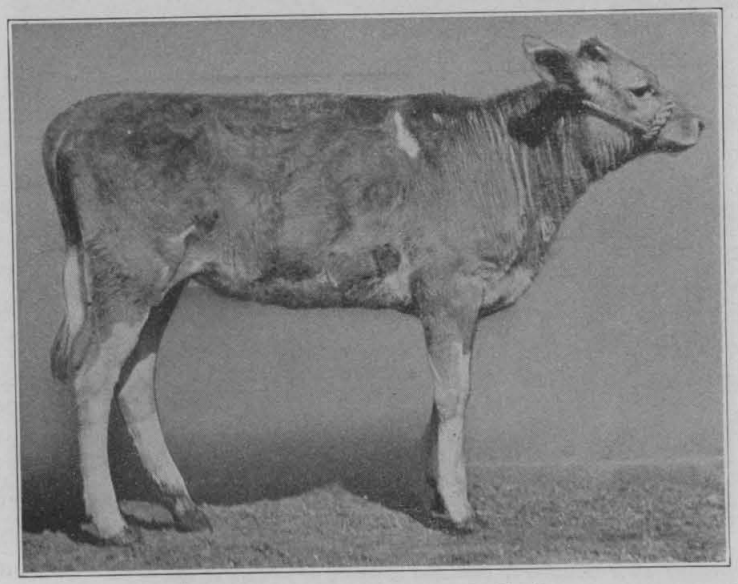
At another time four cows were for two weeks fed silage suspected of causing the death of five cattle. One cow consumed 427 pounds of this silage. No ill effects were noted with any of the four animals to which it was fed. Feeding experiments were also made with a horse and some sheep. More difficulty was experienced in getting these animals to eat the moldy silage. However, after becoming accustomed to it the horse ate 10 pounds, and the sheep 2.5 each, daily, with no bad results. Later the effects of molds were further tested by growing the species found in the silage in the form of pure cultures. Large quantities of these cultures were given the animals in the form of a drench. No effect could be noted. Two of the cattle were slaughtered and autopsied about a month after feeding the pure cultures of mold. No evidence of the mold could be noted.

Altho the experience of some livestock men has led them to believe that moldy silage may be dangerous, these experiments did not indicate danger from this source. Furthermore practical experience teaches that

mold in silage is not generally harmful. Many silo owners can recall incidents when livestock have eaten freely of silage discarded on account of mold without any detrimental effect. It is not maintained as a result of this experiment that silage may not be a source of danger to livestock, as there is conclusive evidence that in rare cases it may be the cause of serious sickness, especially in horses. However, such sickness is not necessarily due to moldy silage. It may occur when silage appears to be entirely normal. The investigations of Graham indicate that these cases are due to botulism rather than to mold.

RAISING CALVES WHEN WHOLE MILK IS SOLD

It is a well established fact that the safest and best way to get good dairy cows is to raise them. The farmer who has plenty of skimmilk has little difficulty in raising calves. However, taking the United States as a whole, 54 out of every 100 dairy calves are from cows from which the milk is sold as whole milk. In Minnesota the proportion of cows from which whole milk is sold is much less, but even at that the problem of how to raise calves when no skimmilk is at hand is important



Grade Guernsey Heifer, Age Six Months

Received whole milk and skimmilk until weaned at 60 days of age. Weight at six months 240 pounds. Her daily gain in weight to six months of age was only a little less than the gains made by calves of this breed fed skimmilk to six months of age. Feed received up to six months: Whole milk 449 pounds, skimmilk 88 pounds, grain 412 pounds, alfalfa hay 295 pounds.

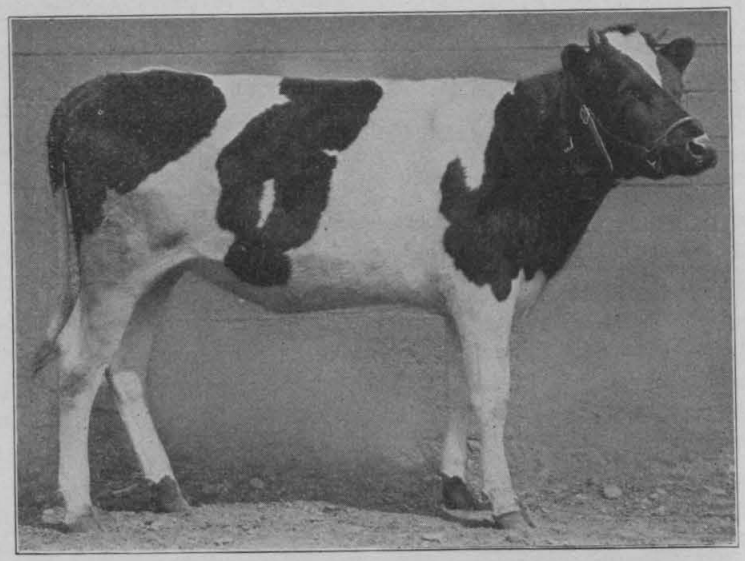
to many farmers of this state. The use of whole milk for calf feeding means that the value of the feed consumed is greater than the market value of the calf when raised.

Various substitutes for milk have been tried but nothing has been found to take its place.

There is no substitute for milk. A calf must receive some milk to make it grow. A large amount is not needed if the proper hay and grain ration is provided. A healthy thrifty calf may be weaned when about 70 days old.

The Minnesota Experiment Station has been working on this problem for five years and has developed a practical plan to meet the situation. It is conceded that there is no complete substitute for milk, and that the real problem is not to dispense with milk entirely but to use the least possible amount and still get the results wanted. To be considered satisfactory any plan of feeding must conform to the following:

1. The ration used must include only common well known feeds easily obtained.



Grade Holstein Heifer, Age Eleven Months
Raised on powdered skimmilk to 70 days of age.
Weight at six months 300 pounds. Daily gain in weight to six months 1.14 pounds. This is slightly less than the average daily gain made by Holstein calves raised on skimmilk to six months of age. Feed received up to six months: Whole milk 134 pounds, powdered skimmilk 70 pounds, grain 389 pounds, alfalfa hay 417 pounds.

2. The ration must be one that can be prepared with little work and fed dry.

3. The plan of feeding must make possible the raising of a calf of which the owner will not be ashamed.

The first experiments were to wean calves from milk at different ages, taking care to use the best combination of grain and roughage. It was found that when a suitable grain mixture and a legume hay, such as alfalfa, is used the calf can get along perfectly well without milk at a much younger age than is usually believed. Entirely satisfactory calves were raised when weaned from milk at 60 days of age. The milk fed before this age may be whole milk for the first two weeks and then skimmilk for the rest of the period. By this plan the amount of milk required for raising the calf may be as low as 450 pounds. The average feed received by a group of calves to six months of age was 603 pounds of milk, 541 pounds of grain, and 271 pounds of alfalfa.

Powdered skimmilk and dried buttermilk are now on the market in large quantities and these products were tried as substitutes for fresh skimmilk. The results were as good as from feeding fresh skimmilk, altho the price of these dried products is such that it would not be economy to use them when fresh skimmilk is available.

Recommendations

With few exceptions the dairy herd should be maintained by raising heifers from the best cows. Even when whole milk is sold the cost of raising the calf need not be excessive. Good calves can be raised with as little as 400 pounds of milk. Calves should be given a good start on whole milk. If no skimmilk is available the feeding of whole milk may be continued for 60 to 70 days. At this age, if the calves have been given a chance to learn to eat grain and hay, the milk may be discontinued, taking about ten days to make the change. The hay recommended is good quality alfalfa. The grain mixture may well be four parts corn, one part wheat bran, and one part oil-meal. Probably other mixtures will be satisfactory, but the one given is recommended.

The cost of raising the calf when no skimmilk is at hand may be still further reduced by using dried skimmilk or dried buttermilk in place of whole milk after the calf is two or three weeks old. No trouble was experienced from sickness when the milk was taken from the ration at this time. Full details regarding the plan of feeding recommended are found in Special Bulletin 91, which may be had upon request from the Division of Publications, University Farm.

SOILING CROPS TO SUPPLEMENT PASTURES

Few old bluegrass or timothy pastures supply enough feed to maintain a good milk flow through the hot dry months of late summer. Short pastures are especially likely to be found on much of the stump land of the northern part of the state. Because of failure of pastures in dry seasons or because the pasture is overstocked, it is often wise to provide some other feed. Corn silage is a very satisfactory supplement when a supply is left over from the winter feeding. When silage can not be provided, however, green soiling crops can be fed to very good advantage.

Good summer pastures are a large factor in the cheap production of dairy products.

At the Northeast Experiment Station, Duluth, summer soiling crops have been fed during the short pasture season for several years. Among the crops used for the purpose is the Russian sunflower. The plants are hardy, vigorous growing, and not easily injured by frost. When sown in drills and cultivated as corn they give a very good yield and can be successfully used either for soiling or as silage. In feeding the crop as green soilage it has been the practice to run it through a small feed cutter and feed it in mangers in the barn. This requires considerable labor but the results obtained were very satisfactory. When used in this way at the flowering stage, the cows have eaten all the sunflowers offered and have maintained a very good flow of milk.

Sweet Clover Soilage

Another crop that has been successfully used as a soiling or green feed crop at the Northeast station, is the second crop of sweet clover. Both yellow and white sweet clover have been used. Because of the finer growth and quality the cows refuse less of the yellow clover than of the white, though the white yielded more heavily. Either may be fed satisfactorily. In feeding the second crop of sweet clover as soilage in the barn, this crop also was run through the feed cutter and fed in mangers. As with sunflowers, it resulted in material gains in the milk flow.

Other Soilage Crops

Field peas in a mixture with oats have also been grown as a soilage crop and are much relished. Millet has been used but is not so satisfactory except when cut very early, in which case the yield is light. The first named crops are much more satisfactory as soiling crops.

VETERINARY DIVISION

BOVINE INFECTIOUS ABORTION—A SERIOUS MENACE TO THE CATTLE INDUSTRY

An increase in livestock production has for many years been urged upon farmers as a means of diversifying and stabilizing the farm business. The number of animals per farm in Minnesota is steadily tho slowly increasing. With the increase in livestock has come also an increase in diseases of various kinds which attack animals and which in many cases result in large losses.

One of the most serious diseases attacking cattle is bovine infectious abortion. This disease is highly infectious and difficult to control. It causes annually large losses from failure of infected cows to drop full-term, living, and healthy calves. Furthermore, aborting cows seldom come into full flow of milk and frequently go dry altogether, resulting in a short and unprofitable lactation. Sterility (failure of the reproductive function) frequently tho not always accompanies or follows an attack of the disease. This is one of the most dangerous factors, from the economic standpoint, affecting the cattle raising industry. With the steady development of purebred livestock, losses from this source are rapidly increasing. The successful breeding of cattle or other livestock is based largely upon regular and normal production of healthy offspring.

The value of the purebred cow is determined mainly by her ability to produce calves equal to or greater than herself in value.

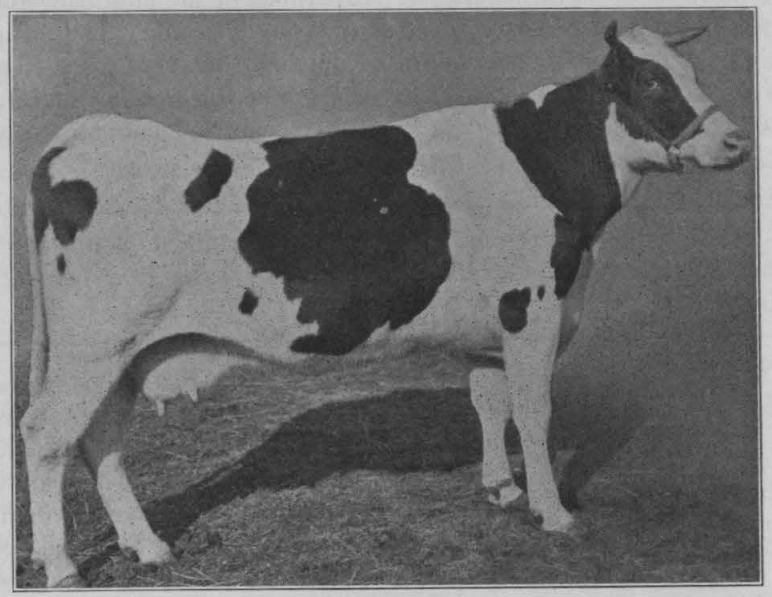
When the organs of reproduction fail to function properly, her breeding power can no longer be depended upon as a source of revenue and she must be sold at beef prices. Sterility may and does occur in the male, tho less frequently than in the female. The decrease in the breeding efficiency of a herd is sometimes due to sterility in the male, and the possibility of such being the case should not be overlooked.

It is impossible to state exactly, in terms of money value, the losses resulting from bovine contagious abortion and the sterility that frequently follows. Estimates have placed these losses at a million dollars or more annually in Minnesota alone. Whether or not this is a close estimate is of little consequence. The seriousness of the disease warrants vigorous methods in bringing it under control.

In studying methods of eradicating or controlling diseases, the Minnesota Experiment Station has provided a well equipped barn and

an experimental herd of 29 cattle where the breeding, feeding, and management of the herd can be accurately recorded and observed. Careful records are kept of each individual. In addition extensive tests are made to determine the value and effect of different vaccines, bacterins, and serums in the prevention and control of the disease.

From the investigations of the last five years, involving the use of the experimental herd for a part of the time, some progress has been made in discovering the methods of infection and in lessening the losses from the disease. It has been found that the living vaccine (which contains the living germs) produces some immunity in bovine infectious abortion (*B. abortus* Bang). The amount of immunity which can be produced varies according to the animal. This variation is large, some animals becoming highly immune and others scarcely at all. The bacterins (containing dead germs) have very little immunizing value. It has been feared that the living vaccines might increase the disease or at least transform some of the animals treated into "spreaders." This has not been the case among the animals used

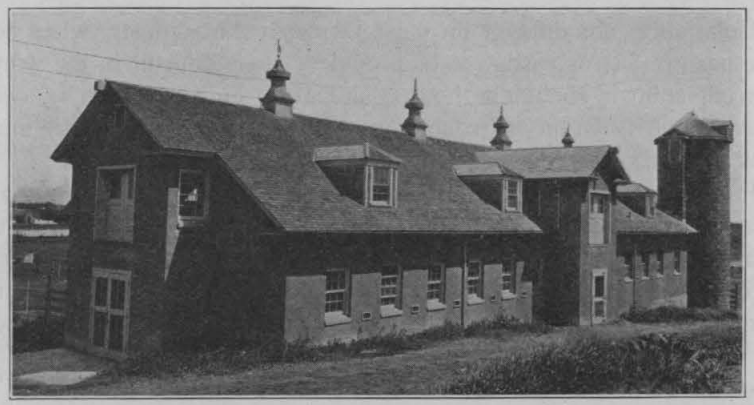


A Sterile Cow

A change in conformation, or shape, resulted from diseased ovaries. Notice shape of rump, particularly the tailhead, also condition of udder.

in the experimental herd. This was shown from the fact that the number of animals which discharged the germs of the disease in their milk and at the time of calving, was not increased by the injection

of this product. The treatment of cows with living vaccines did not always give immunity from abortion. The observations at hand indicate that the number of cases of white scours in calves does not seem to be affected by the use of abortion vaccines or bacterins. Careful studies of the milk of cows, the blood from which gave positive reactions for the presence of abortion, show that nearly 30 per cent of such animals discharged the germs of abortion in their milk. This fact is of possible significance in the spread of abortion to sexually mature animals. The germs in the milk seem to have no effect upon young calves.



Barn Where Experimental Cattle Used in the Work of Abortion and Sterility Were Kept

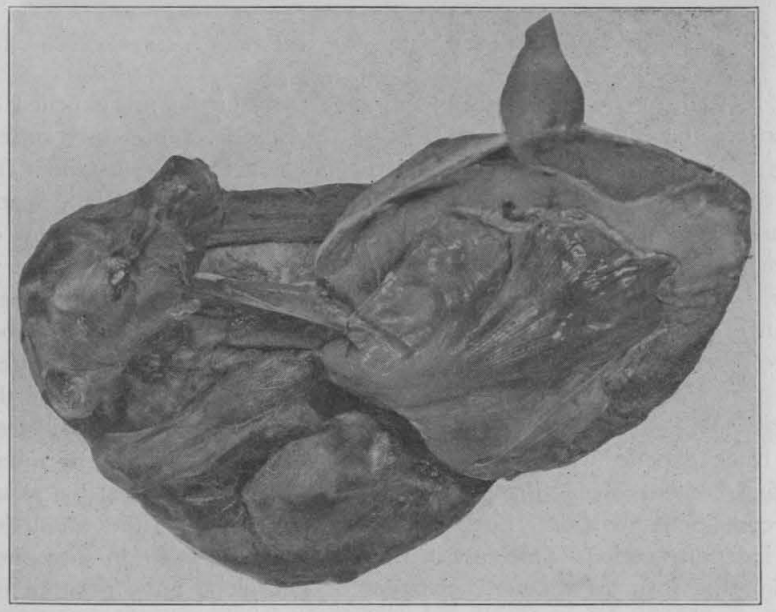
In healthy cows the fetal membranes (afterbirth) are expelled or discharged within two to four hours after calving, while cows suffering from infection or disease of the womb will in most instances fail to clean or expel the fetal membranes. Retention of the fetal membranes, or failure of the cow to clean, is a prominent symptom of abortion disease and is frequently followed by sterility or failure to breed. This condition may be temporary, but occasionally it is permanent. A large number of cows which retain the fetal membranes give positive reactions to the blood tests used in determining the presence or absence of contagious abortion. In the management of the herd some cows were found in which the fetus had perished and instead of being expelled from the womb, it became dry and hard, or mummified. It is probable that this condition is, in certain cases, the result of contagious abortion. Such mummies may remain in the womb for an indefinite period. One cow in the herd suffered twice in succession from this form of disease. Samples of her blood gave positive reactions. In another cow a mummified fetus was found which had been in the womb for 29 months.

The successful control or eradication of contagious abortion will greatly improve the production and profits from many farm herds. Experience gained in handling the experimental herds leads to the belief that when the disease appears the aborting cow should at once be removed from the herd and isolated for from 60 to 90 days.

When a cow aborts in the barn all litter in the stall should be removed and destroyed. It should not be thrown into the yard where other cattle may tramp over it or eat it.

Isolation is not difficult on most farms in the summer, when separate pasture lots or yards can be provided. It is difficult in the winter when all animals should be housed and often only one barn is available. While isolation is troublesome and causes extra work, much better control of the disease is possible where it can be practiced.

It is now believed that infection occurs through the mouth and digestive tract rather than through the reproductive organs, hence the importance of preventing other cattle from consuming litter or feed soiled with the discharges from a diseased animal. A frequent source of infection is the licking with the tongue of the flanks and rear por-



Mummified Calf that Remained in the Womb 29 Months
The cow was destroyed, as she was found to be incurably sterile.

tions of aborting cows by other cattle. This must be prevented if possible. It is one of the chief reasons for isolating the aborting cow. After the litter is removed, the stall should be thoroly cleaned and disinfected. Care should be used to keep the surroundings clean and disinfected. For this purpose any coal tar disinfectant may be employed. Coal tar disinfectants—creolin, lysol, and carbolic acid—should not be used in douching or irrigating the reproductive organs of cattle. The vagina of the cow may be washed out with salt solution (a teaspoonful of salt to a quart of warm water).

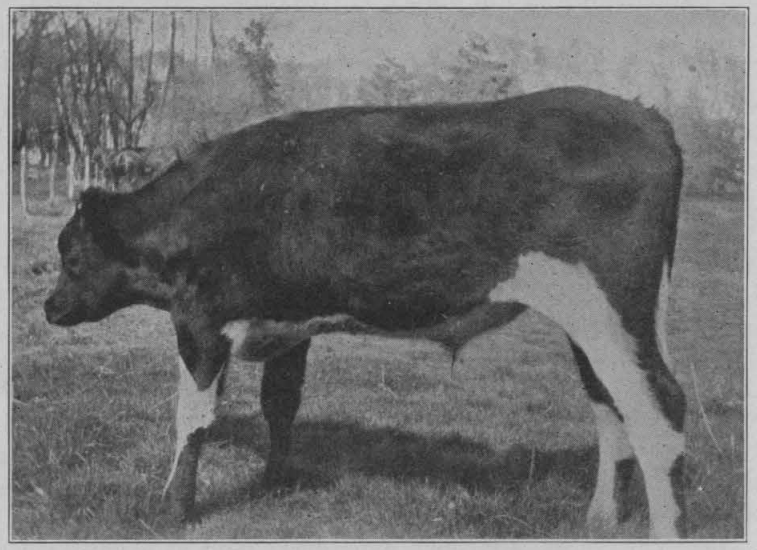
IS SWEET CLOVER HAY DANGERORUS FORAGE?

In recent years sweet clover *(Mellilotus alba M. officinalis)* has come into extensive use for pasture and hay. The hardiness and adaptability of the plants and the vigor of growth when once established make the crop especially valuable. Farmers using sweet clover for pasture are able to carry much more stock per acre than those using timothy or bluegrass. Its use as a pasture crop has given very good results. A few reports have been received of trouble from bloat, but there have been few serious losses from this cause. Caution should be observed in turning cattle on rank sweet clover when it is wet. In general, however, it is as safe for pasture as most other rank growing crops.

Sweet clover has been quite extensively used as a hay crop also. The results from feeding hay have been good, on the whole. Occasionally, however, a fatal disease has appeared in herds fed sweet clover hay. Information as to the source or specific cause of the disease is very limited. Investigations have been made and post-mortem examinations held where outbreaks have been reported. It appears that only occasional lots of sweet clover hay cause the disease.

With a view to gaining additional knowledge of the effects of feeding sweet clover hay to cattle, the veterinary division has fed a few lots under close observation and control. Two yearling heifers were fed on an exclusive diet of sweet clover hay. Both died in a little over a month. The most pronounced symptom noted was that the blood would not clot. Bleeding occurs, and may be internal with no outward manifestation. The animals usually die of hemorrhage. A fatal hemorrhage may occur following castration or dehorning of animals fed on sweet clover. In another experiment yearling heifers were fed on the same lot of sweet clover hay which caused the deaths above noted. They were fed for four months without bad results. In this instance, however, the hay was supplemented by silage, alfalfa hay,

and a grain mixture. The supplemental feeds were taken away and the animals died within three weeks. It is believed that losses from feeding sweet clover hay may be avoided by feeding the hay in limited quantities and with other feeds. The conclusion that only occasional lots of sweet clover hay will cause the disease seems to be justified. Some investigators believe that the trouble may be due to certain molds. No definite evidence is available, however, which justifies such



Steer Affected with Disease Caused by Eating Sweet Clover

Note the large swelling over the entire left shoulder. This swelling was completely filled with blood. The animal died.

a conclusion. Experiments will be continued to determine if possible just where the trouble arises. In the meantime it is believed wise to feed sweet clover hay to cattle only in combination with other feeds such as silage, other kinds of hay, or straw. The disease has not been observed to affect animals pastured on sweet clover, tho it has been reported following the feeding of sweet clover silage.

HOW TUBERCULOSIS AFFECTS THE POULTRY INDUSTRY

The poultry industry of Minnesota has grown by leaps and bounds in recent years. Not only are farm flocks larger now than formerly, but on many small farms poultry raising is one of the main enterprises and a good part of the family income comes from the sale of poultry and poultry products. The importance of this industry in the United States is indicated somewhat by the value of poultry products sold in 1923, estimated by the United States Department of Agriculture as $1,047,000,000.

It seems to be one of the laws of nature that wherever there is an increase in density of population, there is also an increase of disease. This is true in the case of domestic animals as well as of the human race. The poultry population is no exception to the general law, and poultry diseases are becoming constantly more troublesome as the flocks increase in number and size. New houses and clean yards may soon be infested with disease when well filled with a closely confined flock, unless constant watchfulness and care are used.

The discovery has been made in recent years that tuberculosis is very common among poultry. Just how generally prevalent it is can not be accurately estimated. Judging from the number of specimens sent in and from the data so far assembled, it is evident that the disease affects more than 25 per cent of the flocks of the state.

Tuberculosis of poultry is an economically important disease not only to those who keep hens, but to every one who maintains livestock. It has been definitely shown by experiment that tuberculosis of poultry can be, and often is, transmitted to swine, and it has been found among cattle. Avian (poultry) tuberculosis is transmitted through the droppings from the infected birds. The excreta from tuberculous birds are usually teeming with germs.

As poultry quite generally has the run of the barns and yards and is frequently fed with the pigs and other animals, the droppings are found everywhere about the yards and are a constant source of infection to other livestock.

The question is often asked, Is there a possibility of transmitting the disease through the eggs of tuberculous hens? On this question there was but little dependable information. Statements are found to the effect that "Eggs of diseased birds frequently contain the microbes and the young chicks hatched from such infected eggs are diseased when they leave the shell and soon infect the poultry with which they run." For such statements there is very little support from actual experimental work.

In order to obtain information on this point, some investigations were undertaken. Hens which reacted to the tuberculin test were obtained from several flocks in different parts of the state. They were kept in a tightly enclosed pen and a small yard entirely surrounded with netting. They were leg-banded for identification, and the eggs were collected in trap nests. Of 62 hens, only 43 produced eggs. This seems to indicate that about thirty per cent of these tuberculous hens actually would not produce eggs. Of a total of 876 eggs examined, 367 by cultures, and 509 by inoculation into other birds or animals, the tuberculosis germ was found in the eggs of only two different hens and in only occasional eggs from these hens. The conclusions reached are that less than one per cent of eggs from tuberculous fowls actually contain living tubercle bacteria. It has been shown, however, that chicks may be hatched from artificially infected eggs and it is possible that a naturally infected egg might hatch and the chick itself be actually tuberculous. The possibility of this occurring under ordinary conditions, and that it would result in the active spread of the disease, is quite remote. Some investigations were made also of the possibility of dissemination of avian tuberculosis through eggs the shells of which had become soiled with manure containing the tubercle germ. The shells of 209 eggs coming from hens known to be tuberculous were examined. No germs were found, which indicates that this method of spreading the disease is not of great importance.

So far only two practical ways of controlling tuberculosis in poultry have been suggested. The first is to test the flock with tuberculin and kill or remove those which react. Following this, the house and premises must be thoroly cleaned and disinfected, or the disease is likely to recur. If the flock can be removed to a clean house or to new pastures and given new runs, the danger from reinfection will be greatly lessened. Careful selection based on the tuberculin test will enable those who wish to do so to save at least a part of the flock. With common birds, and frequently with well bred birds, it is often best to sell off or destroy the whole flock and start with new stock known to be free from the disease. Before starting again, however, with healthy birds, one should be very sure that the surroundings into which these healthy birds are placed are well cleaned and disinfected. The ground should be plowed up and allowed to remain open during the summer months.

It is folly to place healthy birds on infected premises.

WHAT THE TUBERCULIN TEST TELLS

The control of tuberculosis in cattle has been under way in Minnesota for nearly a quarter of a century. By following constantly a program of education and demonstration, the state livestock sanitary board and the bureau of animal industry of the federal Department of Agriculture in close co-operation with the veterinary division of the Agricultural Experiment Station have made steady progress in bringing farmers and stock raisers to the view that tuberculosis is a serious menace to the cattle industry. Public sentiment throughout the state is now almost solidly behind the work. In four counties one complete test has been made under the area plan. A fifth county is just completing the test. Of these five, two have made the second test with gratifying results. In the work at the experiment station, about 600 tuberculin tests have been made in the various University herds. The ophthalmic, intradermal, and subcutaneous tests have been used singly and in different combinations. In studying the results of the various combinations, three things seem to stand out with special significance.

First, that slight and atypical, or what may be called warning reactions, are more common than supposed and must be taken more seriously. Card records have been kept showing complete tuberculin histories for tuberculous, suspicious, and doubtful animals. They show complete test records usually for a term of years. Studies of these cards indicate many subsequent reactions among animals which earlier gave slight warnings. This appears to be true of all three tests. In the meantime, such animals are left in the herd when it is thought that there is not sufficient justification for condemnation. This means that condemnations must be made with judgment, of course, but on narrower margins.

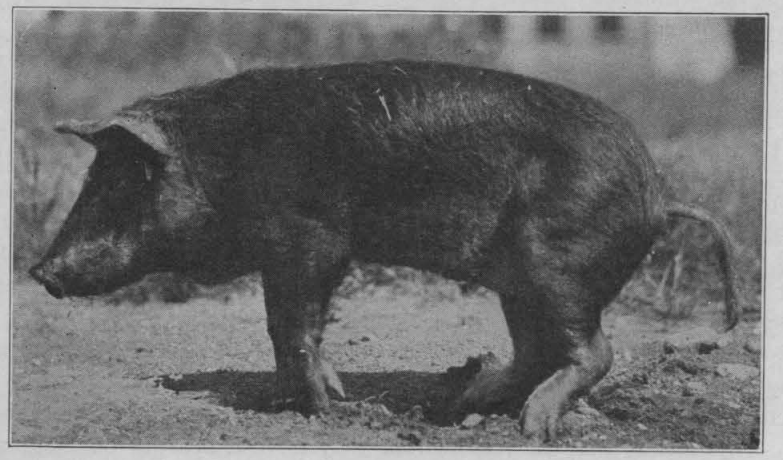
The **second** significant feature developed in this work is that reaction or failure to react to tuberculin is not the only element involved in diagnosis, but factors like experience, skill, judgment, and painstaking care on the part of the operator, together with herd and individual animal histories, contribute very much more to great accuracy than has been supposed. This means that too much reliance must not be put on tuberculin alone, and that very great importance must attach to qualifications of the operator and his consideration of many items aside from the showing of the test.

The **third** point emphasized in these studies is that mistakes are more common in failing to condemn tuberculous cattle than in condemnation of the non-tuberculous, except by incompetent operators. This means that all factors that may have a bearing on diagnosis must be carefully considered for each animal passed or condemned.

BONE AND JOINT DISEASE OF SWINE

Complaints from many parts of the state have been received of a swine disease affecting the bones and joints of growing pigs and shoats. No definite information relative to its nature and prevention has been available. Careful examinations and post-mortems were made of a number of field cases which showed tissue changes in the joints and bones of the diseased animals. The appearance indicated that the difficulty was due to a deficiency in the nutritional qualities of the rations fed, and particularly in the mineral supply.

In studying the problem, several lots of healthy feeder pigs were divided into groups and fed on rations lacking in one or more of the elements necessary for normal nutrition. One group received a ration low in lime (calcium carbonate), certain proteins, and a substance known as Vitamin C. Nearly 50 per cent of the pigs receiving this diet developed characteristic symptoms. The post-mortem findings indicated a mineral deficiency disease in the affected pigs. To a second group was fed a ration lacking in lime and Vitamin C but containing the proteins. The pigs fed on this ration grew well but some became very lame and could hardly move about. To a third group, the protein and Vitamin C were both added, the ration lacking only calcium. Vitamin C was supplied in this instance in finely chopped cabbage. Many pigs in this group still developed the disease. A fourth group was fed the same ration as Group I with the addition of lime equal to two parts to every one hundred pounds of feed. This was provided by slacking quick lime and then drying and pulverizing it. The pigs in this group grew well and finished the experiment without showing any signs of disease. No changes were found in the bones and joints.



Attitude Characteristic of a Mineral Deficiency Disease

The results warrant the belief that lime is an important and essential element in the food of swine. If lime is lacking in the ration, a disease may be expected which will cause weakness, lameness, and what may be called paralysis. The addition of lime will probably prevent the disease. Preventing the disease is far easier than curing it after it appears. Lime is a cheap and easily available mineral. Successful hog growers make it a practice to keep finely ground limestone or other form of lime before their hogs at all times. A good grade of lime can be conveniently supplied from self-feeders at very little cost or labor. It is a practice that should be followed wherever the ration is likely to be short in lime, as it often is when corn only or other starchy concentrates are fed.

LABORATORY SERVICE TO VETERINARIANS AND STOCKMEN

Diseases frequently occur among the herds and flocks in all parts of the state wherein the aid of a laboratory diagnosis is of great benefit. In many instances a laboratory diagnosis is absolutely necessary in order to determine the exact nature of the disease. An early and accurate diagnosis often saves many animals to the livestock industry. A need for this service is certain and its value can not be measured in dollars and cents.

This division, in the course of a year, receives many specimens of animal tissues from veterinarians and stockmen. The number has greatly increased in the last few years, largely because of the many specimens of diseased poultry received. This might be expected when we think of the increase in the poultry business over the same period.

As an illustration of the most destructive infection of young chicks we cite facts in connection with bacillary white diarrhea. Only 18 cases of bacillary white diarrhea were received at these laboratories in 1922, 184 cases in 1924, an increase of 922 per cent. These cases have come from all sections of Minnesota.

The traffic in baby chicks we believe is largely responsible for the spread of this disease. It is an important fact that chicks which have passed through an outbreak of bacillary white diarrhea and apparently recovered, may harbor or carry the germ of the disease in their bodies. The organs most frequently affected in adult birds are the ovaries. In some cases the ovaries are so badly injured that the hens do not lay. In other cases the injury may be only slight and does not interfere with egg production. Many or all of the eggs from such birds may contain the microbe, and if these eggs are used for hatching, the developing chick becomes infected before birth. Not infrequently

chicks die in the shell as a result of this infection. The presence in the eggs of the germs of bacillary white diarrhea apparently does not entirely reduce the fertility of the egg. Many infected adult birds never show signs or symptoms of disease, so that on this basis it is impossible to pick them out from a flock. They can be told, however, by subjecting a small amount of blood from the bird to a certain laboratory test, the agglutination test. If the reaction to the test is positive, the bird is a carrier of infection and should be segregated, and her eggs not used for hatching. Eggs from such birds usually contain the germ of the disease. During the last year the blood of 953 adult hens has been examined by this test.

The first and most important measure in treating chicks that are already sick with this disease is sanitation. It is always advisable carefully and thoroly to clean and disinfect the incubators, hovers, and coops. The more thoroly this is done, the better the success in controlling the infection. Another important step is to divide the chicks into as small groups as possible. The floors of the hovers should be covered with sand or finely chopped alfalfa, so they may be easily cleaned. The droppings of the infected chicks carry many of the germs. Chicks are most susceptible to this disease for the first few days after hatching.

STOMACH WORMS OF SHEEP

Among the most serious diseases of sheep is one caused by the stomach worm. This has been successfully combated by rotation of pasture, which prevents to some extent transmission of the disease, and by dosing all sheep on the farm with a one per cent solution of copper sulfate. To be effective this treatment should be given three or four times during the summer months. Full feeding on well balanced rations is also a factor in overcoming the disease.

GOITER

Goiter is another disease that may cause considerable trouble. It is classed as one of the deficiency diseases and is caused by lack of iodin in the food. The disease affects mainly new born animals, especially pigs and lambs. When sheep are affected with goiter, lambs are born in a weak condition and frequently die soon after birth. Goiter in calves is usually indicated by a swelling of the glands of the throat. Many calves so affected will die at birth or soon after. Some will

live and continue to grow. The enlargement of the glands may persist until they have reached maturity. In swine, the disease is usually characterized by the pigs being born without hair, a large percentage of them dying shortly after birth. The treatment for goiter consists in feeding iodin to pregnant animals. This will prevent the disease in the new born. The feeding of the iodin should be begun soon after breeding and continue until the time of birth. Iodin in the form of potassium or sodium iodide will give the best results. Six or seven grains once a week for each female has been found satisfactory.

POULTRY DIVISION

WILL DRIED BUTTERMILK REPLACE BUGS, WORMS, AND MEAT SCRAPS FOR CHICKEN FEED?

The poultry industry demands annually the production of large numbers of light-weight, non-setting, high-producing hens. Because of this and because it is desirable to have them all of nearly the same age incubators and artificial brooders have largely replaced hens for raising chickens. Chicks raised under these artificial conditions often are poorly nourished, thousands of them die from faulty nutrition, and thousands more appear weak and unthrifty. These grow slowly and seldom develop into strong, vigorous hens. During the early feathering period the wing feathers appear to be abnormally long. The real trouble is lack of normal development of the bone framework.

If chicks are allowed free range and raised by hens this condition is seldom observed. The growing chickens pick up insects, bugs, worms, and often scraps of dead animal matter, and thrive and grow rapidly. Artificially raised chickens often lack the range and supply of insects that those naturally raised get. Manifestly, something is lacking in the feeding and care of the artificially raised chicks.

Growing chickens, like all other young and growing animals, need large amounts of high-protein feed for muscle and bone building.

Insects and worms furnish a supply of such feed for chickens raised in the natural way. Meat scraps are often used when the chicks do not have free range. Powdered whole milk and dried buttermilk are other animal protein products now available for poultry feeds.

To test the relative merits of some of these feeds in feeding artificially raised chicks, the Division of Poultry Husbandry has made a number of feeding tests. In 1924 Single-Comb White Leghorn chicks of the same hatch and of the same brood lines were divided into lots of 40 each. The lots were fed in duplicate on a mash of varying proportions of dried buttermilk and wheat bran. All groups were fed a basic ration of scratch feed composed of 2 parts finely cracked corn, 2 parts finely cracked wheat, and 1 part steel-cut oatmeal. They were also supplied with all the fresh cut alfalfa they would eat. Clean fine sand was kept in the hovers and scratch pens. Exercise yards 4x25 feet were provided for each lot.

The dried buttermilk fed in the mash ranged from 3.37 per cent of the total concentrates to 18.5 per cent. The largest number of chicks died in lots receiving the smallest proportion of buttermilk. When less than approximately 12 per cent of the total concentrates was dried buttermilk, the loss averaged 41.2 per cent. The body weight of the chicks in these groups averaged 354.52 grams. When the mash was from 12 to 18.5 per cent buttermilk the loss was reduced to only 10.4 per cent. The average body weight of the chicks in these groups was 422.65 grams. One lot was fed on a mash composed of buttermilk without the bran. The loss in this lot was 25 per cent and the body weight reached only 362 grams. Another lot, fed a mash composed of beef scraps and bran in which the beef scraps composed 9.6 per cent of the total concentrates, the loss was 25 per cent, but the body weight reached 421.5 grams.

These trials brought out the importance of furnishing a good supply of animal protein in chick feeds. Dried buttermilk, when fed in sufficient quantities in combination with other feeds, provides a satisfactory substitute for beef scraps or for the bugs and insects that chickens normally pick up on an open range.

Liquid Milk By-products as Substitutes for Dry Mash in the Feeding of Young Chicks

The dairy division of the University Department of Agriculture estimates that there will still be 1,750,000,000 pounds of skimmilk, buttermilk, and whey left over in Minnesota after the calves, pigs, and chickens have had all they can use. What to do with this vast amount of valuable dairy by-products is a problem worthy of serious consideration. Concentration of these liquid products into powdered form would be desirable from the standpoint of convenience in feeding and storage. Concentration, however, is expensive and increases the cost of the feed. Feeding in liquid form is possible on most farms. Methods should be devised for using in liquid form as much as possible of these surplus products, which will otherwise be wasted.

To determine to what extent skimmilk, buttermilk, and other liquid dairy products can be used as feeds for poultry and to learn how they compare with mash feeds containing correct amounts of meat scraps, a series of tests was made in the summer of 1924, in which the milk by-products were compared with dry mash composed of 70 per cent bran and 30 per cent meat scraps. A standard ration of chick scratch feed composed of cracked grains and small seeds was fed to all lots. To insure sufficient exercise, this scratch feed was fed in litter deep enough to force vigorous scratching to find it. One lot was fed liquid buttermilk, one sweet skimmilk, one sweet whole milk, and one sour

skimmilk. The check lot was fed a mash composed of bran and beef scraps. The milk products were kept before the chickens in clean troughs and they were allowed all they would consume.

Records were kept of the mortality, the gains made, and the cost of feed. The mortality was lowest in the lots fed buttermilk and sweet skimmilk. It was slightly higher but the same in each of the other three lots—fed sour skimmilk, sweet whole milk, and meat scraps.

The chicks fed on beef scraps made the best body gains, those fed on sweet skimmilk ranking next, those on sour skimmilk third, those on buttermilk fourth, and those on sweet whole milk last. There was not a wide range of difference in the body weights of the chicks at the end of the ninth week. It seems clear, however, that skimmilk fed in liberal quantities will approximately replace the dry mash and that sweet skimmilk is somewhat better adapted than the other milk by-products to the growth of chicks. In feed cost per pound of gain, the lot fed on sweet skimmilk ranks first; the lot fed on beef scraps, second; that on liquid buttermilk, third; that on sour skimmilk, fourth; and the lot fed sweet whole milk, fifth. The cost of whole milk will, of course, prohibit its use for more than a starting period when it might be used if found to reduce the mortality. Some previous trials seem to indicate that it might, but in this case there was no advantage.

Results warrant the conclusion that with milk by-products available at no cost, or a very low cost, they can be profitably used to replace the dry mash in the ration for young, growing chicks.

BEE DIVISION

FEEDING POLLEN HELPS RAISE STRONG BEE COLONIES

Bees ordinarily begin brood raising some time in March. The honey flow usually begins in June. There is a period between of about seventy-five days during which the brood for honey carrying is raised. Honey and pollen are both indispensable in brood raising.

Intensive breeding is necessary if the colony is to reach its maximum strength in numbers at the beginning of the honey flow. If the bees do not have sufficient pollen during this period, brood raising will cease.

Pollen must be either carried over in the combs from the previous autumn or gathered in the early spring.

Young queens breed so late in the fall that they use all the stored pollen. In the spring there is often a period of from one to three weeks in April when no natural pollen is available, and no brood is raised by some of the best colonies. Before pollen becomes available the colony has so dwindled that it can produce little brood. As a consequence, a very poor honey crop or none at all is gathered because of lack of working bees. Provision of pollen in the early spring thus becomes a necessity in the successful management of bees. The feeding of honey to bees is quite well understood, but the collection, storing, and feeding of pollen is not so well understood.

Investigations of the problem of supplying pollen to bees have given some knowledge of the subject which it is believed will be of value to beekeepers.

At this time surplus pollen may be found (1) in colonies that have cast a swarm and have no brood to feed for 10 or 11 days and very little to feed for 21 days. Frames in such colonies get well filled with stored pollen. (2) Surplus pollen may be left in colonies with old queens or those that are superseding their queens. (3) Some colonies, through accident, may lose their queens and remain queenless for a time. Such colonies at times have several frames filled solid with pollen.

From the colonies mentioned frames of pollen may be removed in summer. It is well to provide at least one for each colony to be wintered over. All such pollen frames should be collected into one super and given to a strong colony as a second super to be sealed over during a quick honey flow. The bees will fill the upper third of the pollen cell with honey and seal it. Pollen thus preserved will neither dry out

nor ferment. After the combs have been capped over, the super should immediately be removed and stored in the honey house as honey is stored over winter.

The best time to secure surplus pollen for feeding is in June and July, mostly during the honey flow.

After the bees have had their first flight in the spring, a frame of empty comb is removed from the hive and one of the pollen frames is inserted among the bees next to the brood nest. Other conditions being favorable, brood raising in this colony will go on uninterrupted as long as there is any pollen. Other things being equal, colonies that have had pollen through the whole spring period are much stronger in numbers when the honey flow comes than are those that have had no pollen, and will also gather a larger surplus of honey.