To the Committee on Graduate Study:

I submit herewith a thesis written by Mr. Daniel E. Harris, "Management of Dairy Cattle Breeding Establishments," and recommend that it be accepted for nine quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Dairying.

L. E. Wylie
Major Professor

At the request of the
Committee on Graduate Study,
we have read this thesis,
and recommend its acceptance.

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MANAGEMENT OF DAIRY CATTLE BREEDING ESTABLISHMENTS

-o-

A THESIS

Submitted to the Graduate Committee
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

by

DANIEL R. HARRIS

August 1937

PREFACE

The material contained in this thesis has been collected by the writer during a year of graduate study in Dairying at the University of Tennessee.

A review of the written material on this subject was made and credit in each case has been given to the author of such material used in this review.

Acknowledgement is hereby given to Professor C. E. Wylie, Head, and Mr. S. A. Hinton of the Department of Dairying of the University of Tennessee for their valuable suggestions and assistance during the progress of the research and writing of this thesis.

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--Daniel E. Harris

149515

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INTRODUCTION

According to the figures contained in the 1930 census, there were 33,152,000 dairy cattle of all ages on the farms of this country. Of this number 3.85% or 1,280,161 were registered pure bred cattle representing the four major and three minor breeds of dairy cattle in the country. In number, at least, it would seem that the pure bred dairy cattle industry is rather small and somewhat insignificant, but its importance reaches tremendous proportions when we consider the relation of pure bred dairy cattle to the future of the average American dairy cow and of the Dairy Industry.

The problem of economical milk production hinges upon our ability to breed and develop an efficient producing dairy cow for the average American dairy farmer. The average farmer does not have the knowledge or the capital to do this for himself. It becomes the problem of the breeders of pure bred dairy cattle, to constantly pour fresh strains of blood bred for efficient milk production into the dairy industry, and in this way work toward the goal of more economical milk production.

Many persons feel that the breeding establishments of the country are in the hands of wealthy men or above ordinary farmer-operators and that efficient and economical management is not stressed. This may be true in some cases, but economic conditions are making it more and more necessary for the wealthy owner to require efficient operation of his manager, or for the farmer operated establishment to operate efficient-

ly in order to keep from slipping into the class ordinary farms.

Success in any large enterprise, either agricultural or industrial, is dependent to a great extent on having a good manager. The dairy cattle breeding establishment may be under the direction of a professional manager or an owner-operator. In either case he controls the managerial policies and practices and must put his skill and technical knowledge into practice in the development of all phases of his herd and farm.

It is the purpose of this thesis to present and discuss the problems of farm management and dairy herd management as they apply particularly to the dairy cattle breeding establishment. Much has been written on farm management dealing with the ordinary type of farms of the country. However, the progressive breeding establishment is far from an ordinary farm and special application of farm management facts found in the literature must be made to the breeding establishment. Very little literature relating directly to this subject is to be found.

The problems of farm management as related to farm organization and farm operation will be discussed. Also practices of breeding herd operation and marketing the products of the farm and herd will be presented. The investigation covers surveys of dairy cattle breeding establishments made by both personal visits and by mail questionnaires.

Projects in practical herd management problems will also be presented.

The field of farm management is far too large to be covered in detail in the scope of this thesis. The basic principles will be presented here, and their application to the dairy cattle breeding establishments will be discussed.

PART I

REVIEW OF LITERATURE

and

PERSONAL OBSERVATION

PART I

CLASSIFICATION OF DAIRY CATTLE BREEDING ESTABLISHMENTS

It is evident that as in all other enterprises dairy cattle breeding establishments are not all the same. All have the same purpose of breeding better dairy cows of their respective breeds and selling offspring for the improvement of other herds. Many factors, however, enter into the division of these establishments into distinct classes.

Probably the first factor in this classification is the availability of capital. An establishment that has available an unlimited amount of capital has a decided advantage particularly in purchasing foundation breeding cattle and in getting the proper buildings and equipment to efficiently care for the cattle. Also, sufficient capital will be of great assistance in helping to carry the costs of the investment until a sound business can be developed.

Closely related to this factor of availability of capital is the purpose for which the establishment was founded, that is, aside from that of breeding dairy cattle. It must be kept in mind that many wealthy men own and operate breeding establishments as a purely recreational side line to their business life. They prefer this type of recreation to owning a fine yacht or a fleet of luxurient motor cars. Their willingness to invest money in this recreation varies greatly and with it, to a great extent, will vary the ranking of the es-

tablishment. Some of these men require that the farm be a paying proposition, others would like it to be so, but do not mind standing a nominal yearly loss. Still other men do not care how much the farm loses as long as they have the best money can buy. Capital of this sort in competition with an owner-operated establishment that must furnish a living on a relatively small capital investment is what brings about the greatest division of breeding establishments.

The location of the farm also exerts an influence on its ranking as a breeding establishment. They should be located in or near an active dairy producing area, and one in which their breed predominates. It is easy to see how hard it would be for even an outstanding Holstein herd to reach a top ranking in southern states such as Georgia or Mississippi that are completely dominated by another breed.

Another important factor in the classification of breeding establishments is the man who is behind the organization. Be he a professional manager or an owner-operator his influence, whether good or bad, will have a great deal to do in determining how the establishment will stand. The good merager will constantly push his establishment to the front, the average man will carry it along at a level, while the poor man will drop its standards.

One of the most evident and efficient methods of classifying breeding establishments, their problems and purposes, is the quality of cattle they possess. F. Lathrop Ames, founder of Langwater Farm, the noted Guernsey breeding establishment, in an article in the "Breeders Gazette"[1] gives an explanation

of this type of classification of breeding establishments and points out the purpose of each. He says:

> "The problem which concerns the breeder is gauged by the character of the stock he possesses. Breeders may roughly be divided into three classes; the problem of each is different. Taking first, for example, the men who possess the finest herds in a breed, their problem is distinctly the most difficult, as there are few animals outside of their herds which equal the ones they possess. These men are the breed improvers and they have got to use rare judgment in their breeding operations. .....
>
> "Now let us take up the breeder who we might say is in the second class. He, of course, if he is ambitious, is constantly striving to improve his herd or stud, so that it may become one of the best of the breed he is working with. ..... This breeder, if he wishes to improve his animals, should endeavor to purchase sires with better blood and conformation than his own. .....
>
> "The breeder of the first class sells his males to improve other pure bred herds. The breeder of the second class sells his males to improve the grades of the breed. ..... As the breeders of the first two classes desire their revenue from selling males at good prices, the breeder of the third class markets his product as milk and butter."

Thus it is seen that dairy cattle breeding establishments are divided into definite classes by the type of material they have to work with. The first class includes the establishments owned by wealthy men. They are the Langwaters, the Carnations, the Penshurets, and the Cranberry Runs of their respective breeds. They are characterized by extremely high quality cattle, large amount of available capital, long time operations, and progressive breeding programs. They are relatively few and far between, but their influence on the breed through the highly bred animals they have produced and sold for the improvement of other herds

is far reaching. Their purpose is to constantly maintain the superior quality of their herds through scientific breeding and rigid culling, then to sell the products of these efforts for the improvement of other herds.

The second class of dairy cattle breeding establishments are likewise often owned by wealthy men, but are also often owned by operators who have built them up through hard work. They are characterized by possessing better than average quality cattle, but not the superior quality that is found in the herds of the first class establishments. These second class herds are quite generally headed by bulls which were bred on the first class farms. The second class establishments generally do not have the available capital of the first class. They cannot afford to buy the best animals of the breed, either male or female, but are generally able to pay high prices for an occasional bull or foundation cow from one of the first class establishments. These animals are mated with the good, but not superior animals which make up the general run of these herds and produce males of the type that are best suited to go to the ordinary farmer herds of both pure bred and grade cattle.

Every herd of pure bred cattle cannot be called a breeding establishment. Many pure bred herds are little better than grade herds, and must be considered in the same class. Only those herds that are interested in continually improving through good breeding and rigid culling, and which are of a caliber sufficient to pass on to the herds of the next lower classifica-

tion, animals capable of improvement, should be considered as breeding establishments.

FARM MANAGEMENT

The Industrial Revolution, which had such a generally recognized effect upon the urban life of the county, also had an important, though probably not so noticeable, effect on the farm life of the country as well. The development of industry, large cities, and the use of machinery both on the farms and in the cities revolutionized the commercial aspect of farming and changed the individual farm from a practically independent unit to a highly developed business organization.

Little thought had been given before this time to the principles of farm management. But as in all other business enterprises, success is to a large degree dependent upon good management. With farming now developed in a business scale, the interest in and necessity of good farm management has been greatly increased.

Forster[3] presents one of the best available definitions of farm management. He says, "Farm management may be defined as a study of the ways and means of organizing land, labor and capital and the application of technical knowledge and skill in order that the farmer may use all his resources to the best economic advantage." Or, it may be said that farm management is a subject which has to do with the application of the principles of economics to the organization and operation of the farm.

Farm management in its work of "applying the principles of economics to farm organization and farm operation" must of necessity gather its subject matter from the entire field of

agriculture, a large part of the study of economics, and a good portion of the field of business.[4]

In agriculture, it may be called upon to coordinate any crop or type of livestock into a specific farm business, so it must be acquainted with the factors of production of all types of crops and livestock. Economically, farm management must decide those problems of the farm which bring up the question of how to make the farm produce most profitably. In business, farm management must keep detailed records of the farm business, and solve the problems of efficient marketing of farm products and the purchasing of farm supplies.

It must be kept in mind that farm management is best applied on an individual basis. Many generalizations can be drawn and recommended for a group of farms in a definite locality or of a similar type of farming. However, no complete system of farm management can be applied to any two farms, no matter how similar they may seem. This is especially true of the larger type farms, for their large acreages and volume of business make many modifications to any set system of farm management.

The management of a dairy cattle breeding establishment must of necessity entail strict adherence to good farm management principles. The manager of such an establishment should have at his command a wealth of scientific knowledge on subjects relating to the agricultural, economic and business advancement of his farm and herd. Breeding establishments may vary in their complexity a great deal and the manager must

be able to cope with any situation that may arise.

Generally speaking, the management of dairy cattle breeding establishments must of necessity deal in a major proportion with the management of the breeding herd, for it is within this portion of the business that the greatest interest and the greatest investment usually lies. Thus, a proportionately larger amount of this thesis will deal with the management of the breeding herd. It is desired, however, to present a brief discussion of the general principles of farm management as they particularly apply to the breeding establishment.

Farm Organization

Farm organization, the first division of farm management, refers to the arrangement of the various physical elements and to the proportion in which these elements are combined.[3] It deals with all those things which must be planned for and arranged before the farm can actually be put into operation.

The first consideration of farm organization is choosing the farm sight and the actual farm itself. If one were choosing a farm from which to earn a livelihood many different considerations would have to be dealt with. But in choosing a farm location for a breeding establishment, two of the main requirements are that it be located in a region advantageous for the sale of breeding cattle and marketing its milk, and secondly that it be near the owners interests so that he may benefit from it through personal contacts. Thus it is seen that a Holstein breeding establishment has no place in the South, as its markets are dominated by Jersey

cattle and a demand for Jersey milk.

In selecting the individual farm the requirements are to a great extent alike for the family farm and the breeding establishment. The farm should have a good topography and rich soil, and the climate should be favorable to the particular enterprises that are to be carried out.[2] The land should also be easy to work, free of rocks and stumps, and well drained. A good supply of pure water should be available. It is also important that there should be good roads between the farm and the local market. This is particularly important with the breeding establishment, for they must plan on having a number of visitors.

Once the farm has been chosen the next step in organizing the farm is the determination of the productive enterprises or the types of livestock and crops that will be producted. With the breeding establishment, the cattle will of course be the main enterprise of the farm. The other enterprises of the farm, both livestock and crops, will to a large extent be determined by the amount of land and capital left after the cattle have been cared for. Supplementary enterprises in livestock are generally selected to utilize byproducts of the cattle, while those in crops are selected to produce feed for the animals.[3] The choice of the supplementary enterprise may also be governed by climate, soil, markets, and labor.

When the enterprise of the farm has been selected, it is important to so organize the farm business as to make maximum use of power, land, labor, and capital, and to provide for

the needs of the farm. The farm plan should lead to the avoidance of emergency by providing reserve quantities of grain, hay and other feeds. The plan of organization should be such that all the factors of production will be used at a maximum, for it is only then that the greatest efficiency in farm operation is realized.[4]

One of the most important functions of the business organization of the farm is the keeping of accurate records on the farm business. Most any breeding establishment is large enough and has sufficient capital invested to warrant the keeping of a complete set of cost accounts on the farm business. Such a system of accounts will furnish the following types of valuable information:[4]

1. How the business stands with the owner and with others.
2. Cost of production of the various farm enterprises.
3. A history of the various fields and enterprises.
4. Basic data for the purpose of obtaining loans, and calculation income and other taxes.

The basis of farm accounts is the inventory. The inventory is an itemized list of the land, buildings, equipment, supplies, livestock and growing crops, with their value, and the cash used in the farm business, at the date when the inventory was taken.[5] The inventory is best taken at a time when the amount of stored material is low, about March or April first being a good time.

The cash receipts and expenses for the various enterprises are kept in a distributing cash journal, and the total

are transfered to the ledger. Charges are made at the end of each month or each year for labor, use of machinery, interest, depreciation, and use of land or buildings. Breeding establishments may divide their cattle into milking herd, test herd, young stock, calves, and bulls, or other simple divisions. In many cases the show herd enterprise is a separate account. It is also well to keep accounts with any other livestock enterprise and such crops as alfalfa, other hay, corn silge, corn for grain, oats, barley, and any other that happen to be grown.

Budgeting farm receipts and expenses is a useful method, assisting the farm organization.[38] A farm budget is a definite plan for using the resources of the farm. It enables the operator to consider not only present problems but also future problems and in this way plan to make definite improvement in the organization and management of the farm.

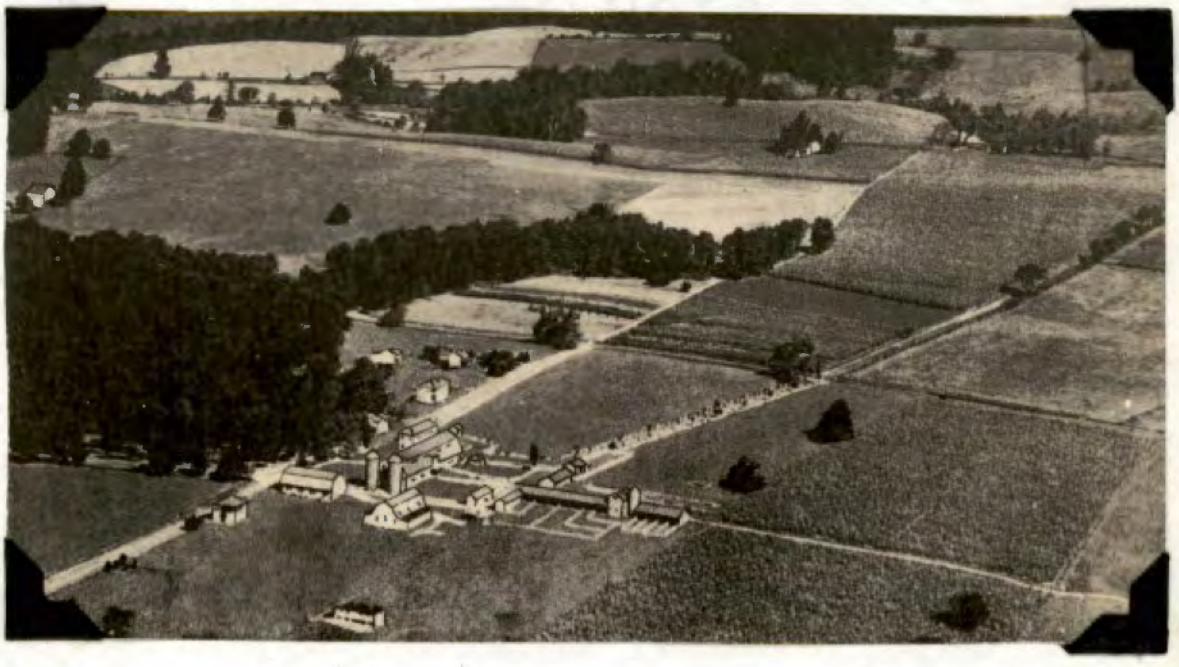


Figure 1. - Well arranged farm of an eastern breeding establishment.

The farm layout may have much to do with the efficiency of operation, and it is well to consider this point in organizing the farm. Farm layout may be affected by such factors as topography, distribution of soil types, access to water and the presences of highways, railroads, etc., which cut the farm at odd angles.[3] The farm should be divided into a number of fields of equal size sufficient to carry the crop rotations planned for. So far as possible, the type of soil should be consistent in any one field.[3] Fields should be as large as the size of the farm will permit, for there is greater efficiency in farming large fields.[6] A rectangular shaped field is the best possible shape for efficient working,[2] as well as efficient fencing. The plans should also be laid for permanent pasture, and woodland. The farmstead should be so arranged that the buildings are efficiently placed in relation to each other, and at the same time far enough apart to reduce the fire hazard.[5]

The crop rotation that is to be used is another consideration of farm organization. The crop rotation should be designed to supply as much of the feed as possible and to maintain the fertility of the land.[15] The crop rotation should be selected and designed to fit the individual needs of the farm in question.

The equipment of the farm is the next important consideration in farm organization. With the breeding establishment the most important part of the equipment is the breeding herd and their selection is of paramount importance. Breeding animals are selected for two purposes, first for their breeding power and

second to produce milk economically. Females are usually selected from a number of sources and representing a number of different lines of breeding of the particular breed. It is attempted to get a number of sound, high quality animals for the foundation herd, and if possible to have their breeding coincide with the program that is to be followed. In selecting males, it is the purpose to select a bull of strong breeding quality which, when mated on these foundation females of several types and lines of breeding, will produce a second generation of uniform offspring of good dairy character. The problem of selecting the herd is not so easy as may be thought from this writing, but a complete discussion would take far too great detail for this thesis.

The other items of importance in equipping the farm are the machinery and the building. One of the greatest cares to be exercised along this line is to be sure that the investment in this type of equipment is not made too rapidly, and is kept in proportion to the rest of the business.[4] Before machinery is purchased there should be a definite need for it and an assurance that there will be sufficient use to make the investment efficient. Unless there is a great deal of capital available, buildings should be kept as practical as possible.[4] Building should be designed to provide maximum protection to the particular livestock or crop which they are housing. The climate conditions should be considered in determining the amount of protection that is needed for the livestock. The

buildings should be arranged to provide a windbreak for a barn yard, if such is to be used.



Figure 2. - Substantial dairy buildings of a modern breeding establishment.

Farm Operation

Farm operation, the second division of farm management, has to do with all those factors which concern putting into operation the farm organization plan. Farm operation must devise a plan of work to cover all the many things about the farm that need attention. Farm operation must see that all the available labor is efficiently and completely utilized and that power and machinery available are also used to the best advantage of the farm.

In order to be sure that all the details of the farm are cared for, a plan of work is laid out for each enterprise on the farm. There are three steps in the making of a plan of work as follows:[4]

1. List the different industries which make up the farm business.
2. List all operations to be done in connection with each industry, such as methods of preparing land, seeding, harvesting, etc., and ways of caring for the stock.
3. Indicate time limits within which the work must be done.

The efficiency of the plan of work is no greater than the ability of the manager to do his work on schedule. Crop production depends to a large extent on getting plowing, planting, and harvesting done at the proper time, and this is one of the greatest responsibilities of the farm operator.

The farm plan should be so arranged that the various enterprises will supplement rather than compete with each other in their demands on labor and power. The distribution should be such that the labor and power can be efficiently utilized at all times, with little overlapping of requirements for their use.

Labor management is an important consideration in farm operation. The farm operator must provide enough labor to efficiently carry out the farm plan. Sources and quality of labor vary greatly. Workers from the immediate neighborhood usually furnish the best type of workers, while transient and irresponsible foreign types are usually of the lowest class.[5] The farm operator should maintain a crew sufficient to handle the work of the farm at a moderate time, that is, not at a

peak season or in a dull winter season. Extra labor can usually be picked up during heavy seasons. A certain amount of care need be exercised in choosing the labor to get the highest quality labor available at the price that can be afforded.

Work should be planned to keep the men busy all the time. Field work must be given preference to meet proper climatic conditions.[39] If field work is stopped by rain it is well to direct the labor toward such items as will speed up work as soon as the weather will permit field work to be started again. Some types of work will fit as well fall, winter or spring.

A proper management of the power and machinery of the farm is also a part of farm operation. To get the most efficient use, machinery should be used at a maximum.[4] Farm power, both horse and tractor should also be used as much as possible. It is well to use horses first where even possible, rather than a tractor. An idle horse costs interest and depreciation plus feed, while the idle tractor cost only interest and depreciation.

The final function of farm operation is the purchasing of feed, seed and supplies. These items must be on hand when needed, and the alert farm manager will look ahead as to the needs of his farm and have them ready to use when the time comes. He should also know how to buy to advantage and save as much as possible on these farm needs.

MANAGING THE BREEDING HERD.

To the dairy cattle breeding establishment there is no single unit of the farm business that approaches, in importance, the breeding herd. In a good many cases, the entire receipt of the farm comes from the breeding herd, from both the milk and stock sold. In these instances all the products of the farm are used by the breeding herd and the financial returns for all of these enterprises are dependent upon the breeding herd. It is quite a general fact that on breeding establishments there is more human interest in the breeding herd than the other enterprises of the farm and when we consider the fact that many such herds are established primarily to furnish such an outside interest to their owner, considerable more importance is attached to the breeding herd.

The science of the management of herds of breeding dairy cattle is a vast subject covering the field of breeding, feeding, care and handling of cattle. To go into specific detail on all of these topics would be to produce a volume of almost unlimited size, which is far beyond the scope of this thesis. The subject of the management of the breeding herd is of such importance to this thesis as to be considered the main topic and a fuller treatment will be given than the foregoing discussion of general farm management.

Feeding and Management of the Milking Herd.

The milk cows in any dairy enterprise, either breeding or commercial milk producing herd, are through the sale of their milk the chief source of revenue to the farm and in such

capacity should rate as the most important group contained in the breeding herd. The efficiency with which the milk cows are fed and handled is more directly reflected in the economic operation of the farm and herd than is that of the bulls, or calves, or hiefers, altho each has its own place and ultimate effect.

Feeding for Milk Production

The dairy cow uses the feed she consumes for five main purposes, namely, maintenance, growth, body fat, development of fetus, and milk production.[7] Of these five, milk production is of the greatest importance to man, but of the least importance to the well being of the cow. If the future usefulness of the cow we are feeding is to be considered at all, it becomes of primary importance that we feed her first to maintain good physical condition and to reproduce regularly, then to see that we add the feed necessary for milk production.

Feeds for dairy cattle may be classed roughly into four groups which are pasture, succulent feeds, concentrate mixture, and hay.

Pasture for Dairy Cow

A good pasture furnishes an unexcelled feed for dairy cows. The feed is extremely palatible, it is succulent and it supplies an abundance of food nutrients for the cow, being rich in proteins, mineral matter and vitamins. It is also a fine tonic for the animal as well as a good conditioner. It is while cows are on a good luxuriant pasture that they prod-

uce milk the most economically. Unfortunately all pastures do not possess these ideal conditions mostly for the reason of neglect. Cows cannot be expected to produce milk efficiently when pastures are poor and improperly managed. The manager should do all in his power to provide a plentiful supply of pasture. This will necessitate having a mixture of early, medium and late maturing grasses in the pasture, and to supply plant food by top dressing when needed with manure and fertilizers.

When the cows are turned on pasture in the spring the first consideration is for the pasture rather than the cows. The cows should be withheld from the pasture until the grass has gotten a good start. Grass will grow only when it has leaves exposed to the air and sunlight, and if the cows take these early in the season there will be little grass later on.

The change from dry feed to green pasture should be made gradually, for several reasons. First a sudden change at this time will cause a decided effect on the taste of the milk, whereas if the change is made gradually, there is little or no effect on the taste of the milk.[6] Also heavy milking cows will often gorge themselves on the tender young grass if left on pasture too long at the start, and it is quite possible that digestive disorders will result. One or two hours daily at first will be sufficient.

Pasture alone is not always sufficient for a summer feed for dairy cattle, particularly in the case of high producing cows, and it is well that the manager plan for some feed to supplement the pasture. Good pasture alone will provide suffi-

cient nutrients for body maintainance and the production of 10 to 20 pounds of milk, depending on the richness.[9] However, due to the fact that grass is from 70 to 90 percent water, high producing cows cannot eat enough grass to maintain this high production.

Grain concentrate should be fed to heavy milking cows.[9] The pasture will supply sufficient protein so the allowance of this nutrient in the grain mixture can be reduced, a 12 percent ration being sufficient. The amount of grain to be fed will depend on the individual cow, but it will be approximately 1 pound of grain for every 3 pounds of milk over a 20 pounds milk production basis.[10] It has also been shown that some hay may be fed to supplement with pasture, thus further reducing the amount of grain concentrate needed.[9] When pasture grows short in mid and late summer, it may be necessary to supply a roughage supplement as well as to increase the grain being fed. Summer silage, either corn or a grass silage, or hay may best be used for this purpose.

Breeding establishments usually desire to feed the grain supplement somewhat more liberally in order to insure a fairly high degree of condition on the cows.

Realizing the benefits of an abundance of good pasture, it seems well worth the effort to take the necessary steps to provide a more than abundant supply. Aside from proper care of the permanent pastures, supplementary rotation pastures should be provided for the purpose of allowing several weeks of midseason rest for the permanent pasture. It may be possible to cut this rotation pasture once early in the season and get one cutting of a fine early hay which will be extremely

palatable for calves. Then by mid-season it will have obtained sufficient additional growth to relieve the permanent pasture for several weeks.

Feeding Silage and Soiling Crops.

The many advantages of feeding silage to breeding dairy cattle in comparison with the few minor disadvantages make it one of the most popular of the winter feeds for dairy cattle. Silage has the advantage of being the cheapest roughage for dairy cattle, and is an excellent supplement. It is palatable, succulent and mildly laxative, all these factors which are important to the ration, particularly in winter feeding. Ensiling has the economic advantage of saving a greater portion of the crop than any other method of handling. It also economizes in saving storage space and labor. The chief disadvantage of silage is its lack of variety, particularly where it is fed both summer and winter.[8] Some men hesitate to feed silage on the basis of unsubstantiated claims that it effects the breeding of animals.

Corn is the chief silage crop throughout most of the country. This is due to the fact that it yields more nutrients per acre, has sufficient sugar to ensile well, and packs down well in the silo. Crops such as kaffir corn, sorghum, and sunflower are used extensively for silage in the south, and other regions use legumens to some extent. In ensiling legumens, the low sugar content makes it necessary to add a molasses solution to supply sufficient sugar for proper ensiling. The high water content of fresh green legumens is also

a disadvantage in making legume silage.

It is a general "thumb rule" to feed silage at the rate of 3 pounds of silage to every 100 pounds of body weight,[10] thus averaging between 25 and 40 pounds per day. This factor no doubt varies considerably in practice, some feeders being extremely liberal with silage while others are very conservative. Connecticut[12] trials indicated that milk and butterfat yields were maintained as well on a limited allowance of silage (1½ pounds of silage per 100 pounds of body weight) as on the heavy silage ration (3 pounds of silage per 100 pounds of body weight).

Soiling crops are green forage crops that are cut in the field and fed in a fresh condition to livestock. Although used to some extent, soiling crops are not a popular feed for dairy cows. Probably their greatest use is as an emergency feed during periods of mid-summer drough which effects pastures.

Soiling crops are much less economical than silage because they are immature plants of a lower nutritive value[9]. They are more expensive because they consume more labor, seed and fertilizer. They are heavy and hard to handle and generally must be cut and handled each day in small quantities.

A variety of crops are available to be used as soiling crops. Soybean, alfalfa, oats, vetch, cowpeas, and the clovers are all acceptable.

Soiling crops are usually fed on the basis of what the cows will eat. The mangers are filled and the cows take what they want, the rest, of course, having to be hauled away.

The grain mixture

In order to maintain their bodies, to produce milk and to reproduce their kind, dairy cows must consume large quantities of feed. Few cows are able to eat enough roughage alone to carry out these functions efficiently, so that it becomes necessary to supply feed nutrients in a concentrated form. A mixture of various grains, grain byproducts, and a mineral supplement will generally answer this purpose.

The first requirements of a grain mixture is that it supply the feed nutrients of protein, carbohydrates, fats, minerals, and vitamins in a concentrated form and in a proportion that will be in balance with the roughage supplied in the ration.

There are other considerations of the grain mixture which must also be taken into account. Several writers 8, 9, 10, 13, point out the importance of such factors as palatability, bulk, variety, high digestibility, slightly laxative, and economy in cost must be considered in the ration. All of these factors are of considerable importance to the grain mixture and a weakness in any one will be reflected to a great extent in the efficiency of the mixture.

There are a great variety of feeds available to be used as ingredients in the grain mixture. Of the grains, corn, oats and barley are the most important, with wheat and soybeans being used to a lesser extent. The chief byproducts used in dairy cattle rations, are wheat bran, linseed oil meal, cottonseed meal, hominy, oat feed, distiller and brewers dried grains and

dried beet pulp. Products such as molasses, salt, bone meal, and ground limestone round out the list of principal ingredients.

It is often a problem of management to decide whether or not it is best to grow and mix feeds on the farm, or to buy commercially mixed feeds. Most breeding establishments have the facilities to grow a good portion of their grain, and grinding and mixing equipment is not excessively expensive when there is a sufficient amount of feed to be ground. On the other hand commercially mixed feeds are for the most part intelligently and honestly mixed and not excessive in price.[9] The chief disadvantage to commercial feeds is the fact that one is unable to know their composition and consequently what he is feeding his cow, as most such feeds are sold on a "closed formula" basis. It is up to the individual farm manager to decide which is better for his conditions, and this may only be correctly done by using the findings of cost accounts on his farm.

The grain ration should contain at least two grains and one mill by-product feed ground to a medium fine consistancy. The percentage of protein contained in the ration is the most important factor, for the protein is the most expensive of the feed nutrients. The amount of protein required in the concentrate mixture depends primarily upon the protein content of the roughage which is fed.[9] Thus a grain ration fed with a poor quality roughage will require from 19 to 24 percent protein, whereas one fed with a good quality legume roughage will need only from 12 to 16 percent protein.[14]

It is a generally accepted fact that the amount of grain to be fed is governed by and is in proportion to the amount of milk produced, the only varying factor being the size and breed of the animal. It is generally recommended[9,10,13] that the smaller breeds (Jersey and Guernsey) should be fed at the rate of about 1 pound of grain to each 2½ to 3½ pounds of milk, while the larger breeds (Holstein, Ayrshire and Brown Swiss) should be fed at the rate of 1 pound of grain to each 3½ to 4½ pounds of milk.

The condition of the individual animal is another very good indication of the amount of grain to be fed. If a cow has a tendency to put on fat her grain should be reduced for she, in all probability, is getting too much and is storing it as fat. On the other hand, if a cow loses weight and becomes thin she should be fed more grain for she is receiving too little and is drawing fat from her body. Recent investigations[32,33,34] are pointing to the practicallity of feeding limited or no grain rations.

Feeding Hay to Milk Cows

Hay is the chief source of roughage, other than pasture, for dairy cattle. In the winter when pasture is not available it is of extreme importance in economic milk production. Hays are divided into two general classes, the legumens, and the non-legumens, or grass hays.

Legume hays make an excellent roughage feed for dairy cattle and far surpass the non-legumens for this purpose. This is due to their abundant supply of high quality protein, calcium, and the essential Vitamins A and D. The dairyman

who fails to grow a good supply of legume hay generally reduces his net income considerably. Corn or sorghum usually furnish cheaper, more abundant roughage, but these do not furnish sufficient protein, which is essential in milk production.

The chief legume hay crops of the country are alfalfa, clover, lespedeza, cowpeas, soybeans and vetch. Of these, alfalfa is probably the most important. Alfalfa is unexcelled as a dry roughage for dairy cows.[9] Beside the properties it has in common with the other legumens, alfalfa supplies a very large yield and is extremely palatable. When good quality alfalfa is fed with corn silage and a low protein grain ration considerable saving can be made in the cost of the concentrate. In some parts of the West alfalfa is fed alone or as the only roughage. This ration is too bulky and low in digestable nutrients, and is not suitable for high producing cows.[9-33]

Lespedeza has to a great extent taken the place of alfalfa in the South due to the inability of many regions being unable to raise alfalfa efficiently. The clover hays are also a popular legume as are also mixtures of legumens and grass hays.

Hays from the non-legumens are generally much inferior to legume hay for dairy cattle.[9] Non-legumens are at their best when cut somewhat in advance of the mature stage, for it is in the immature stages that these grasses contain their highest amount of protein. Non-legumens, timothy in particular, are often used to feed for short times in order that the cows may have a variety from a straight feeding of alfalfa. Even in these instances it is often the case that the timothy is mixed with clover.

There is considerable variation in the rates at which hay is fed to dairy cows, probably due, in some degrees at least, to the difficulty of getting an accurate weight of the amount fed and thus not knowing just how much is fed. The most general recommendation[9,10,13] is to feed all the hay the cows will eat and allow the cows to balance their ration with the hay. This will usually range between 15 and 25 pounds of hay per day.

Mineral and Vitamin Considerations

The farm manager who plans his rations to contain a liberal amount of good quality hay, preferably legume, and a normal amount of protein in grain ration need have little worry over mineral and vitamin deficiency. The legume hay, as has been mentioned before, is particularly abundant in its supply of calcium and vitamin A and D, which are the most essential vitamin to the dairy cow.

Morrison[9] states that "Dairy cows will usually receive sufficient phosphorus if they are fed enough concentrates to meet the recommendations of the feeding standards and the concentrate mixture includes at least 25 percent of the high phosphorus protein supplements, such as wheat bran, cottonseed meal, and linseed meal. The only exception may be when the roughage is from soil decidedly deficient in phosphorus."

Many dairymen, to be sure that there is sufficient calcium and phosphorus in their ration, will add "mineral supplements" which generally consist of ground steamed bone meal, ground limestone, ground oyster shell, ground marl, raw rock phosphate, acid phosphate, etc. The ground steamed bone meal

is probably the best of these for it is rich in both calcium and phosphorus, and in a highly assimilable form. These supplements are added to the grain mixture at the rate of from 1 to 3 percent.

Salt is also very important and it is quite necessary that cows have access to it to thrive. Salt is best supplied in the grain ration at the rate of about 1 percent.

Vitamins A and D are the only vitamins that are likely to be deficient in a ration. Dairy cows have a rather high requirement of vitamin A and the content of that vitamin in the milk is directly dependent upon the amount in the feed. Morrison[9] states that, "The Vitamin A and D requirements of dairy cows will be amply met when they are fed the usual amount of roughage of a good quality, including a seasonal amount of well cured hay. Hay that has a green color is always rich in vitamin A value (Carotene), while that which is bleached has but little."

Corn silage will aid in supplying vitamin A provided it is not cut too early. Cod-liver oil should not be added to the ration of a dairy cow to supplement its vitamin content, as the cod-liver oil will reduce the fat content of the milk and may possibly have a toxic effect on the cow.

Management of the Milking Herd

The best fed dairy herd in the world will not produce milk efficiently if they are carelessly and neglectfully managed. Feeding supplies the raw material from which a cow makes milk, but proper management is necessary to surround

her with the proper environment and care that is so necessary in economical milk production.

Housing Dairy Cows

Government workers[15] indicated that the main purpose of housing dairy cattle, other than to keep them warm, is merely to keep them dry and out of the winds and drafts. Temperature is not a vital consideration, for these workers noticed that cows produced the highest in winter and lowest in summer.

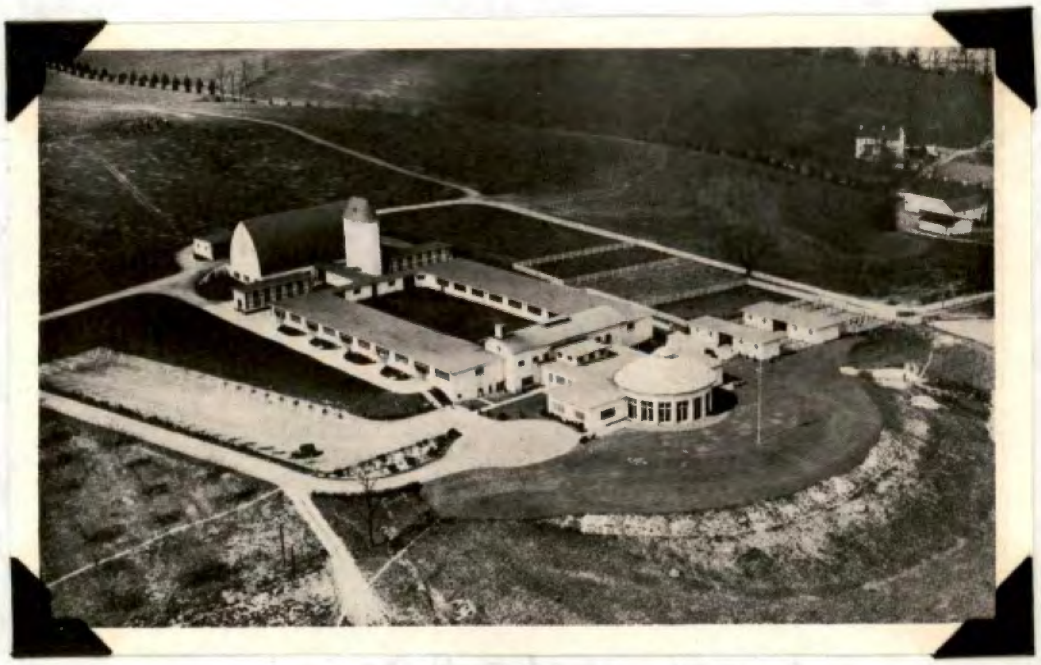


Figure 3. - Ultra modern barns and plant of an eastern breeding establishment.

A well planned dairy barn will be roomy, well supplied with sunlight by numerous windows and ventilated by a no-draft ventilating system.

There are five types of buildings suitable for use as dairy barns. First there is the basement barn, where the cow stable is on the lower level and the barn floor is on a level with the top of the ground. These are generally warmer in the winter and a little more difficult to light, but are usually quite satisfactory.

The one-story and two-story barns are as a rule easier to light and ventilate than are the basement barns. The two story barn is more convenient in that the feed is overhead rather than in a separate building, and is often more economical because one roof covers both the cows and the feeds.

Round barns and open shed barns represent very economical types of barns. The round barn is able to house more area with a definite amount of material than any other type of barn. Other than convenience, there is apparently no advantage to having the silo in the center of the round barn for this type of silo is harder to fill and will often fill the barn with odors which taint the milk. The open shed or covered barnyard has its greatest usefulness in warmer climates. It is economical to build and conserving of manure, but uses a relatively larger amount of bedding.

The type of stalls used is an important factor to consider. The metal swinging stanchion is very popular, having replaced the old-fashioned rigid stanchion. It gives the cow considerably more freedom and is fairly comfortable. The chain tie stall is another step in advance of the swinging stanchion. It gives the cow a maximum of liberty for the

size of the stall. In some ways it is too much liberty, for the cows can move up and back too far and are thus harder to keep clean.

The pen type of stalling, in which the barn is divided into several large pens which may hold from four to fifteen cows has met with approval where it can be accompanied by a separate milking room.[35,36]. The cows can run loose in the pen and be fastened for feeding. Chief objections to this system are the difficulty of keeping the cows clean and the large amount of bedding necessary if cleanliness is to be accomplished in any degree, to say nothing of the fact that it is sometimes hard to fasten the cows for feeding.

Generally speaking, this pen system is much better adapted to commercial dairies than breeding establishments. Breeders want their animals looking at their best at all times, and it is difficult to accomplish this with the cows loose in pens. Also it is hard for a breeder to show a particular animal off to a prospective buyer if she is constantly milling around with eight or ten other cows.

The box stall is of course the ideal arrangement when considering the comfort of the cow. Naturally they are more expensive, and require more labor and more bedding. The cows will usually produce more milk in a box stall, but not enough to pay for the extra labor and bedding. Box stalls have the advantage of showing off the animal to a much greater extent than the other types of stalls. This coupled with the extra milk production are factors that interest the breeding estab-

lishments.

When the type of barn and stalling equipment has been chosen the only remaining factor is planning the layout. In arranging the equipment in the barn efficiency in handling the cows, the feed, and the milk are the primary considerations. Many steps can be saved if a barn is well laid out. The question of whether to have the cows facing in or out in the stanchion rows may be left to a great extent to personal preference, for the two methods about balance in the consideration of their advantage and disadvantage.

Preparing the Cow for Freshening

After due consideration has been given to the proper housing of the breeding herd, the subject of management is then focussed upon the cows, individually and collectively. Probably the first consideration given to the individual cow is in preparing her for the all important event of calving. Good breeding of course depends upon reproduction and it is the aim of every good breeding herd to have the cows average one calf per year.



Figure 4. - Isolated Box Stalls are excellent at calving time.

All dairy cows should be given a rest from production between each lactation. The reasons for this are;[15] (1) To rest the organs of milk secretion, (2) to permit the nutrient in the feed to be used in the development of the fetus instead of in producing milk, (3) to enable the cow to replenish in her body the stores of minerals which may have been depleted through milk production, and (4) to permit her to build up a reserve of body tissue before calving. The length of the dry period will depend upon the condition of the cow and the amount of milk produced in the preceeding lactation.

There are two methods of drying off a cow. The first and most generally used is merely to lessen the frequency of milking by missing milkings until production is low enough to stop milking altogether. The second method[a] is to stop milking altogether for a period of one week. On the fourth day a half pint to a pint of milk is removed from each quarter and on the seventh day the cow is milked out completely and removed from the herd as a dry cow. The theory behind this method is that the pressure of the milk accumulating in the udder temporarily stops circulation of blood to the udder and in turn stops secretion. This method must be qualified in that it may not be used on an udder that has been infected with mastitis and that it requires more skill than does the first method. When the cow is dry it is often well to disinfect each teat and seal off the end with an adhesive substance.

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a. Observation of the author.

Once the cow is dry the whole aim in feeding should be to bring her into a good state of body condition. The amount of feed required for this is dependent on the condition at the time of drying off. Good legume hay and corn silage make an excellent basis for the dry ration.[8] The grain ration need not be complex. Many feeders feed the regular milking ration. In large herds, however, it is usually considered best to feed a fitting ration that is especially designed for replacing body condition. Such a ration will generally contain more fattening and conditioning feeds such as corn meal and linseed oil meal than does a milking ration. About two weeks before calving the amount of grain should be cut in half and that which is fed should be of a character to keep the cow laxative.

A day or so before calving all silage should be removed from the ration and the concentrates should consist solely of wheat bran. At the first signs of calving, many feeders will give a dose of epsom salts to insure a laxative condition. Several days before calving the cow should be placed in a clean, roomy, well lighted stall, preferably away from the noise of the rest of the herd.

The condition of the cow should be noted regularly. Water should be withheld from 12 to 24 hours before calving. After parturition, the cows condition may be likened to a runner at the end of a race. She is tired from the exertion of labor, and warm. She will want water and this should be given at body temperature. It is advisable to blanket the cow and allow her to cool off slowly. In many cases this will

prevent the retention of the afterbirth.

The cow should not be milked out clean for a day or so after calving. Allow the calf to nurse at will and then several times a day sufficient milk should be drawn from each quarter to relieve the pressure. After the second day the cow can be milked out entirely[15] and on the third or fourth day is ready to take her place in the herd.

Summer and Winter Management Problems

The chief difference between the summer and winter management practices with dairy cattle are of course supplied by the difference in climatic conditions and the availability and use of pasture. In most parts of the country, and particularly in the north, winter management calls for keeping the cows inside most of the time. This necessitates greater attention to bedding, lighting, ventilation, and handling manure. The comfort and cleanliness of the cows must be kept in mind at all times. A good bed should be kept under the cows and the manure should be removed or covered up as much as possible to keep the animals clean. Ventilation should be closely watched. The cows should not stand in drafts, but should have an ample supply of fresh air.

In summer these problems are to a great extent removed by the fact that the cows are on pasture most of the day. When shade is provided in the pasture, the cows may be left on pasture all the time except at milking time. In some cases, during very hot weather, it may be advisable to bring the cows into the barn in the heat of the day and allow them on pasture only

during the more comfortable hours.

In most parts of the South and the more temperate regions of the Pacific Coast, the cows are left on pasture nearly all year around and the management for the whole year is quite similar to summer management in the northern regions. Greater cautions must be taken to protect the cows against sudden changes in weather conditions in the use of summer pasture in the south. The cows should not be turned out on very cold, rainy, or sleeting nights as there is a greater chance of the cows suffering from exposure.

Water and Salt Supply

Although the supplying of water and salt to milking cows could properly come in a discussion of feeding, it is quite an important management problem. Water is best supplied to cows in drinking fountains at their stalls. By this method the cows have access to water at all times and is a saving in labor from having to turn the cows out to water. Where it is necessary to use a trough it should be seen that the water is kept free of scum and foreign matter and that it is warmed during cold weather. It is very hard on the cows to have to drink cold water.

Salt should be supplied in a place where cows can have free access to it, in order to supplement that which is in the grain mixture. A good suggestion is to make a small trough for this purpose and place it in the pasture or paddock under shelter. A ground salt is prefered to rock salt or salt bricks, as the cows often receive aggravating cuts from the sharp edges

of the large crystals of salt.

Disease Prevention and Herd Management

The old axiom "An ounce of prevention is worth a pound of cure" has a shining example in dairy herd management. A few simple precautions of disease prevention on the part of the alert herdsman or manager may save much grief and expense.

In dealing with contagious diseases such as tuberculosis and Bang's disease the herd managers most effective weapon is regular testing by a reliable method and the immediate removal from the herd of all reactors.[8,16,17] Tuberculosis testing has been developed to such an extent that a yearly test is all that is necessary, while with testing for Bang's disease it is undoubtedly safer to test twice yearly. Cows that react to the test should be removed from the herd and either slaughtered or placed in an isolated "positive herd". The use of a positive herd has been of great assistance to breeding establishments. Often times great brood cows will react to the test and still breed but by placing them in isolation they may be retained and their calves saved. Two other preventative methods at the disposal of the herd manager are the avoidance, as much as is possible, of purchasing animals from other herds and the quarantining of all animals that are purchased. It should be the practice of the breeder to purchase animals only from herds that are tested and accredited free from disease. Once the animals are at the farm they should be placed in a 90 day quarantine away from all other cattle and should be required to pass a clean test each

30 days of the quarantine period.

Mastitis is an inflammation of the udder and is quite quite similar in nature to the above mentioned diseases as to control, but can be dealt with in safety without the necessity of isolation, with the exception of severe cases.[18,19,20] Testing regularly is again the basis of a control method. Severe reactors should be removed from the herd, their production is probably so low that their presence in the herd is no longer an economic question. Cows showing mild reactions should be placed at the end of the milking order and the hands of the milkers should be thoroughly washed and disinfected between each cow or before handling a negative cow. The teats should be dipped in a disinfectant solution to remove the remaining drop of milk and kill organisms on the outside of the teat. Where milking machines are used the teat cups should be dipped in a disinfectant solution between each cow.[20] Avoid exposure to inclimate weather, crowding in sheds or stanchion, and the use of excessively high protein rations. The cows should be given plenty of bedding.

There are several non-contagious diseases which can cause a great deal of grief in the breeding herd. The diseases that affect the cow at calving time are of the most importance and at the same time are probably the easiest to prevent. Retention of afterbirth and milk fever can be prevented almost a hundred percent by making sure that the cows are in good condition to calve and that they have the proper attention at calving time. Milk fever is apt to attack any cow at calving

time and particularly mature cows.[8-15] The good herdsman will always have a milk fever apparatus ready at all times to treat the disease before it has gone too far. The number of retained afterbirths in a herd can usually be reduced by avoiding the feeding of too high a protein content in the ration and by seeing that the cow does not cool off too quickly after calving.

Foot diseases also find prevalence in dairy herds. They may be controlled to a great extent by seeing that the cows get a normal amount of exercise, by trimming badly shaped hoofs, and by cleaning out a hoof at the slightest sign of lameness in a cow.

It should be kept in mind that the veterinary profession is specifically trained to treat the diseases of cattle, and no herdsman or herd manager should be so confident as to believe that he can treat all the ills of his animals without that training. True, there are some things the herdsman can do, but he should know where to stop in his attempts. Any herd of valuable animals should have the services of a competent veterinarian subject to their call. The herdsman should comply to the best of his ability to carry out the directions of the veterinarian.

General Management Problems

The outstanding general herd management is that of deciding upon the method and frequency of milking. The manager has to choose between hand and machine milking, and two, three, or four times a day milking.

The Method of milking to be used will depend to a large extent upon the size of the herd and the amount of labor available. Modern milking machines in the hands of careful operators and followed by stripping, for all practical purposes do about as good a job of the milking as do hand milkers.[15] Hand milking will produce somewhat more milk and for this reason is almost universally used in milking cows on official tests. Many breeding establishments will milk their main herds by machine, but quite a large proportion will milk all cows by hand. This is particularly true in the areas where labor is cheaper.

The frequency of milking will to some extent be governed by the availability of labor, but in the case of breeding establishments a desired frequency will be maintained irregardless of the cost of labor. Government workers[15] state that, "The increase to be expected by milking cows three times a day instead of twice a day will vary from about 10 percent for short periods of a month or so to 20 percent or more for the whole lactation." They also indicated that there is greater persistency where cows are milked three times a day. The intervals between milking should be as near equal as possible.

The problem of flies in the dairy barn is an important management problem both from the standpoint of sanitation and the comfort of the animals. Flies are divided into two general classes, the house flies and the stable and horn flies. House flies may be effectively combated by traps properly baited with molasses, sugar solution or milk and placed in a

sunny spot. Stable and horn flies must be combated by the use of spray. There are many types of sprays on the market most of which are quite effective. The cows and the windows of the barn should be sprayed at least once a day during the fly season.

The problem of dehorning vs. allowing the cows to keep their horns is important in herd management. Woodward and his associates[15] state that there is no reason for cows to keep their horns other than for appearance sake and their added value in the show and sale ring. However, the majority of the breeding establishments of the county seem to feel that these factors are of sufficient importance to allow the cows to keep their horns, for very few establishments dehorn their cattle.

Feeding and Management of Cows on Official Test.

Official testing of cows for milk and butterfat production has become one of the most important parts of the purebred cattle industry and without it no breeding establishment can be considered to be doing a really constructive piece of breeding. This kind of testing is the proof of any breeding program and is our best method of answering the question of "Are we breeding better dairy cows?" By testing we prove the transmitting ability of the bulls and give cows an accurate and comparable basis for judging her ability to produce milk. The purebred industry is fast approaching the time when there will be no market for the offspring of untested animals.

Since a cow inherits a certain milk production capacity, it is reasonable to believe that if we control the factors of environment in such a way as to give the cow every opportunity to produce at her maximum capacity, the total milk and fat she produces will be an accurate indication of her inherited ability to produce milk.[21] In handling cows on official test, the object is then to give the cow every care possible in order to secure the maximum amount of milk and butterfat.

Two types of testing are available to the breeder. The Herd Test plan calls for the testing of all cows in the herd each year, while Advanced Registry or Registry of Merit testing allows the testing of any number of individuals for either a year or ten months. Tho both types have their separate advant-

ages and disadvantages. The latter form is the most popular by a good margin.

In most cases where individual testing is done the individuals to be tested are selected by the nature of the breeding program. That is to say the daughters of certain bulls and certain cows are most likely to be chosen to be tested because of the interest in proving their line of breeding, rather than just to select a cow to make a large record.

Feeding test cows is much more of an individual proposition than even the feeding of a regular group of dairy cows. The first consideration is in seeing that the cow is properly fitted to be put on test. The cow should be given a dry period of not less than two months and should be fed a good fitting ration with plenty of legume or mixed hay. At calving, test cows should show a maximum of finish without being excessively fat. The greater the amount of condition, the longer high milk and fat production will be maintained.

After proper precations have been taken and the cow is safely through calving, she should be moved to the barn in which she is to be milked on her record. A box stall is preferred for this purpose for reasons mentioned previously, but many test cows are successfully handled in stanchions.



Figure 5. - An excellent test cow barn.

The feeder should use careful judgment in getting the cow on full feed. Maximum feed and consequently maximum production should not be reached until about the 40th day after calving.[21] The feeder should make a gradual change from the fitting ration to the milking ration starting a day or so after calving. Once the milking ration has replaced the fitting ration the increase in feed may be started. A good rule to follow in making this increase is to increase the amount of grain at the rate of 0.1 pound per feed until maximum feed has been reached.[9] Every precaution should be taken to prevent forcing the cow and throwing her off feed, for this means a serious loss in production and time.

Pasture and silage should be limited in their use in feeding test cows.[21] These feeds tend to fill the cow with a bulk, low nutrient feed and reduce the amount of concentrate that can be consumed. Pasture should be limited to two or three hours a day and might well be divided into two

portions each day. Silage should be limited to 30 pounds or less per day and in many cases is replaced entirely by beet pulp.

Hay is important in test cow feeding. The ideal is the best quality alfalfa that is possible to obtain. An occasional feed of mixed hays will give the ration a little variety. The usual practice is to feed all the hay a cow will eat.

The grain ration should contain a variety of palatable, light feeds, about five or six different grains and by-products being considered as a minimum number. The protein content should vary according to the quality of hay available and the stage of lactation. Some feeders find it advantageous to have a mixture of a medium protein content and supplement this with corn meal or linseed oil meal to lower or raise the protein content of the feed according to the requirements of the individual feed. The grain should not be fed separately as it will tend to form balls in the cows stomach and not be completely digested. For this reason it is best that the grain be mixed with a bulky feed such as beet pulp.

The use of special feeds such as chopped beets and carrots, beet pulp and molasses have been found to have a stimulating effect on milk production.[9] Soaked beet pulp is particularly advantageous to feed to test cows because it is bulky, succulent, palatable and cooling.

The management of test cows should aim to provide comfort, regularity, and quick, complete milking. The efficiency of the milker is an important factor. He should be gentle

with his animals, regular in his hours and above all be able to milk the cow completely at each milking. Carl Crockerall[22] famous for the three Worlds Champion Holstein and Guernsey cows he has produced states that it pays to make "pets" out of test cows and render them such care as will gain their complete confidence. Daily grooming and giving them an extra bit of their favorite feed after milking will go a long way in helping to get the maximum production that is desired.

Calf Raising and Growing Heifers

Within the breed, all other things being equal, the larger cow has the advantage in the show ring as well as at the milk pail. The size of a cow at freshening is dependent on the thoroughness with which the heifer has been grown out. The ability of the growing heifer to convert feed into good body growth is to a certain degree dependent upon the start she received in life as a baby calf. So it may be seen that to a certain extent at least, efficient milk production starts with the young calf the day it comes into the world.



Figure 6. - The well grown calf has the advantage in milk production, breeding, in the show ring and in selling.

Proper calf management should start as soon after birth as the attendant can be there. It is wise to observe the cow closely as calving time approaches so that any necessary assistance may be given. The first thought for the calf should be to see that it is breathing properly.

Calves are often lost at this time due to a stoppage in the nasal passage by water or mucous. If the calf is not breathing properly, it should be raised by the hind legs and any water in the passage allowed to drain out. The calf should then be laid down and any mucous removed from the nostrils and mouth. Artificial respiration can then be applied by a rythmic application of pressure and release on the chest cavity.[23,25]

Once the calf is breathing well it should be dried. The cow will no doubt attend to this, but it may be well to assist her. Once dry, attention should be turned to the naval. It need not be tied or cut, but should be disinfected with a good disinfectant solution and then covered with a disinfectant dusting powder which will tend to hasten drying and shriveling of the tissue.[8,23,24].

By this time the calf no doubt will want food. If it can stand and get to its mother all is well, but if not it should be assisted in nursing the important colostrum milk from its mother. Provided everything is normal to this point, the calf and cow are best left alone.

Authorities disagree on the length of time the ~~cow~~ calf should be left with its mother. Shepherd and Miller[23] say that 12 hours is sufficient while Mead[24] recommends that the calf be allowed to stay 36 to 48 hours. Both methods are in common practice, the majority, however, seeming to favor a time of three or four days. Where shorter times than this are used, the milk of the mother should be fed to the calf until it is four or five days old. The calf should at once be taught to drink from a bucket, if it is to be fed by hand.

There are a number of methods of calf feeding from which the breeder may take his choice. His selection will to a great extent be influenced by economic factors, chief of which is the nature of his milk market. The most used methods are the use of nurse cows, feeding whole milk, feeding skim milk, the feeding of prepared calf meal and the feeding of dried and condensed dairy products, particularly skim milk and buttermilk.[23,24,25]

The use of nurse cows for raising calves is not very widespread simply because it is more expensive than other methods.[25] However, many breeding establishments have one or two old brood cows no longer suited for service in the herd. These cows must be kept for the value of their own offspring and many herd managers find it advantageous to allow them to raise four or five calves each year. Calves are usually left with nurse cows until they are fifty to sixty days of age, then gradually weaned by reducing the number of times they nurse each day.[25] By this time they are eating sufficient roughage and concentrates to grow normally without milk. The calves have been given an excellent start and after that growth comes easier.

Whole milk is unsurpassable as a calf food but the high cost makes it impracticable to feed for any length of time. It would be quite ideal to be able to feed whole milk for from four to six months, but this would make the cost of raising the calf almost beyond reason. A substitute for this method that has proven satisfactory in many cases is the minimum whole milk

method.[24] By this method calves are given a good start with a months feed on whole milk, then weaned and carried on grain and roughage. It is advisable to include a fair quantity of dried skim milk or soluable blood flour in the grain mix with this method.

No food so satisfactorily replaces whole milk as does skim milk and the authorities generally agree that so far as future development is concerned it is quite on a par with whole milk.[8,24,25] Wherever it is practical for a breeder to obtain skim milk in sufficient quantities to feed to his calves in liberal amounts until they are from four to six months of age, he should make use of it. Fresh skim milk is best suited for calf feeding but where this is not available either pasturized or reconstructed skim milk can be used with no ill effects. The three methods of calf feeding may also be used interchangeably without serious consequence to the calf.[26]

When skim milk is fed the calf should be given a start of two or three weeks feed on whole milk and then changed to skim milk by gradual substitution, about seven to ten days being required to make the change. Skim milk should be fed until the calf is from four to six months old, the usual result being that the longer the skim milk is fed the better the results.

The use of calf meals, either commercially or home mixed has been widely accepted as a calf raising method among the wholesale milk producers. These, calf meals, often called "milk substitutes" are usually of a mixture of grains and grain

by-products, with liberal amounts of skim milk powder, soluable blood flour, steamed bone meal and other animal sources of protein. A typical example of a calf meal is found in the Beltsville Calf Meal developed by government workers.[23] It contains:

50# ground corn
15# linseed oil meal
15# finely ground rolled oats
10# dried blood flour
10# dried skim milk
1# salt

Calf meal may be fed either as a finely ground mixture or in the form of pellets, as is often the case with commercially prepared feeds. The usual procedure in feeding calf meals is to feed the calf liberally on whole milk for the first four weeks, thus giving the calf a good start. The calf meal and a good quality roughage should be kept before the calf at all times and the calf encouraged to eat as much as possible. If the calf is normal at four weeks of age the milk is gradually discontinued and the calf fed only the calf meal and roughage.

In some sections of the country large quantities of concentrated dairy products are available and have been found in many instances to make good calf feeds.[23,24] The use of such products as dry skim milk, dry or semi-solid buttermilk and whey have been successful in the feeding of calves. The condensed and dried products are usually diluted down to a normal consistency, the dried products being diluted in the ratio of 1 pound of powder to 9 pounds of water and the condensed skim milk and

semi-solid buttermilk in the ratio of one pound of condensed product to three pounds of water. Where whey is used it is fed in its natural form. Care should be taken to see that it is pasturized before leaving the plant and that the acidity is not uncommonly high.

There are a number of general considerations in calf feeding, of which the lack of attention to any one might cause serious results. In the first place all milk should be warmed and fed to the calves at body temperature. Variations in this or neglect may cause serious digestive disorders in the calf. Another important factor is the care of milk feeding utensils. All cans, pails, and other containers used in feeding calves should be thoroughly scrubbed, rinsed, and sterilized after each feeding. A good rule is to handle the calf feeding utensils in the same way one handles the regular milking utensils.

The grain ration of a calf need not be complex.[23,24,25] Four constituents, yellow corn, oats, wheat bran, and linseed oil meal are the basis for practically all calf grain rations. In fact, an excellent ration can be made by mixing equal parts by weight of these four ingredients. The protein content may be varied by raising or decreasing the amount of corn and linseed oil meal to give the desired proportion. As has been indicated before, grain rations intended for use where milk is removed from the ration at an early age should contain one or two sources of animal protein, the best of which are dried skim milk and soluable blood flour.[24]

Calves should be induced to eat grain in small amounts from the time they are about a week old. This may be done by placing a little in the bottom of the bucket after the calf has had its milk. It is well to place a small box containing the grain mixture in the stall of the calf where he may nose over it and acquire a taste for the grain. A normal calf should be eating approximately two pounds of grain per day by the time he is two months old.[23]

Calves show a preference for and do better on whole or coarsely cracked grains.[9-25] Corn can be fed either whole or cracked once and oats can be fed whole or rolled. This applies to calves up to six to eight months of age, after which it is best to grind the mixture to a medium consistency.

Hays for calves can be drawn from any classification of hays, provided the several qualifications are met. First the hay should be of good color, light, early cut, and free from heavy stems, and second, it should not be laxative. Alfalfa, when not too bright and rich is a good calf hay. Clover is also very good, but probably the best of all is an early cut mixture of timothy and clover. Hay should be fed in mangers or racks where the calves can have constant access to it between feeding times, without soiling it.

Silage is generally conceived to be a satisfactory feed for calves provided it is fed in limited quantities and is not fed at too early an age.[23] About two to three months of age is as early in life as a calf should be offered silage.

Water, minerals and vitamins are important in calf feeding. The calf should be supplied regularly with fresh clean water. With young calves it is well to offer water once a day about midway between the feeding times.[23] Calves old enough to run together should have access to a water trough or bowl. Minerals are not usually found lacking, with the possible exception of salt which should be incorporated in the grain ration. Calcium is generally supplied by the hay and milk while phosphorus is found in large quantities in the wheat bran and linseed oil meal. To be on the safe side many breeders place a box containing salt and ground steamed bone meal in the calf pen. This is of most importance after the calf has been weaned, and the source of calcium in the milk has been removed.

Like the minerals, the vitamins are also supplied by good quality hay and a grain ration of a normal protein content. In regions where there is a low amount of sunlight in the winter, breeders will often feed a small amount of cod liver oil in order to insure sufficient vitamin A and D. This is usually fed in the milk of younger calves and mixed with the grain for older calves.[23,24]

Pasture should not be counted on too heavily as a calf feed. Many breeders turn heifers on pasture at too young an age and afterwards discover that the heifers are not well grown out at freshening. Belteville workers[23] state that fall and early winter calves will make good growth on pasture the following spring and summer if the pasture is supplemented by skim

milk and grain, or grain alone when the calves have reached the age of four to six months. Late winter and spring calves should be allowed pasture only as a means of exercise.

When care has been taken to give the calf a good start its year as a yearling heifer should not be neglected. All too often yearlings are stuck off on a back place of the farm and little thought given to their feeding until they come up at freshening time and are stunted from lack of care. The feeding of the yearling heifer need not be as particularly done as is that of the calf, for the heifer is better able to take care of itself. After the calf has been weaned, the object should be to keep the heifer growing. The main thing in accomplishing this is a constant and liberal supply of good roughage.[23] Good pasture in summer and good roughage and silage in the winter will supply the needed roughage. Grain should be fed in addition in quantities sufficient to keep the heifers in a good condition of flesh. Heifers should not be kept fat, but a good fleshing indicates that the heifer is getting food sufficient to satisfy growth requirements, whereas with a thin heifer one cannot be sure that the growth requirements are being met.

The housing of calves should be given more detailed attention than is necessary for the milking cow. The ideal calf barn provides individual stalls for the smaller calves and groups the larger calves into groups of from four to ten. The barn should be light and airy but free from drafts. It should be tight enough to keep the calves warm in the winter, but should have sufficient ventilation to provide ample air supply. Above all, the calf barn should be kept clean. Bedding should

not be allowed to accumulate and the mangers or feed troughs should be kept clean. Pens should be completely cleaned out, disinfected and supplied with new bedding before a new calf is placed in it. In housing heifers the main consideration is to provide shelter and a place to feed. In some climates a shed will do for this purpose, but in colder regions a closed barn should be provided where the heifers can be tied up and fed in mangers.

Disease prevention among calves is to a great extent a management proposition. Clean surroundings, good feeding, avoidance of drafts, and close attention to the individual is the best method of keeping the calf herd healthy. The two most dreaded diseases, white scours and hemorrhagic septicaemia are successfully combated by innoculation in most cases. Once these diseases have a hold in the herd, all calves should be innoculated for both within a few hours after birth.

Selection, Care and Management of the Herd Sire.

There is an old saying that "A good bull is 50% of the herd, while a poor bull is 100%". No animal in the herd exerts as much influence on the future of the herd as does the bull. If he improves the milk producing efficiency of the herd, it is the general practice to give him credit for half of the good work. But if he lowers the standards of the herd, all of the blame is heaped upon him.

Selecting the Herd Sire

The breeding establishment literally stands or falls on their ability and success in choosing a herd sire. This is the most difficult task of all, to be able to select a bull that will raise the quality of an already good group of cows. And once they have made their selection and found just the bull for the purpose, their troubles are only commencing, for they must now start again and find a still greater bull to continue the improvement. If one were to study the history of an unusually successful breeder he would no doubt find his success was largely based upon one or more great transmitting bulls. A noted southern breeder was once asked to give his opinion on who were the five outstanding breeders of his breed, to which he replied, "The men with the five best bulls of the breed." And so it is seen that a breeder is no greater than his bull and his bull depends largely on his ability to select a dairy sire.

Generally speaking, we have two alternatives in selecting a herd. First we may choose a bull that on the basis of the appearance and performance of his daughters has stamped himself as an outstanding sire, or we may choose a young bull on the basis of ancestry and individual appearance as an indication of an animal that will sire good dairy cows.

A proven sire may be regarded as one having a minimum of five tested daughters out of tested dams. A good proven sire should have daughters which average 20 percent higher than the breed average for butterfat production. Consideration should be given to the possibility of a difference in the feeding and handling of the dams while making their records as compared to the conditions under which the daughters made their records.

It is best to select a bull that sires a uniformly high increase in milk and butter fat production, rather than one which makes large increases in some daughters, and decreases in others.

The selection of a sire by choosing a proven bull is the shortest way out of this perplexing situation for it is possible to actually look at the finished product of his ability as a sire, rather than guess at his prepotency from looking at the individual himself and his pedigree. The one disturbing factor in this otherwise pretty picture is the fact that good proven bulls are comparatively rare and when one is found, it is a rare occasion that he may be bought at any price. It therefore, in most cases, becomes necessary to give up the idea of purchasing a proven sire and select a bull that the breeder can prove at home.

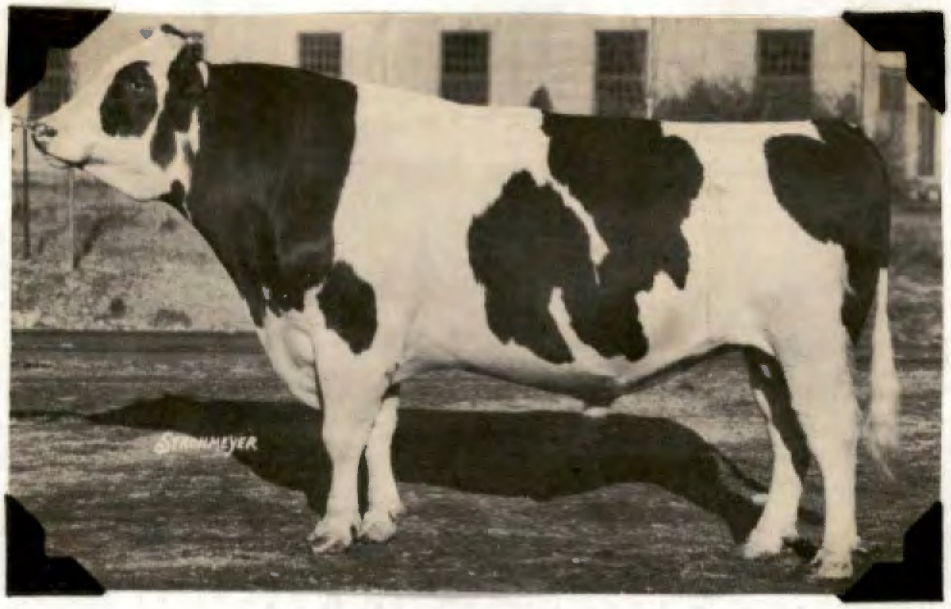


Figure 7 - The proven bull; a fine individual and the sire of show type and superior production.

Where an unproven bull is to be selected many things must be taken into consideration, first of which is the pedigree of the animal in question. Selby and Jones[27] are in disagreement with Eckles[8] as to whether the maternal or paternal side of the pedigree is the most important. Most genticists[30] seem to agree that the two parents contribute equally to the genetic make-up of an individual.

The sire's side of the pedigree should be headed by a good proven bull. His daughters should be uniformly good producers and of acceptable type. It is well if he has one or more sons that are also proven bulls in good herds. The dam of the sire should be the daughter of a good proven bull and the sire's sire should be a good proven bull.

On the maternal side our first consideration is the record of the dam herself.[27] She should be a cow of superior producing capacity and good individual type. Her sire should be a good proven bull and her half sisters from her sire should be uniformly good producers. Secondly, she should have tested offspring of both sexes whose production indicates her ability to transmit high production to her offspring.

Considering the pedigree as a whole it should first of all show uniformly high production throughout as indicating an ability for that quality to be handed down from generation to generation. Show ring winnings indicate type and its ability to be transmitted.

The relationship of the production of the dam to that of her daughters and more particularly that of her sons' daughters is particularly important and interesting when selecting an untried bull. Copeland[40] studied this relation in some 694 Registry of Merit Jersey cows who had at least one Registry of Merit daughter and one Registry of Merit son. He states:

> "It is evident that there is some correlation between a cow's producing ability and the producing ability of her daughters. In general the daughters show about 32 per cent as much variation from the breed average as do the dams.
>
> There is a slight correlation between the dams record and the record of her sons' daughters. However, it appears that very little progress can be hoped for if sires are selected solely on the basis of their dams' records.
>
> The results of the last phase of this investigation indicate that when an average is made of the dams' record, the dams' sisters' records and the dams' daughters' records the average figure obtained

> in this manner provides a more accurate and reliable index as to a bull's probable transmitting ability than does any one of these factors considered by itself."

Eckles[8] indicates considerable variation in bulls transmitting ability even when the best methods of selection are employed.

After due consideration has been given to the pedigree of the individual in question the animal should be considered from the standpoint of his type and appearance. In diary breeding this factor is less indicative than in beef breeding.[8] However, the conformation of the bull should give an indication of what his daughters are to be like, and it is best that the bull should show good bred character, dairy temperament, capacity and constitution, and masculinity.

There are several other factors to be considered in the selection of the bull that deserve mention here.[27] In the first place the breeding of the bull should fit into the breeding program of the herd. He should represent currently popular bloodlines that fit well into the scheme of the breeding of the rest of the herd. Next the reputation of the breeder means something. The breeder should be willing to stand back of his animals and make them good in case of failure. Other factors, such as age, fertility, cost, and health must also be kept in mind.

It must be kept in mind that a bull possessing all the qualities outlined in the foregoing paragraphs is an ideal and is as rare and individual as the good proven bull. When such

an animal is to be found it is only the upper class of breeders who can afford to own him. The rest of the breeders must be content with bulls lacking some of the qualities of this ideal, but keeping these points in mind should strive to get as many as possible in their bull.

Feeding and Management of the Herd Sire

The feeding of the herd sire, both young and old is a function of good dairy management that is all too often neglected. It should be kept in mind that the purpose in feeding youg bulls is to promote a maximum of growth, while in mature bulls the object is to keep the animal potent and in good breeding condition.

Young bulls may be fed and handled much in the same manner as are heifers.[28] It must, however, be kept in mind that bulls will usually grow faster than heifers and in order to insure maximum growth, feed increases should be made a little faster than for a heifer. Where skim milk is available for feeding the age of weaning should be delayed to eight or ten months of age. If skim milk is not fed, liberal amounts of animal protein such as skim milk powder or dried blood flour should be included in the grain ration until the bull is eight to ten months old. Young bulls are usually separated from the females at six months of age.

Service age bulls may be fed grain rations similar to or just like those used for the milking herd. Many breeders prefer a special bull mixture containing larger quantities of oats. A good grain mixture for service bulls is as follows:[29]

300# ground oats

200# wheat bran

100# soybean meal, linseed oil meal, or cotton seed meal.

Grain should be fed according to the size, condition and amount of service of the bull. The bull should be kept in a normal flesh as either extremes may cause impotency.

Hay is an important feed for bulls, though many breeders do not like to feed large quantities of it. A good legume hay is very good, but a mixed legume and timothy is probably the ideal. It is advisable to feed all the hay the bull wishes.

There is a great deal of contraversy as to the advisability of feeding silage to bulls. It is quite a common belief that silage will injure the breeding powers of the bull. Most authorities[9,23] agree that there is no scientific backing for this belief. Common recommendations are to feed silage to bulls in rather limited amounts, not usually in excess of 20 pounds daily. Large amounts of silage tend to make a bull paunchy and slow in breeding.

Breeding bulls should be housed in a separate building from the rest of the herd. In milder climates a shed with a southern exposure will be sufficient, but in the colder regions a complete inclosure should be provided. Where there are many visitors and the condition of the bulls is important from a selling standpoint, it is best to provide a complete enclosure. (The bull will stay in a better condition of hair and be more presentable.) Each bull pen may be provided with a

separate exercise yard approximately sixty to eighty feet long and about twenty feet wide. It is often a practice to turn a number of bulls together in a large yard or lot for exercise. The bulls usually get plenty of exercise, but there is more handling and greater danger from this method. A barrel or post may be placed in the yard for the bull to butt and encourage exercise. A breeding rack should be supplied either adjacent to or near the bulls yard.



Figure 8. - Bull barn on modern breeding establishment.

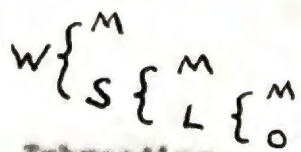
The bull never should be allowed to be petted. He should always be handled with firmness and caution. He should be taught to lead and stand correctly and should be handled as often as is practical. When about a year old he should have a strong ring placed in his nose and as soon as the wound is healed he should be taught to lead and be handled by it. Artificial exercise, such as a bull merry-go-round or a tread mill is excellent wherever practical.

A young bull is ready for light service at the age of 10 to 12 months of age[27,28]. From twelve to eighteen months he may have about one service per week, and from then to two years about two services per week. After that he may take his place among the service bulls for regularly spaced service.

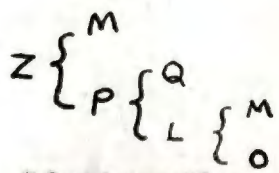
Breeding Methods in Dairy Cattle

A number of famous men have spent their lives studying and writing on the subject of breeding dairy cattle, and have developed the art to such an extent that to cover it completely would be far beyond the scope of this thesis. It is hoped, in this thesis, however, to briefly describe the several methods of animal breeding and to show their relation and practical application to the methods used by our modern breeding establishments.

There are three principle systems of breeding dairy cattle in use at the present time, namely, inbreeding, linebreeding and outcrossing. Some authorities[30] are inclined to combine the first two systems and call all animals inbred if any ancestor appears more than once in the pedigree. Other writers[31] divide inbreeding and linebreeding according to the intensity of the inbreeding. It is, however, hard to draw a line separating the two types of breeding. There is general agreement[8,27,30] that inbreeding may be defined as those cases where the parents of the animal have fifty percent or more common ancestry, whereas linebreeding may be defined as those cases where the parents of the animal have from twenty-five to fifty percent common ancestry. The following examples taken from Lush[31] show how inbreeding and linebreeding may appear in a pedigree.



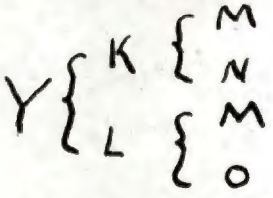
Inbreeding.



Linebreeding.

The animal W it is seen is intensely inbred to M, where Z is a clear case of linebreeding.

Even with this rather clear distinction between inbreeding and linebreeding, the following example Lush[31] considers linebreeding, but the parents have fifty percent common ancestry in that they are both sired by M. This is possibly an exception for most authorities consider this mating of half brothers and half sisters as linebreeding.



Inbreeding and linebreeding, whether considered as two different degrees of inbreeding or as two separate systems of breeding are, next to selection, the most effective processes at the hands of the breeder. It serves the intelligent breeder in two ways, first to produce outstanding animals and after that to maintain their good qualities over as long a period as possible. Many bad traits have been attributed to inbreeding and linebreeding, though usually without sound backing. It is true, however, that defects are fixed by inbreeding and linebreeding just as surely and just as strongly as are the good points that we are breeding for. It is therefore necessary in breeding of this nature that we start with as nearly perfect an animal as possible and then use rigid selection to remove the defects as they appear.

"Family breeding" has played an important part in the breeding of every breed of dairy cattle, and its success in

holding together the desirable characteristics of a certain outstanding individual may be attributed almost completely to inbreeding and linebreeding. The great May Rose Guernsey family or the Design Jersey family have retained their outstanding qualities through many generations only by the constant systematic inter-breeding of the descendants of May Rose II and Design Fern Oxford. Had their blood been scattered at random through the breed the great breeding powers of these individuals would have been lost in one or two generations.

Outcrossing is the third important system of breeding now used by our dairy cattle breeding establishments. Outcrossing differs from inbreeding and linebreeding in that rather than intensifying blood it deals with the introduction of entirely new blood into the breeding program. This method of breeding is often used to introduce new blood into a herd that has been inbred or linebred, and in many cases the outcross is to another highly developed family of the same breed through an animal that is distinctly inbred or linebred. This represents practically the only use of outcrossing in modern dairy cattle breeding.

No discussion of breeding methods could be complete without an accompanying discussion of the care of selection. Rommel[37] states that "------one must have clearly in mind a standard which he sets for himself as the ideal toward which he must work. This standard must be definite and should be as practical and simple as possible. The exercise of selection, wisely and judiciously pursued, offers the breeder one

standard. Selective culling of inferior animals from the herd should be a regular function of the breeder.

The "nicking theory" is quite prevalent in dairy cattle breeding.[8] This theory holds that certain bulls when mated with one group of females will give very desirable offspring, but when mated with another group of equally good females will give a decidedly poorer offspring. Eckles,[8] recognizing the fact that this phenomena has been observed many times in actual breeding practice, maintains that "---if both cow and bull are prepotent for high production, the descendants of such a cross are bound to be high producers." Eckles theory may be right, but if a breeder finds that a well bred bull is not working out right on his well bred cows, it is better that he change to another bull.

Considerable interest has been shown in recent years in the use of bull indexes as a method of evaluating the transmitting ability of breeding bull. There are many different types of these indexes, chief of which are the Mount Hope Index, the Pearl-Gowen Index, and the Gowen-Gifford method.[27] The aim of each of these is to evaluate the transmitting ability of a bull in terms of the production of the bulls daughters in comparison with that of their dams.

E. Parmalee Prentice,[41] originator of the Mount Hope Index which was the first to be devised, in speaking of indexes says that, "Of course, the characteristics of milk production does not express itself in the male. It is however, transmitted by the male, and appears in his daughters,

where it is mingled with the inheritance they receive from their dams. Since productive ability is inherited, it follows that, on the average, the daughters are between parental levels. If, then, the dam's average is known, and the daughter's average is known, it is not difficult to place the sire."

In other words the producing ability of a bull's daughter is effected by his and the dams transmitting ability in such a way that their average is between those of the parents. If the daughters average is higher than that of the dams, the bulls average is still higher, and if the daughters are lower, the bulls average is on a still lower plane.

Keeping Records on the Breeding Herd

One of the quickest ways of distinguishing between a progressive and an ordinary dairyman is to notice the completeness of the records that a man keeps on his dairy herd. The good dairyman realizes that it is extremely difficult to progress without a complete knowledge of the performance and breeding of his herd. The operator of the breeding establishment also realizes the important part records play in the progress made by his herd.

The starting place of all dairy herd records is in the keeping of milk production records. Eckles[6] points out the fact that there are five distinct advantages to be derived from the keeping of daily milk records. They are:

1. It makes it possible to know which cows are profitable and to dispose of inferior animals. It is one basis upon which a breeder might cull his herd, for he must keep only those animals that can produce up to his standard. The exception to the rule comes in the old brood cow no longer kept for milk production but for the value of her offspring.
2. It makes possible the feeding of cows according to their milk production. Efficient feeding is based upon knowing the amount of milk being produced by each individual in the herd, and efficiency cannot be had by guessing.
3. Keeping of daily milk records gives the herdsman an opportunity to detect sickness in any individual before it would otherwise be detected. It is a

well known fact that a cow will show a decrease in production as one of the first reactions from a sickness. This is an immediate sign to the alert herdsman.

4. Daily milk records afford the herdsman an opportunity to check on the efficiency of his milkers. Milkers vary a great deal in their ability to completely milk a cow, and the herdsman by matching the milk records can detect this fault.

5. The last advantage of keeping daily milk records is the added interest the feature creates to a task that is at best more or less monotonous. Watching the actual figure of a cows production through the year adds greatly to the interest one takes in the cows he is handling.

The daily milk records should be accompanied by periodic butterfat tests of the milk to learn the amount of fat each cow is producing. Records are usually spoken of in terms of the fat produced during the lactation. Butterfat tests are best run on a monthly or bimonthly basis[8] with a preference usually for the monthly type of record.

Of equal or even greater importance than the milk production records are the breeding records that are kept on the herd. Little confidence can be shown in a breeder who cannot show an accurate set of breeding records kept in all sincerity and honesty. The breeding establishment should be extremely particular in the method of breeding records that are kept.

A breeding record should contain the date of service, the name and number of the cow and the name and number of the bull and the approximate date of calving.[15] When the calf arrives the date of birth, sex, disposal and remarks should be recorded.

Breeding records should be made at the time of the service and preferably by the man who handles the cattle at service. Breeding is such a common place duty in a large herd that it is all to easy to forget to record the incident. Where the breeding record is not kept by the herdsman or man who handles the cattle, he should be required to make out a slip, giving the name of the cow, name of the bull and the date. These should be turned in to the bookkeeper as soon as possible.

The combining of milk, breeding, and progeny records into one permanent record is an important factor.[8] The herd book, as such a record is usually referred to, should be a complete and accurate record of the performance of each individual animal during her stay in the herd. Figure 10 illustrates an efficient type of herd record.

Each animal should have a separate page in the herd book. There are many forms in use for this type of book but the material recorded is essentially the same. On the front of the page the top space should contain the cow's name, registration number, herd number, date of birth, and name of the breeder. Immediately under this should be a pedigree form to contain a three or four generation pedi-

INDIVIDUAL COW RECORD

Summary of Total Milk and Butterfat Production

NAME _____ HERD NO. _____ REG. No. _____

CHISLEY PRINTING CO. KNOXVILLE

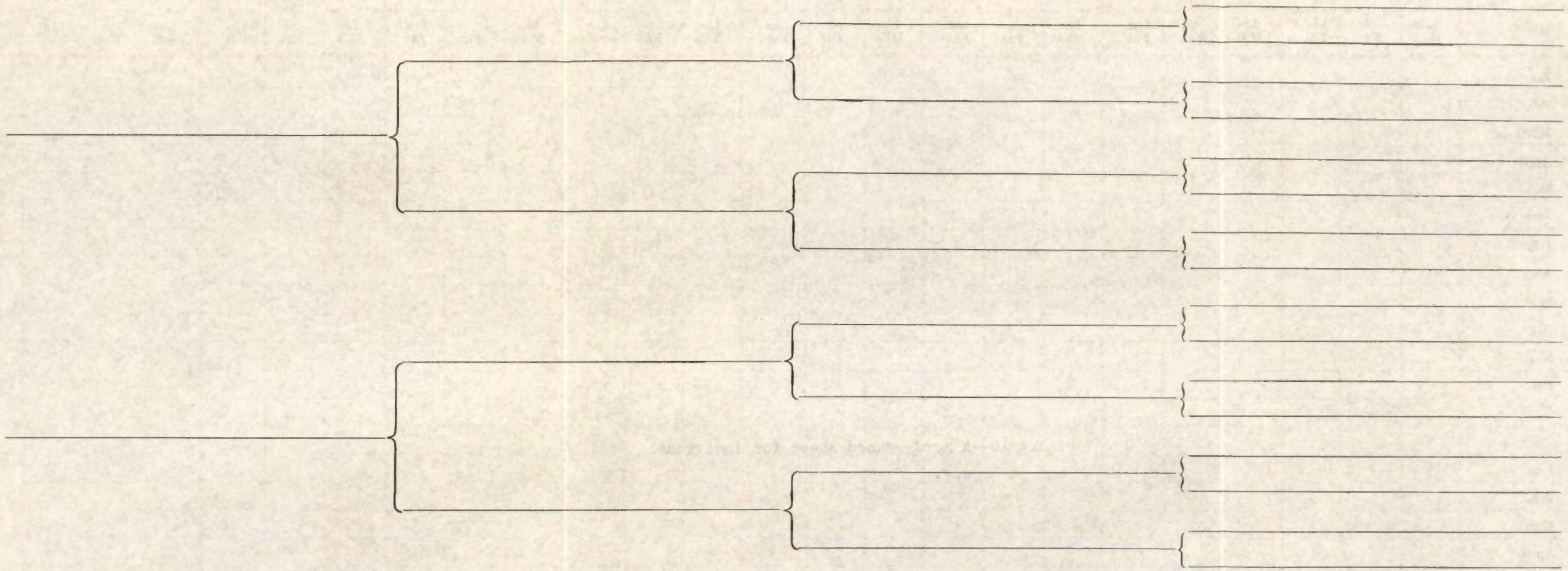
	19 and 19 Lactation No.			19 and 19 Lactation No.			19 and 19 Lactation No.			19 and 19 Lactation No.			19 and 19 Lactation No.			19 and 19 Lactation No.			19 and 19 Lactation No.			19 and 19 Lactation No.			19 and 19 Lactation No.		
Month	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat	Lbs. Milk	% Fat	Lbs. Fat
Jan.																										
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July																										
Aug.																										
Sept.																										
Oct.																										
Nov.																										
Dec.																										
Total																										
Days in Milk																										

Figure 10--A herd record sheet for individual cow.

HERD No. _____

NAME _____ REG. No. _____ RECORDED _____

DATE OF BIRTH _____ BRED BY _____ DISPOSITION _____ DATE _____



	Date Bred	Name of Sire	Date Due	Date Dropped	No. Days Gest.	Sex	Birth Weight	Herd No.	Name and Reg. No.	Entered on Folder	Disposition

gree.[8] On the same side of the sheet the breeding and progeny record should appear with columns for date bred, date dropped, sex of calf, name and herd number if raised for the herd, name of sire, number of sire, to whom sold, when sold, and remarks. (In this connection it is advisable that a separate breeding book be kept in which all the services are to be recorded. Only the services which produce calves are recorded in the herd book).

On the reverse side of the herd book page the milk production data may be found. This may be in the form of one column for each lactation and space for monthly recording of milk, fat and test. Totals and average test for each lactation will appear at the bottom of the column. The number of days in milk should also be recorded. Also the back of the herd book sheet might contain a record of show ring winnings.

There is often a question of a method of keeping registration, transfer and advance registry test certificates. It is doubtful if it is practical to keep them in the herd book. One of the best solutions to this problem is an envelope file for each animal.

Registration and identification is another problem that might well be considered under herd records, for herd records are of no avail if the animals are not properly identified. Each calf should be plainly marked before it is removed from its dam.[15] There are several kinds of mark-

ings available. The use of ear tags are quite popular and there are several types of these available. Neck straps containing a number are also often used.[15]

Tattooing is probably the most positive method of marking, for if it is properly done the calf has a permanent mark that will be with it for its lifetime and cannot be lost.

A diagram of the color markings should also be made. The use of nose prints in identifying cattle has also found favor among some breeders.

Fitting and Showing Dairy Cattle.

The showing of dairy cattle in competition has the primary object of encouraging the breeding and feeding of improved classes of dairy animals for practical purposes. Also the educational value of the show ring cannot be overestimated.[43] But besides these general advantages the breeder sees in showing the cheapest and most effective means of advertising their herds, as well as a medium of selling surplus stock.[42]

The first consideration in fitting and showing dairy cattle is the selection of the animals to be shown. This is usually a year around proposition ending in the final selection about 10 to 12 weeks before the herd leaves home. Most breeders are constantly watching their herds for show prospects and when prospects are found, they are watched for development.

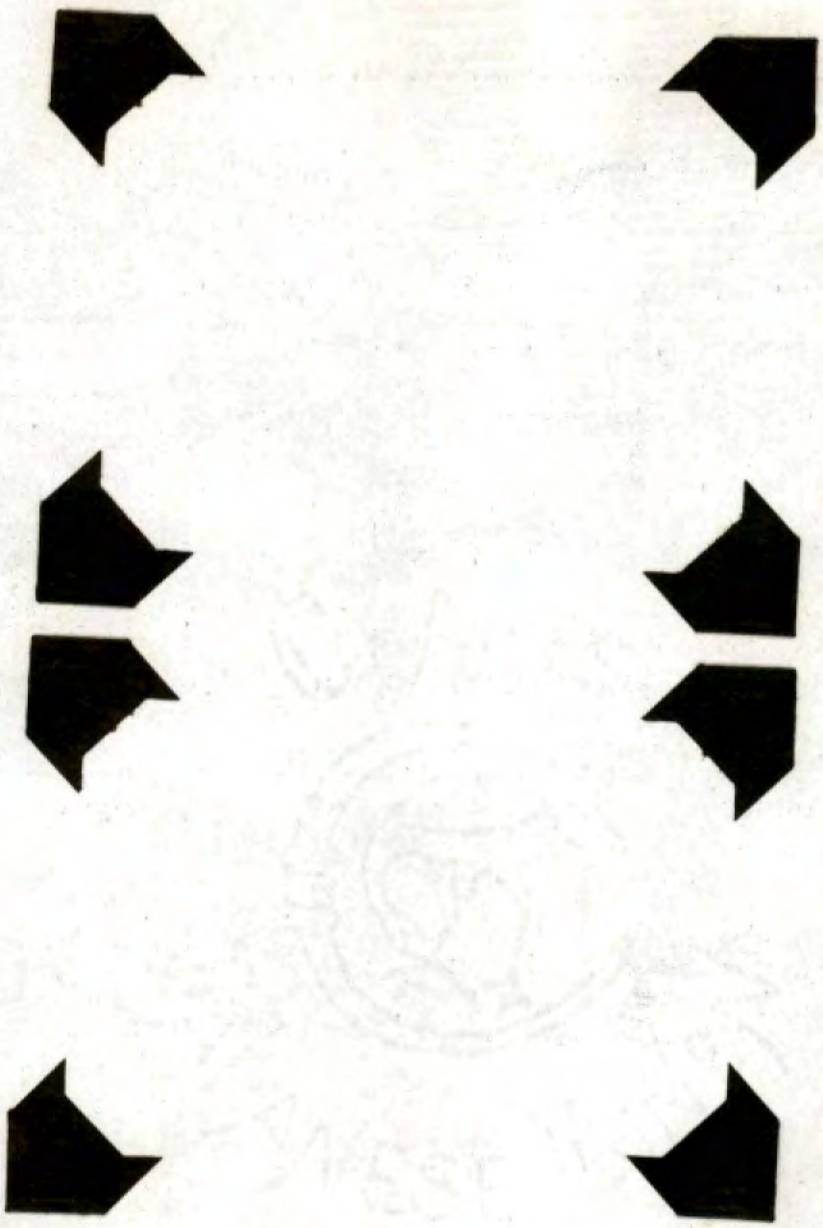


Figure 11. - Successful show animals add greatly to the prestige of the breeding establishment.

Cooper[42] points out the fact that there are five primary considerations in the selection of the show herd. They are:

1. Age and size. Animals should be as near the maximum

age allowed as possible and should show as great a growth as it is possible to obtain.

2. Breed type. Close conformance with breed type and dairy character are the first consideration in the show ring.

3. Stage of lactation. An animal close to freshening will always show greater bloom than one well along into the lactation.

4. Uniformity. A herd closely matching in color makes a better display than does one of wide variation in color. Uniformity is particularly helpful in the group classes.

5. Size of the herd. This will depend to a great extent on the number of animals that can be accommodated in a railroad car and the number that can be shown to a financial advantage. Usually one animal to each class is sufficient, and a herd of sixteen or eighteen animals will fill all classes.

The breeder must be a keen judge of breed type and dairy character for the success of his herd depend on his ability to pick for these qualities while the animals are in an unfitted condition.

The fitting period should begin from six to ten weeks in advance of the time the animals are to leave for the first fair.[42,43] The fitting barn should be cool and well ventilated and the animals should be lined up as nearly as possible in the order they will occupy at the fairs. A good method to

use in this is to line up by age starting with the bull, except the calves, and followed by the females in descending age order. The string may end with the bull calves.

The herd may be put on the fitting rations slowly. Most feeders like to feed a good conditioning grain ration such as the one suggested by Taylor[43] which contains equal parts of corn, ground or rolled oats, wheat bran, and linseed oil meal. Several commercial fitting rations are also on the market which give excellent results.

Most feeders prefer a succulent feed such as soaked beet pulp because of its succulence, bulk, laxative effect, and ability to tone up the appetite.[42,43,44] Silage is usually scorned. Grain may be mixed with the beet pulp. Hay should also be fed in large quantities. Many feeders like alfalfa for older animals and a mixture for the younger ones. A mixed clover and timothy is probably the ideal hay for the whole herd.[42] All feeding must be done according to the needs of the individual animal to get the desired results. Water should be given twice or three times daily.

As soon as the herd is in place in the fitting barn, blanketing becomes the first consideration. Blanketing induces sweating which mellows the hide, hastens shedding, keeps the hide clean and makes the hair lie smoothly, in addition to protection against flies and sudden changes in temperature.[43] Blankets should be made to fit smoothly and cover the cow completely. Lined blankets are not usually necessary, a heavy duck making the most practical blanket-

ing material.[42] Light cotton sweat blankets may also be provided to be pinned on underneath the regular blanket when the occasion demands.[42]

The daily operations around the animals are very important. Daily brushing is essential to put the hair and hide in a clean, soft and pliable condition. A rather stiff brush can be used at first to get out dirt and dead hair, but as showing time approaches a soft brush should be employed.[42] Washing light spots particularly on the flanks should also be a daily operation. The tails should also be washed and combed out every day.

The trimming of the feet and training of the horns is an important function for the early part of the fitting period. In fact horn training should not be put off until the fitting period, but taken care of during the winter. The feet of all the animals in the herd should be trimmed to a proper shape to give the animal a good upstanding hoof.[42] Care should be taken not to cut too deep and cause the animal to limp from soreness. Hoof trimming should not be put off as the animals must be given an opportunity to become accustomed to their properly trimmed feet.

Clipping is one of the most important functions of fitting. Contrary to popular belief it is rarely advisable to clip an animal all over.[43] The long hair on the body should be removed by blanketing and brushing. Those parts of the animal which tend to give the animal a shaggy appearance, such as the head, neck, udder, and tail, should be clipped to give

a clean-cut appearance.[43] The face of the cow and the top of the neck should be clipped clean and blended in to the other portions. As much switch as possible should be left on the tail and the rest clipped clean.[43] The underline and the udder may be clipped clean to show the mammary development. The underline on heifers is clipped only enough so that it does not look shaggy, as the added hair adds to the depth of the body.[42] This clipping should be done about a week before the herd leave for the first fair, and each animal should be trimmed up a day or so in advance of each show.

Daily exercise is essential.[42] This may also be turned into a training lesson to teach the animals how to lead, to walk slowly, to stop and start, to stand correctly and also to move its feet when touched by the foot. The number of times the animal is handled is probably more important than the length of each period.

The horns of each animal in the herd must be trained into proper shape.[42,43,44] If the horns are too long an inch or so may be sawed off of the ends without harm. A heavy rasp is used to give the horns a desired shape, and these are then finished off with a successive use of a light file, heavy sandpaper, light sandpaper, emery cloth, and finally polished with pummice stone and oil. A shoe polish or metal polish may be put on before the show.

Before the herd is ready to move the transportation should be arranged.[45] Trucking is only practical where there are a relatively small number in the herd and making only one or two nearby shows. In all other conditions a car is more

convenient. A fifty foot box car is needed for a full herd of sixteen head. Horse cars or special express cars are nice but expensive and not necessary.

To provide ventilation, a board should be removed from the sides about two feet from the floor.[42] Stalls should be built for all bulls over two years of age and should be about three and a half feet wide. Individual stalls for the larger females are also advisable[45] while the younger animals may be grouped by twos or threes. An overhead deck is usually placed in each end of the car and is generally from ten to fifteen feet long. Feed, bedding and sleeping quarters for the men are arranged here.

Lights in the car may be conveniently arranged at a low cost by using an auto battery and auto lamps.[45] Three lights are usually sufficient in the car with a switch near the caretaker's bed. Water is stored in a cylindrical tank in the center of the car and fresh water can be added at each division point. The tank should be raised about a foot off of the floor and provided with a faucet.

Rollers on the doors of the car usually need oil if they are to be closed quickly and easily.[45] Gates may be built to be locked, not nailed into the doors. This facilitates matters at loading and unloading time.[42] A good bedding of shavings and straw should be provided in the car, and the needed feed, hay and bedding loaded the day before moving.

When in the car the cattle should be tied both ways to prevent them from hooking. Grain feeding should be cut

in half while in transit, and water given in small, but frequent amounts to prevent excessive loosening of the bowels.

On arriving at the town where the show is to be held, one of the men in charge may leave the car, go to the fair grounds, locate the stalls assigned to his cattle and see that a comfortable bed is arranged. As soon as the car is "spotted", the cattle may be unloaded at once, taken to their stalls, cleaned up and allowed to rest.

It is best that the cattle be given a good rest before show day to get acclimated after their trip.[42,43,44] For this reason, many showmen plan to arrive at the more important shows several days and even a week ahead of the opening date. In doing this they can be assured of enough time to straighten out any animals that suffered from the trip. Where a complete circuit is scheduled it is hard to accomplish this and the best must be made of the existing conditions.

Preparation for show day is always a big job and it is preferably started the day before the show.[42] At that extra pains should be taken with the daily grooming and when the herd has been cleaned up a good bed is provided and care is taken in immediately moving manure so that the animals will not get dirty before show time. Tails should also be thoroughly cleaned at this time. The practice of braiding tails has been prevalent, but many showmen do not use it now.[43]

Filling the animals is also of importance in preparing for show day and it must likewise start on the night before the show. Taylor[43] points out that there are three ways of

putting fill on animals, as follows:

1. Give a liberal feeding of salt in the grain the night before and withhold all water until an hour or so before the class is called, then allow the animal to drink all the water it wishes.
2. Withhold hay a day before showing and allow the animal to fill on hay the morning of the show. Salt the grain the evening before and allow the animals to fill with water immediately before entering the ring.
3. Salt the grain liberally the night before the show and withhold water. About an hour and a half before the class is called, allow the animal all the soaked beet pulp it will eat and all the water it wishes.

The beet pulp fill has the advantage of lasting longer than the other fills, particularly if a good amount of hay is eaten the night previous.

On show day the animals should be brushed and curried early and their hair hand rubbed with a light application of a good fitting oil. Horns may be given a last shining and hoofs cleaned, then the animal is ready for the show ring.

The showman should be neatly dressed in white with a dark tie, belt and shoes. The number of the animal should be displayed according to the wishes of the showman. Showing starts the minute the ring is entered. Walk the animal slow-

ly, keeping one eye on the animal and one on the judge. Keep the head up and back straight. When asked to stop place the animal in a good pose and allow the judge to inspect it. The alert showman is always prompt and willing to comply with all requests of the judge, and others in the ring. The good showman is also a good sportsman and able to take victory without conceit and defeat with a smile.

Advertising and Selling Pure Bred Cattle

It would be a difficult problem indeed, to pick from all of our vast livestock breeding industry, a truly successful and progressive breeding establishment that has failed to realize the value in and make use of advertising. Holcombe[46] sums it up very thoroughly when he states that, "A large part of the breeders of the country are advertising. As a matter of fact it may be stated that every prominent and successful breeder advertises regularly."

Unfortunately, there seems to be very little literature available that gives any idea as to the best methods of advertising farm products and breeding stock in particular. Poag[47] indicates that industrial methods of advertising could be made to apply effectively in publicising farms and livestock. Industrial advertising, however, is carried on on a tremendous scale and for agriculture to approach it in scope would mean a highly organized cooperative enterprise. This would completely destroy the possibilities of a breeder advertising his own cattle, which of course is most necessary under a competitive system such as now exists. State advertisements in the breed papers are the nearest approach to cooperative advertising of breeding cattle.

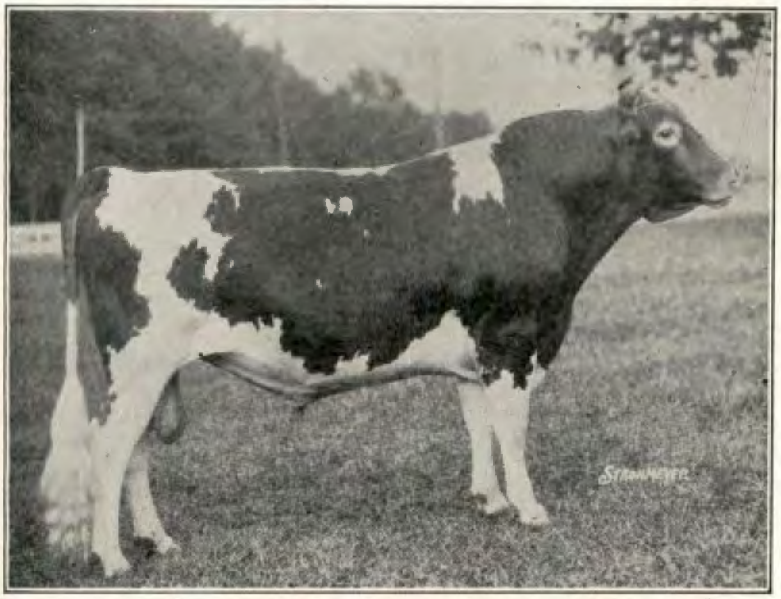
For the dairy cattle breeding establishment the best recognized media of advertising is the breed paper, for it reaches a greater proportion of prospective buyers than does any other publication. Dairy papers usually have a greater circulation than the breed papers, but they are less direct, having contacts among all breeds, and usually have a higher

advertising rate, thus limiting the amount of space one can use.

There are occasions when the breeder might want to reach a different kind of trade than is reached by the breed paper. He may have a number of animals not good enough to warrant advertising in the breed paper, but which might find a ready market in his own community. For this purpose the local, county, or state paper is a suitable media of advertising. A well written advertisement in one of these papers will reach a great many farmers who are prospective buyers for this class of animals.

The writing of a good advertisement is an art in itself, and far too complicated for detailed discussion here. Suffice it to say that the writer should first have something to talk about, then say it in a concise, direct manner and use an illustration if possible (see Figure 12). Probably the greatest fault among the writers of advertisements for breeding cattle is that of trying to crowd too much material into the allotted space. This detracts greatly from the value of the advertisement. Only those most interested in its contents will be willing to read all of it, and too many will pass over the advertisement entirely.

Arrangement of the material should also be given a great deal of thought. The illustration should be spotted to catch the eye, with written material below or alongside. The name and address should appear prominently, preferably at the bottom of the advertisement.



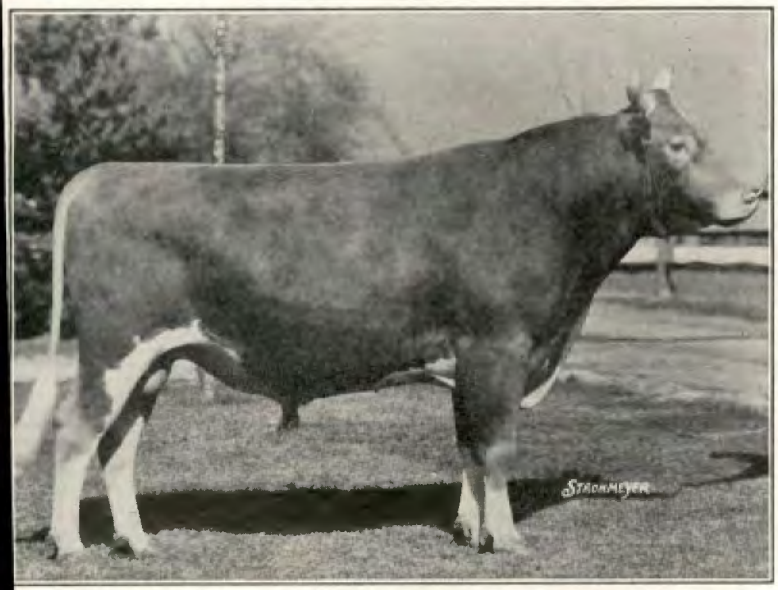
Continuity . . .

Foremost's Gay Lad 117256, A. R.

Foundation sire of the Klondike Guernseys, is still in the Herd. Sired by Langwater Foremost 39191, A. R., out of Rockingham Maid 94933, A. R., (820.4 pound Class D daughter of Langwater Holliston 28055, A. R.) with 4 A. R. daughters and 4 A. R. sons. He is the only son of "Foremost" out of a daughter of "Holliston."

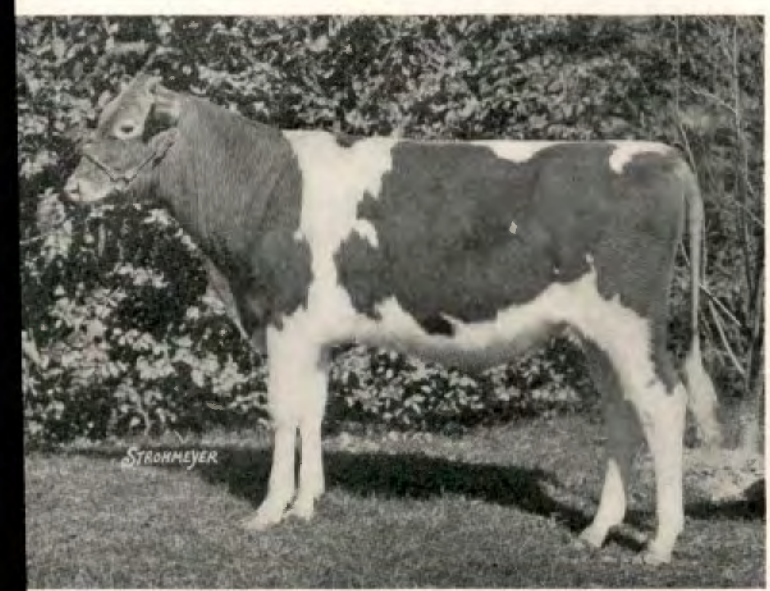
"Gay Lad" now has 20 A. R. daughters, 3 A. R. sons and 11 daughters on test.

Figure 12--A well written advertisement of a breeding establishment.



Argilla Knight 193529

Was added to the Herd in 1932 to follow on the daughters of FOREMOST'S GAY LAD 117256 and now has 6 daughters on test with over 30 more being developed in the Herd. His sire, Dolly's Foremost of High Rock 67827, A. R., "greatest sire of production" is a grandson of Langwater Foremost 39191 and his dam, Upland's Eleanor 104827, A. R. (a 708.1 pound Class AA daughter of Langwater Cavalier 21012, A. R.) has 3 A. R. daughters averaging 719.9 pounds, and 1 A. R. son.



Klondike Hollimost 237473

is now being developed to follow on the daughters of ARGILLA KNIGHT 193529 and other granddaughters of FOREMOST'S GAY LAD 117256. His sire is FOREMOST'S GAY LAD 117256, A. R., and his dam, ROCKINGHAM MARGUERITE 196236, A. R., 14424.1 lbs. Milk, 691.8 lbs. Fat, Class C (2 A. R. sons) sired by LANGWATER HOLLISTON 28055, A. R., is a paternal sister to the dam of "GAY LAD." He is expected to CARRY ON a line of breeding that we have adhered to from the start, and that has produced high production, excellent udders and uniformly good type.

We usually have young bulls of this line, out of high record dams, for sale.

Klondike Farm

ELKIN, N. C.

THURMOND CHATHAM
Owner

RUOHS PYRON
Manager

Herd Fully Accredited for Tuberculosis and Abortion

Illustrations play an important part in advertising[48]. A poor picture should never be allowed for it may leave an untold number of bad reactions toward the breeding establishment. Professional animal photographs are of course as near perfect as possible and in most cases are to be preferred. However, they are expensive and sometimes objected to by those who think that all professional pictures are retouched and do not present the animal in its true form.

For those who wish to make pictures themselves, Moore[48] gives these rules to follow:

1. The animal must be brushed, curried and clipped, so that it may appear at its best.
2. It must be posed to show an attitude of alertness, and in such a manner that its topline, depth of body, and general typyness may be displayed to advantage.
3. A photograph must be taken near the time when the animal is to be advertised and the picture displayed.



Figure 13. - The bull and his daughters is the theme of modern advertising.

As the herd sire is the most important individual in the herd it is he who is usually given the greatest consideration in the advertising. The bull, as represented by the performance of his offspring, is the main theme behind general advertising of breeding establishments. Where there are a number of herd sires, it is often the custom to run a series of advertisements, each one of which features a different bull and tells of his individual merits. Often it is desirable to portray a group of the breeding matrons of the herd. This is generally done by using separate pictures of each animal, and under the picture give the name of her sire and dam, her record and the records of her parents. Several

such cows may be presented in one advertisement.

Where it is desired to advertise a specific animal in an advertisement it is usually the custom to give the entire space to that animal. A small pedigree might appear as well as smaller pictures of the sire and dam.

It is important to keep in mind that persistency is one of the most important virtues of written advertising. Eckles[8] states, "A reader confronted weekly with the name of a certain farm or breeder after awhile has that name so firmly fixed in his mind that he naturally goes to this place to supply his wants."

Beside written advertising, the breeder has at his command three functions which assist him in his breeding as well as provide very effective advertising. These functions are showing, official testing and herd classification.



Figure 14. - Showing is the breeders cheapest form of advertising.

It has already been stated that showing is the breeders cheapest and most effective form of advertising.[42] It follows that he must show successfully if the advertising he gets is to be good. Hundreds of people see the animals on exhibit at the various shows and an immense amount of good-will may be established by a successful show herd.

Official testing is not only an indispensable part of the breeding program but is also a potent source of local, state and national advertising. Records are given national publication in the breed papers, and good records become news material that is gladly printed by local papers as well as national agricultural papers. Eckles[8] points out that official testing is an especially good means of advertising for the smaller breeders.

Herd classification is another method of attracting buyers to the breeding establishment. Classification on the basis of breed and dairy type has the advantage over showing in that all the females of the herd are judged rather than only a selected few. A herd that makes a good classification is marked as a group of outstanding individuals from the standpoint of type, and buyers are attracted by this factor.



Figure 15. - Herd classification attracts considerable attention to the breeding establishments.

A combination of all these factors, persistent advertising in the breed paper, successful showing, good official records, and a good herd classification, are bound to bring buyers to the breeding establishments.

The breeder has two methods of selling his cattle, that of sale by private treaty, and sale at public auctions. A great many animals are sold at private treaty without the buyer seeing the animal, as the result of mail correspondence. Eckles[8] points out that there is a tremendous amount of correspondence necessary to make a sale, and the breeder should maintain a policy of answering all inquiries promptly

even though he may not have anything for sale at the time. The breeder should be able to send on request a description, pedigrees and pictures of the animals he has for sale. Many establishments follow the practice of sending a sales list, or a list of all animals for sale with the essential information on the first request. If the inquiror is interested in any particular animals he may specify the ones he wishes to have pedigrees, pictures and prices on.

Many animals are sold at private treaty by selection on the farm. This is probably the most satisfactory method of buying, where it is at all practical. The breeder has a greater opportunity to show the animals off and to lay greater stress on its merits. In this connection, Eckles[8] stresses the importance of always keeping the animals and the farm in a presentable appearance in order that the best possible impression may be made on the buyer.

There are two forms of public sales, the individual or breeders sales, and the consignment sales. Comparatively few establishments are large enough to support an individual sale unless the entire herd is being dispersed. The breeder must be well known and offer good animals if the sale is to be successful.

In consignment sales, a group of breeders band together to supply a sufficient number of animals. It may be local, state or national in scope. Usually the management deducts a certain percent of the sale price of each animal to cover

the costs of the sale. Breeders must stand the cost of fitting and shipping the cattle to the sale and their care until sold. The animals are usually carefully selected for these sales and are of good quality and physical condition. The management of the sales always strives to maintain high quality, so good animals are usually insured.

Eckles[8] points out that in period of rising prices, higher prices may be obtained, as a rule, at public sale rather than at private treaty. In periods of falling prices, the reverse of this condition is usually in effect.

MARKETING THE PRODUCTS OF THE FARM

Adams[4] states that, "Marketing is the goal of production. Farm management is concerned therefore not only with the production of crops, stock and stock products, but with their disposal when ready to market. In the proper selling of farm products rests much of the profit getting ability of the producer."

With the dairy cattle breeding establishment, the two main products are naturally breeding cattle and milk. The marketing of breeding cattle is so closely related to herd management that it has already been discussed under that subject.

In milk marketing, the manager of the breeding establishment has several avenues of outlet to choose from. Chief of these are marketing milk wholesale, for either fluid milk trade or to be manufactured into dairy products, and the retail market for fluid milk. The selection of the type of market to use will depend upon a number of factors.

It is generally the case that a man interested enough in the dairy business to breed good cattle is also able to produce milk of a sufficiently high quality to command a premium in either the wholesale or retail trade and is rarely found selling his milk for a lower type of usage.[b] Consequently, breeding establishments are usually found selling their milk to a high class wholesale trade or retailing it themselves.

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b. Authors observation.

Wholesale selling of milk is advantageous provided a sufficient premium is paid to reward the producer for his extra efforts in producing a high quality product. Such milk should be sold, if possible, to a near-by dealer. Often it is the case that the dealer will bottle the milk and sell it as a special grade under the name of the farm. Still again, a common arrangement is for the milk to be bottled on the farm and distributed by a dealer in a near-by town.

Where the breeder feels that he cannot get a fair price for his milk by selling it to wholesale trade under one of the systems mentioned above, he usually turns to the development of a retail trade. To retail milk requires considerable more labor, equipment, and effort than is the case when milk is wholesaled. Washing bottles and utensils, bottling the milk, and delivery require a large amount of labor and expensive equipment. To develop a profitable retail trade requires considerable extra work in the form of soliciting trade and bookkeeping.

The breeder usually tries to market his quality milk at a premium. He should be sure that the area in which he wishes to sell his milk has sufficient wealth to pay the premium he seeks. Guernsey and Jersey breeders have the advantage of a nationally known trade mark to sell under. "Golden Guernsey" and "Jersey Creamline" are nationally branded as high quality products and are backed by a large amount of advertising. Also the man selling these trade marked milks has the advantage of many services rendered by the breed

association in marketing his milk and developing a local as well as a national reputation.



Figure 16. - Attractive delivery equipment leaves a good impression on the customer.

To retail a high quality milk, the breeder should attempt to surround the milk with an environment of equal quality. His farm, building and herd should be kept neat and clean and always in a presentable condition. His milk handling equipment and creamery should be equally well qualified to stand the inspection of his customers. To many customers, their only impression of the establishment is its delivery equipment, which should be efficient and attractive. The drivers may be uniformed, and should be prompt and courteous to their customers.



Figure 17. - Well kept farm grounds assist in marketing milk.

Naturally the producer of higher quality milk will want to meet the health regulations of his community. Milk ordinances should be complied with in every degree. The inspectors score cards of his barns and plant should show a rating well above the average. Employees may be examined regularly by a physician for symptoms of contagious diseases. Where all these requirements are rigidly met, good use can be made of the high rating of the farm in advertising.



Figure 16. - Health standards must be rigidly met in marketing premium quality milk.

In many cases the breeding establishment carries side lines in livestock and crops which call for different markets and different marketing operations. Swine are a popular side line with many breeding establishments. Beside the sale of breeding hogs they may also sell animals for slaughter to either local packers, or ship them to central markets.

Often times cash crops are grown as an additional source of income to the breeding establishment. Of these, truck crops and wheat are most often grown, the other crops being fed to the breed. Wholesale marketing is generally used for these crops as it takes less labor. Labor is usually the limiting factor. Commission merchants are one of

the best ways of handling this type of product.[4] Home grading and packing will aid greatly the price received for these products.[4]

THE FARM MANAGER.

It has been previously pointed out that any business, whether it be agricultural, industrial or mercantile, is to a large extent dependant upon its management for success. Management, in turn, is to a large degree dependant upon the manager. A good manager may make a success of an organization in which success seems impossible, and a poor manager may ruin the business of an already successful enterprise. The manager is in most cases the key man on dairy cattle breeding establishments. He must decide upon and put into action, the management policies and practices best fitted to the organization.

Adams[4] defines a farm manager by saying,

> "A farm manager may be defined as a man in charge of an agricultural enterprise large enough to necessitate use of his full time in supervision and business details, who does none of the actual labor of production, but who is charged with the selection of crops and products, the organization of the work, its proper execution, the care of the labor, the selling of the products, the keeping of records and farm books, the handling of all funds and financial transactions, and the observance of legal regulations."

From this it would seem that the farm manager stands relatively high in the scale of farm personnel. His responsibilities, however, are numerous and he must possess considerable ability to handle the job successfully.

What qualities make a good manager? Reinoehl[49] touches the high points of the qualifications of a good manager when he says,

"The farm manager must be a well-trained agriculturalist. He must be far more than that; he must be a practical farmer who knows how to adapt technical knowledge to farm conditions; and all this is of very little use unless he knows human nature so that in dealing with family farm groups he is able to secure from the farmer his cooperation in improving the farming program."

The manager of a dairy cattle breeding establishment must possess these basic qualities as well as many more which are of particular value in his specialized field of farm management. Some of the more important of these qualities are:

1. Ability with cattle. - The manager of a dairy cattle breeding establishment should give first consideration to his breeding herd for therein usually lies the greatest investment and interest of the owner. The manager should know his herd completely as to their breeding and production. He should be able to talk to a visitor or prospective buyer concerning any individual in the herd. He should be on friendly terms with the other breeders and managers of his breed and should possess ability in the way of successful showing, testing and progressive breeding of his herd.
2. Ability to please owner. - The manager is in many cases hired specifically to carry out the aims and wishes of the owner of the

establishment. These wishes are often inconsistent with good management practice, and the manager must strike a medium which will both satisfy the owner and permit efficient operation.

3. Ability as a salesman. - Another qualification of the good manager of a dairy cattle breeding establishment is that he be a good salesman. On the establishments where owners do not care about efficient operation this is not so important, but if advancement is to be made in breeding, the manager should be able to sell the stock he breeds, and if a dairy organization is to operate efficiently, the manager must be able to sell milk. As these are the main products of the breeding establishment, they demand the most of the managers attention as a salesman.

The manager should have at his command a great fund of technical agricultural knowledge. Either a college education or a great deal of practical experience are the first essentials, and a combination of the two is ideal. As Reinoehl[49] states, he should also be able to put his technical knowledge in practical use in every phase of the farm business.

SUMMARY OF REVIEW OF LITERATURE

1. Dairy cattle breeding establishments may well be classified into three divisions on the basis of the quality of the cattle they possess. The function of each division is not only to maintain and improve their own herd, but to sell cattle that will aid in improving the next lower classification of breeding establishments.

2. Farm management may be divided into two functions of farm organization and farm operation. The former function deals with the problems of acquiring the farm, arranging its layout, determining the productive enterprises, planning the business, and equipping the farm. The latter function, that of farm operation has to do with laying out a program of work, management of labor, power and machinery, keeping records of the business and purchasing supplies.

3. The breeding herd is the most important part of the breeding establishment. The reputation of the establishment depends largely on the care and management given the cattle.

4. Milking cows should be fed to produce milk, maintain their bodies, and reproduce regularly. Good pastures, hay, silage and a grain concentrate are the most important feeds for the milking cow. The grain mixture should be palatable, bulky, and nutritious, and should contain a variety of feeds. The cows should be managed in a way which will provide a maximum of comfort and regularity.

5. Official testing is an important phase of the breeding and advertising programs of the breeding establishment. The aim is to secure a maximum production which will be indicative of the inherited producing ability. Feeding should be liberal but not excessive and management such as to produce the greatest possible comfort to the animal.

6. The raising of calves and heifers is important in that it supplies the next generation of animals, which is essential from a breeding and management standpoint. Calves should be given every opportunity to grow. Milk feeding will depend to a great extent on the conditions of milk marketing. Skim milk feeding is excellent from a feeding as well as an economic standpoint. Hay, grain, silage and pasture are also fed. Exercise and sunlight should be provided the growing calf.

7. The breeding bull is the most influential animal in the herd. A bull of proven transmitting ability should be used where possible. However there are too few of these and it is often necessary to rely on young bulls whose pedigree, individuality, and the production of immediate ancestry indicate the greatest possibility of a high level of production in his offspring. Bulls should be fed to reach a maximum of growth and then to be kept in good breeding condition. Exercise and sunlight should be provided.

8. Inbreeding, linebreeding and outcrossing are the three most common systems of breeding in dairy cattle. The first two serve to intensify the blood of an individual while the latter method serves to bring in a new strain of blood

to the breeding program.

9. Records are essential to the breeding establishment. Complete records of production, breeding, and reproduction should be kept on each animal in the herd.

10. Showing is the breeders cheapest form of advertising. Animals should be selected, fitted and shown to show a maximum of breed character and dairy temperament. The breed papers and agricultural journals are the best media of advertising. Beside written advertising, showing, testing, and herd classification serve to bring the herd before the public. Private treaty and public auction are the two common methods of selling breeding cattle.

11. Milk and breeding cattle are the chief products to be sold from a breeding establishment. Milk may be sold retail or wholesale. Many establishments sell premium quality milk.

12. The manager of a breeding establishment should have ability with cattle, be able to please the owner, and be able to sell profitably. He should be well trained in all phases of agriculture and should be able to put his technical knowledge in practical use.

PART II

ORIGINAL INVESTIGATION

PART II.

ORIGINAL INVESTIGATION

Plan

The investigation in connection with this study of the management of dairy cattle breeding establishments is divided into two parts. In the first part, Section A, it was intended to study the practices of dairy herd and farm management used by modern breeding establishments. This was arrived at by two methods, first by personally visiting farms and talking with the managers, and second by sending out mail questionnaires. The results of these two methods are discussed separately. In the second part, or section B, experimental problems of particular interest in dairy herd management were studied. These investigations were carried out in the dairy herd of the University of Tennessee. All actual work was done by the writer and the results listed as obtained.

It is evident that research such as that contained in the first section deals with the statement of facts which are not as a rule based on figures. For this reason few figures will be given in this thesis and but little use can be made of tables and charts.

SECTION A.

INVESTIGATION OF DAIRY CATTLE BREEDING ESTABLISHMENTS.

Investigation by Personal Visit.

During the year 1936-37 (September to July) in which the writer was preparing the material contained in this thesis, he made personal visits to thirty-two recognized dairy cattle breeding establishments for the purpose of collecting data on the management practices and policies of these farms. These farms were located in seven states from Northwestern Mississippi to Eastern Pennsylvania. The proportion by states was as follows: Tennessee, 11; North Carolina, 4; Pennsylvania, 9; Virginia, 1; Delaware, 3; Georgia, 3; and Mississippi, 1.

The farms visited represented three of the major breeds of cattle in the proportions as follows: Jersey, 15; Guernsey, 12; and Holstein, 5. Some of the outstanding breeding establishments of the country for each breed were visited. Such farms as the Shelby County Penal Farm, Rotherwood Farms and Falklands Farms represent the Jersey breed. Establishments such as Quail Roost Farms, Breidablik Farms, and the Trion, Georgia, Riegeldale Farm represent the Guernsey breed, while Winterthur Farms, Lauxmont Farms, and Robertson Farms represent the Holstein.

A complete list of the farms visited with their address and breed are as follows:

Knapp Farm, Nashville, Tenn. - Holstein

West Tennessee Experiment Station, Jackson, Tenn. - Jersey

Shelby County Penal Farm, Memphis, Tenn. -	Jersey
Rotherwood Farms, Kingsport, Tenn. -	Jersey
Portland Farm, Nashville, Tenn. -	Jersey
Crieve Hall Farms, Nashville, Tenn. -	Jersey
Biltmore Farms, Asheville, N. C. -	Jersey
Hill Girt Farms, Cossart, Pa. -	Guernsey
Sherwood Forrest Farms, Fredricksburg, Va. -	Guernsey
Falklands Farms, Schellsburg, Pa. -	Jersey
Lauxmont Farms, Wrightsville, Pa. -	Holstein
Robertson Farm, York, Pa. -	Holstein
Breidablik Farms, Wilmington, Del. -	Guernsey
Cowview Farms, Wilmington, Del. -	Jersey
Liseter Farms, Newtown Square, Pa. -	Guernsey
Ashley Farms, Newtown Square, Pa. -	Holstein
Longwood Farms, Kennet Square, Pa. -	Guernsey
Clearview Farms, Butler, Pa. -	Jersey
Quail Roost Farms, Rougemont, N. C. -	Guernsey
Klondike Farms, Elkin, N. C. -	Guernsey
Ashland Farms, Chattanooga, Tenn. -	Jersey
Happy Valley Farms, Rossville, Ga. -	Jersey
Riegeldale Farms, Trion, Ga. -	Guernsey
University of Georgia, Athens, Ga. -	Mixed
Valkyrie Farm, Asheville, N. C. -	Guernsey
Duntreath Farms, Memphis, Tenn. -	Jersey
Cayoso Farms, Horn Lake, Miss. -	Guernsey
Joydale Farm, Franklin, Tenn. -	Jersey
Winterthur Farms, Winterthur, Del. -	Holstein

Tennessee School for Deaf, Knoxville, Tenn. - Jersey

Beverly Hills Sanitorium, Knoxville, Tenn. - Jersey

Sunny Ridge Farms, Chadds Ford, Pa. - Guernsey

The writer had an opportunity to see every class of breeding establishment in operation. Rich-mens hobby farms and farmer-breeders are represented. Old, well established organizations and new developing farms were visited. Farms that made money, farms that nearly paid expenses, and farms that lost money are represented. All things being considered, a fairly good cross-section of the dairy cattle breeding industry is represented in this investigation.

A questionnaire was prepared to be filled out during an interview with the managers of the establishments. In a number of cases it was not possible to fill them in a complete form as managers often had not charge of farm work. In other instances it was not possible to see the manager or herdsman, or the time of the visit was too short for a complete coverage.

The personal visit questionnaire served to get specific information as well as an outline by which the discussion might be lead. Much information was acquired which is not detailed and specific enough to include in this thesis.

Briefly, the questions asked covered the following material:

1. Number of acres; acres tillable; acres in wasteland; acres in woodland; acres tillable but in permanent pasture; acres not tillable but good for pasture.

2. Diagram of building group; condition of buildings; construction material; age of buildings; methods of maintainance.

3. Equipment bought from one or several lines of manufacture; method of equipment maintainance; housing of equipment.

4. Amount of investment; approximate division of investment.

5. Crop rotation; rate of liming; rate of use of fertilizer; schedule of applying manure; crops to be raised by a commercial dairy; crops for cash crop.

6. Type of grain fed (home grown, home mixed, mill mixed, ready mixed); rates of feeding; kind and quality of hay.

7. Preference of calf raising methods; age of feeding silage; feeding grain to heifers on pasture; kind of calf hay preferred.

8. Method of milking; method of marketing; sidelines for breeding establishments.

9. Does advertising pay; best methods of advertising.

10. Do you think breeders should show.

11. Type of testing; testing program; age to test.

The results are reported in a discussion form, concerning the various points of the two main topics, dairy herd management practices and farm management practices.

Dairy Herd Management.

Feeding Methods

There were three principal methods of obtaining grain feeds on the farms visited. These were, the use of ready mixed feeds, the use of home grown feeds and supplements, and the practice of having a local mill mix the grain feeds to a stated formula. Of these methods the most popular was the use of home grown grains and purchased protein supplements which were ground and mixed on the farm. This also included one or two cases where high protein milking rations were purchased and cut down with home grown and ground corn and oats.

Probably the best example of the use of home grown feeds was seen at Quail Roost Farms, Rougemont, North Carolina. The farm is of sufficient size to permit growing all of the grains necessary for feeding the large herd. A well equipped granary was used to house, clean, grind and mix all the feeds used on the farm.

The number of farms using ready mixed feeds was surprisingly low, and was exceeded by those having feeds mixed privately by a mill. One eastern establishment went as far as to have its feeds mixed by a Wisconsin mill. This might be taken to indicate that breeding establishments prefer to feed feeds of which they know the formula, rather than ready mixed feeds of an unknown formula. However, the manager of one farm indicated that, under his conditions at least, ready mixed feeds were cheaper than home grown feeds.



Figure 19. - Barns at Rotherwood Farms, Kingsport, Tennessee.

The rates of feeding were also studied on the farms visited. An average of all herds of 1 pound of grain for each 3½ pounds of milk was found to exist as the rate of grain feeding. The range in rate of grain feeding was from 1 pound of grain to each 2½ to 4 pounds of milk produced. Feeding hay ad libidum was found to be the most common practice among these herds. One or two herds fed as low as eight to ten pounds of ground hay and herds not using silage fed as high as 30 pounds of hay daily. The rate of feeding silage ranged from ten pounds to thirty-five pounds daily in the herds visited. Twenty-five and thirty pounds daily were the most popular rates of feeding, the average of all herds

being about 28 pounds of silage daily. A number of herds fed silage ad libidum.

The type of hay being fed on the various farms was also noted and made quite an interesting study. Alfalfa was by far the most popular hay for feeding milk cows. Mixed hays, principally timothy and clover were the next most important and soybean, lespedeza, timothy, and clover hays were also fed in a number of cases. A number of farms used small amounts of mixed hay, clover or timothy as an occasional feed to give variety to the alfalfa feeding. It was noticed that the quality of the hay was, generally speaking, very good when the drought of the previous summer is considered.



Figure 20. - Buildings at the
Shelby County Penal Farm, Memphis, Tennessee.

As a large number of the visits were made during the winter, a striking example of the use of winter pastures in the South was seen. The Shelby County Penal Farm, West Tennessee Experiment Station, Biltmore Farms and Quail Roost Farms all had extremely fine winter pasture which permitted nearly 100% year around pasturing. A series of five rotation winter pastures at Biltmore Farms in Asheville, North Carolina were the outstanding examples of the use of winter pastures. It is not difficult to understand how the South can make greater use of the limited grain feeding systems with such pastures available the year around.

Calf Raising Methods.

The managers of the farms visited were asked to state the order of their preference as to the following methods of milk feeding for calves: (1) nurse cows, (2) home mixed grain and skim milk, (3) prepared calf feeds. The results were quite interesting. The use of home mixed calf grains and liberal amounts of skim milk was a 7 to 1 favorite over the other two methods, and the use of prepared calf meal was a 4 to 1 favorite over the use of nurse cows, thus giving a rather definite lineup of the preference of the breeders as to the method of milk feeding of calves.

It must be understood that their preferences were not in all cases in use as preferred. Individual conditions on the farms tended in some cases to require the use of methods other than those preferred.

Some interesting modifications and combinations of the three methods were noticed. One establishment used nurse cows for all the bull calves to be sold, and the rest on commercial calf feeds. Another farm used nurse cows for the first month and then fed skim milk and grain. Still another herd fed whole milk for the first month and then weaned the calves and fed a home mixed grain.

A study of the age at which silage was fed to calves was also made. This was divided into three groups, namely silage feeding to young calves (under 10 months), silage feeding to yearlings and silage feeding only at milking age. Response to this study showed that 47% of the establishments started feeding silage to calves before they were ten months of age, 14% started feeding silage as yearlings, and 39% withheld silage feeding until milking age or did not use silage at all.

The managers were asked to state the kind of hay they preferred for feeding calves. The results indicated that a mixture of clover and timothy was the favorite. Other hays preferred by the breeders were alfalfa and timothy mixed, alfalfa, timothy, clover, oats, lespedeza, and any legume. The breeders usually specified a preference for a light, early cut, good colored hay for feeding calves.

In most instances heifers were fed hay, grain and silage during the winter and pasture during the summer. Some breeders liked to feed some grain to the heifers on pasture. One breeder fed only a fair quality oat hay and his heifers

and milking cows showed the effect of the policy, being small for the breed and rather shallow in the middle.



Figure 21. - Robertson Farm, York, Pennsylvania.

Care of Bulls

In all instances the bulls on the farms visited were given good quarters and ample yard space for exercise. Falklands Farms, at Schellsburg, Pennsylvania, had the best equipped bull barn that was seen (See Figure 8). Only one establishment, Cayoso Farms, at Horn Lake, Mississippi, used any form of artificial exercise, this being a "merry-go-round" on which the bulls were given a daily exercise.

Dairy Buildings

The buildings which housed the herds visited varied a great deal as to quality. All were very substantial and adequate for housing a dairy herd. In most cases the buildings were maintained in very good condition. One or two were re-

modeled barns, the rest were of modern construction. Quail Roost Farms, Riegeldale Farms, and Lauxmont Farms had the most attractive buildings that were seen. In all these cases, the buildings represented a considerable investment.

Testing

Every herd visited, with but one exception, was doing either Advanced Registry or Herd Improvement Registry testing. Advanced Registry testing was by far the most popular form of testing in use. Some establishments used combinations of Advanced Registry, Herd Improvement Registry, Dairy Herd Improvement Association, and private testing. The combination of Advanced Registry and Dairy Herd Improvement Association testing was the most popular of the combinations.

There was, as would be expected, a great variation in the number of cows on test. Cayoso Farms had 56 cows on Advanced Registry test which was the largest number of all the herds. The Shelby County Penal Farm, Riegeldale Farms and Quail Roost Farms all had well over 40 cows on test. In some instances it was the authors observation that the establishments would have done well to reduce the quantity of testing and increase the quality, or in other words to have tested fewer cows and tried to produce better records with these animals.

It was almost the universal practice to handle test cows in box stalls and milk them by hand. However, in a number of cases the cows were kept in stanchions. Where

there were individual test barns they were either all box stalls or box stalls with a few stanchions. Tie stalls were a popular replacement for the rigid stanchions in the newer barns. Quail Roost Farms, Riegeldale Farms, and Falklands Farms had the best type test barns that were noticed.

There was considerable variety in the opinions of the managers as to the age at which it was best to give an animal its record and also as to the testing program followed. The majority indicated that they believed cows should be tested first as two year olds for several reasons. Some felt that testing as two year olds would help form a habit of heavy productions, others that two year old testing proved the bulls quicker. Objections to two year old testing included the fact that there was greater possibility of injury to udders. All agreed that the animal must be in good physical condition to be put on test at any age. Testing as three year olds and as mature cows was also mentioned.



Figure 23. - Milking Parlor and Combine Milker at Lauxmont Farms, Wrightsville, Penna.

Milking

Hand milking was a three to one favorite over machine milking on the farms visited in making this survey, and machine milkers in the barn held the same margin over the use of combine milking units. It is rather hard to say definitely why hand milking was so much more popular than machine milking. A number of reasons were given by the breeders for their preference. Those using hand milking, in general, felt that it was better for the udders, gave greater production, and checked the spread of disease. The most evident reasons given for the use of machines are that they take less labor and are quicker. The high initial

cost is the most evident reason for the few combine units in use.

Marketing Milk

Of the establishments visited, 47% marketed their milk by means of a retail route, 40% sold wholesale milk and 13% sold both wholesale and retail milk. Individual conditions in most cases governed the method of marketing that was employed. Most of the Guernsey establishments and several of the Jersey breeders sold under their breed trade mark. A number of the farms had very successful retail routes. At Breidablik Farm, Wilmington, Delaware, a very good roadside business has been developed over a period of a few years. Large quantities of milk, cream, ice cream, and other specialties are sold at this attractive roadside market (see Figure 24).



Figure 24. - Roadside Market at Breidablik Farms, Wilmington, Delaware.

The managers were asked to indicate enterprises that would make successful sidelines to dairy cattle breeding establishments. Quite a variety were given, of which hogs and poultry were the most prominent. Fruit, truck crops, dairy products, turkeys, cotton, potatoes, tobacco, and beef cattle were also mentioned.

Advertising and Showing

Twenty-four of the thirty-two establishments visited showed their cattle to some degree. Two of the eight that did not show indicated that it was because they were building their herds and had no animals of their own breeding to show. The managers of the establishments that showed indicated that they derived sufficient advertisement from the enterprise to make it a paying proposition, beside the stimulus to breed better typed animals. Establishments that did not show generally gave as their reason the danger of bringing in disease.

Most of the herds advertised in their respective breed papers, and this was the main form of advertising used. Some few indicated that they used local papers as an advertising media. Several of the establishments had prepared folders and booklets describing their cattle to be distributed in answer to inquiries. For the most part these folders and booklets were quite attractive and well served their purpose in advertising. Showing, testing and herd classification work also

were considered as advertising methods.

Financial Arrangements

A special study was made on a selected group of five of the farms visited to attempt to learn something of the financial arrangements that existed between the owners and the managers. In all the cases studied, the farms were owned by wealthy individuals. One manager indicated that he was required to show a profit on his operation. Three other managers indicated that they were required to make the farm pay all its expenses, and the fifth manager stated that as his establishment was as yet young and still developing, he was not required to pay quite all expenses, but in the near future would be operating on that basis.

All the managers indicated that the owners were willing for them to use any or at least a part of the profit they earned for improvements to the farm and herd.

It is known that at least three of the five farms were established to operate at a loss, but later the owners required that they be operated on their own income.

The managers indicated that the owners of their respective farms were usually agreeable to the recommendations of the manager as to investments in machinery and important breeding stock, and considered them as additional investment in the farm rather than their being taken from the profits. So far as possible, however, it is preferred that these additions be made from the farm receipts.



Figure 25. - Barns at
Riegeldale Farms, Trion, Ga.

With this same group of farms a study was also made of the method of inventorying the cattle on the record books of the establishment. This is important in that high priced cattle cannot usually be inventoried as are ordinary cattle, because of their greater value and their appreciation as well as depreciation, and because they have two values, one a sale value and one their value to the breeding program of the herd. That is to say, an old brood cow might not bring $200.00 if sold, but she would be worth many times that amount to the herd so long as she lived and reproduced.

The most prevalent method of inventorying such cattle was to inventory them each year at their market value, or the price for which the manager felt they could be sold at that particular time. One establishment inventoried at 50 to 60% of market value to take care of slumps and losses. The one weakness to this method is, to quote one of the managers, "Almost anybody can make a place show a profit or a loss depending on how the herd is inventoried. In fact, an inventory can be made so elastic as to show either a profit or a loss in a statement."

One manager had a rather definite system of inventorying his cattle which was briefly as follows:

1. Purchased animals inventoried at cost.
2. Young stock valued at $100. per year and transferred to the milking herd account at $250. at approximately 2½ years of age.
3. All cattle other than those being appreciated as above, are depreciated at the Federal Income Tax allowance rate for breeding animals of 12½% per year.
4. Calves sold before an inventory value is on the books are considered sold at a profit of that sum. Cattle sold or lost by death after an inventory value has been placed on it is considered as a loss or gain depending on whether it is over or under the current inventory value.

This system has its merits particularly where it is desired to make a maximum use of the Income Tax allowance.

Farm Management Practices

Amount of Land

The amount of land in the farms visited varied a great deal, the range being from 250 acres to 8000 acres. Large acreages were quite common as many of the establishments were a part of large estates. However, in most of these instances, large amounts of the estates were given over to the farm operation. The amount of land is really not much an important factor provided there is sufficient to properly take care of the cattle. In every instance but one, that of the smallest acreage, there was an abundance of pasture, and in most cases sufficient tillable land to grow most of the feed required.

Investment

This is a rather difficult subject upon which to get definite information. However, it was attempted to find out the approximate total investment on some of the farms as well as the way the investment was proportioned between land, buildings and cattle. The approximated investments in the farms visited, according to managers figures and the writers estimate, ranged from about $120,000 to well over $700,000. It is difficult to make an average of the investment for the figures given were not definite enough. An estimated average would be about $300,000.



Figure 26. - Main Barn at
Breidablik Farms, Wilmington, Delaware.

It was also very difficult to estimate the proportion of the investment between land, buildings and capital. Due to the large acreages, land was the most influential element in this consideration, and the proportion usually was dependent on this factor. An average proportion of the farms visited would be, land 50%, buildings 25%, and cattle 25%. To look at the most of these places this proportion is rather hard to believe, for the buildings and cattle are most prominent in appearance. However, the fact that most of the farms visited were located near cities, influenced the land values to an extent that would bring this proportion into existence.

Farm layout, Buildings and Equipment

In most cases the layout of the farms visited was very good. In some cases where the acreage was quite large the farms covered so much territory that much time was lost in

getting to the outlying fields. This was the only criticism of the farm layouts.

Building arrangement was also very efficient in the majority of cases. The only instance of what the writer would call poor arrangement was noticed in one barn that attempted to house under one roof, the herd bulls, test cows, and calves. It would seem that these are conflicting factors that it would be more efficient to house separately.

The usual method of building maintainance was to make all necessary repairs as they were needed. Several farms, however, made it a practice to budget a certain amount each year for building maintainance. This included regular painting.



Figure 27. - Machine shed at Klondike Farm, Elkin, North Carolina.

The majority of the managers indicated that it was more advantageous to buy all farm equipment from one line of manufacture rather than to choose from several lines. The reason in practically every case was that better service could be had by having only one line of equipment. Those who bought from several lines were usually situated so that good service could be had on all lines. Practically all the farms indicated that they worked over all their equipment during the winter to be sure it would be in good condition when needed. Figure 27 shows the machine shed on one of the farms visited.

Cropping system

All of the farms visited carried on rather definite cropping systems, the main objective of which was to produce as much feed as possible for the cattle. A rather simple three or four year crop rotation of corn, small grains, (usually oats, barley or wheat), and hay (alfalfa, clover, mixed or lespedeza). The other rotations that were mentioned were longer and more complicated but in general produced the same crops.

All the farms but one made use of lime, the usual case being that it was applied before alfalfa planting, either in regular amounts or as soil tests showed a need. Seventy-five percent of the farms indicated that they fertilized regularly, the amounts and formulas varying according to the region. Fertilizers were usually applied on hay and pasture land and before planting corn and the grain. Manure was used in the main in top-dressing pastures and hay land, and for rather

heavy applications on corn land.

The managers indicated that the production of roughage, both hay and silage, should be the first consideration for the cropping system of the breeding establishment. After that, grains such as oats, barley and wheat should be grown. When asked as to what crops made the best cash crops, wheat and truck crops were found to be the favorites, with fruit, tobacco, barley, and hay also mentioned. A number of the managers indicated that it was their opinion that breeding establishments should not attempt to raise cash crops.



Figure 28. - Milking barn at Cayoso Farm, Horn Lake, Mississippi.

Scoring the Farms

The writer selected a number of points on which to score the farms on the basis of the nearness to which they each approached what the writer would consider a practical perfect. Each point to be scored was given a possible 100 points. A total of nineteen points of farm and herd management was scored. The average of the nineteen points was made, and these averages for the thirty-two farms were again averaged to give an average score of 81 for all the farms. The range was from 60 to 95, the Shelby County Penal Farm attaining the highest average.

Table I gives examples of how these farms were scored on this basis.

TABLE I.

EXAMPLES OF FARMS SCORED BY AUTHOR*

Farm	1	2	3	4	5	6
Quality of Cattle	85	80	85	95	80	100
Equipment	88	85	70	100	80	95
Sale of Milk	100	80	75	95	80	95
Attractiveness to Visitors	98	85	40	100	70	95
Average Herd Production	93	70	85	85	85	100
Production Testing Program	80	75	85	85	70	100
Superior Show Herd	75	40	70	85	80	95
Outstanding Individuals	75	80	70	95	70	100
Care and Handling of Herd	95	80	70	95	75	95
Economic Operation	95	80	90	100	90	90
Sale of Cattle	70	30	80	100	80	100
Breeding Program	90	70	95	95	80	100
Health of Herd	100	100	95	100	100	100
Raising Crops	40	40	95	80	90	90
Raising Calves	80	50	80	90	90	95
Quality of Land	90	95	95	90	85	85
Quality of Milk	97	90	90	92	90	92
Management	100	75	90	95	90	95
Training and Experience of labor	80	60	90	90	80	85
Average	86	60	75	93	80	95

* Key to farms on file in dairy office and with author.

Investigation by Mail Questionnaire

The mail questionnaire survey of dairy cattle breeding establishments was divided into two parts. The first questionnaire was short and dealt with the size of the farm and herd, calf raising methods, type of testing, and general policies. The second questionnaire was sent to those who on the original contact expressed a willingness to answer a more detailed questionnaire.

One hundred and fifty-one of the first questionnaires were returned for a 62% response from the number sent. Breeding establishments in 34 states from all sections of the country returned these questionnaires. Some of the leading states in the number returned were Pennsylvania, 20, New York 18, Maryland 10, Michigan, Ohio and Massachusetts each with 8. All the major breeds of cattle were represented in the following proportion; Guernsey 57, Holstein 50, Jersey 31, Ayrshire 16, and Brown Swiss 2.

Size of Farm and Herd.

On the questionnaires the managers were asked to state the total number of acres in their farms, acres in crops, acres in pasture, number of cattle in herd, number cows milking, number of young stock, number of herd bulls, and number of young bulls. The average of all 151 farms on all of these points gave the following average figures:

Acres in farm	546.6
Acres in crops	251.5
Acres in pasture	178.1
Number cattle in herd	136.2
Number cows milking	62.3
Number of young stock	58.5
Number of herd bulls	3.7
Number of young bulls	8.5

From these figures it would seem reasonable to conclude that the average dairy cattle breeding establishment of the country is quite a major operation both in the number of cattle and in the size of the herd they operate. It is to be noted that a rather large amount of crops are grown and quite ample pasture acreage is provided. A rather surprisingly close correlation is noticed between the number of cows in milk and the number of young stock kept. It would seem that for every animal in milk approximately one young animal is kept. Also it is seen that a rather large number of young bulls are kept on hand, the greater proportion of these it can be assumed are for sale.

The questionnaires were divided into groups, first according to the size of the farm as expressed in the total acres in the farm, and then according to the size of the herd as represented by the number of animals in the herd. The groups were totalled and averaged for all the above points and the results shown in Tables II and III. Table II shows the results of the division according to the size

TABLE II AND III.

COMPARATIVE AVERAGES OF GROUPS OF FARMS WHEN DIVIDED ACCORDING TO SIZE OF FARM AND SIZE OF HERD

Averages of 151 Farms — TABLE II — Size of Farm

Acres in Farm.	No. of Farms	Total Acres	Crop Acres	Pasture Acres	No. Cattle in Herd	No. Cows Milking	Young Stock	Herd Bulls	Young Bulls
0 - 100	8	82.2	37.1	33.6	62.7	37.0	38.6	2.7	7.5
101 - 250	46	175.4	111.6	52.4	79.8	37.0	34.5	2.7	4.8
251 - 500	44	384.2	181.7	132.1	120.3	56.3	53.5	3.4	6.9
501 - 1000	34	725.1	339.8	170.6	176.2	85.7	74.0	4.7	13.0
Over 1000	19	1686.6	690.5	563.7	225.6	104.4	104.0	6.2	11.7

Averages of 151 Farms — TABLE III — Size of Herd

No. in Herd	No. of Farms	Total Acres	Crop Acres	Pasture Acres	No. Cattle in Herd	No. Cows Milking	Young Stock	Herd Bulls	Young Bulls
0 - 50	21	206.0	69.8	78.2	39.2	16.6	16.9	1.8	3.8
51 - 100	50	430.6	112.3	200.3	76.6	35.9	33.3	2.6	4.6
101 - 200	59	587.8	260.8	184.2	145.0	67.2	59.5	4.0	8.8
201 - 400	17	859.5	388.4	232.2	283.0	131.6	116.6	7.0	15.9
Over 400	4	1804	970.0	660.2	511.2	238.0	237.5	9.5	27.7

of the farm, while Table III shows the average figures resulting from the division according to the size of the herd.

Several very interesting relationships were noticed as a result of these tabulations. In the first place, as is to be expected, the number of acres in crops and pastures increased proportionately to the total number of acres in the farm. A similar proportional increase is seen in the number of cows milking, young stock, herd bulls, and young bulls as an increase is shown in the size of the herd.

The close relationship between the number of cows in milk and the number of young stock kept, noticed in the averages of all farms, also remained constant in the averages of the groups. It is also noticed that the greater number of farms fell in the medium divisions, both by size of herd and size of farm. This is probably true in any average figures.

Testing and Showing; Type of Testing

The managers were asked to state which of the two, testing and showing, in their opinion was of the greatest value to the breeding establishment. Testing was preferred by 122, or 79%, showing by only 2, and 18 emphasized that both were necessary for the best results.

When asked if they believed the progressive breeding establishment should attempt to carry out a program in both testing and showing, 125 managers answered in the affirmative with only 9 answering in the negative.

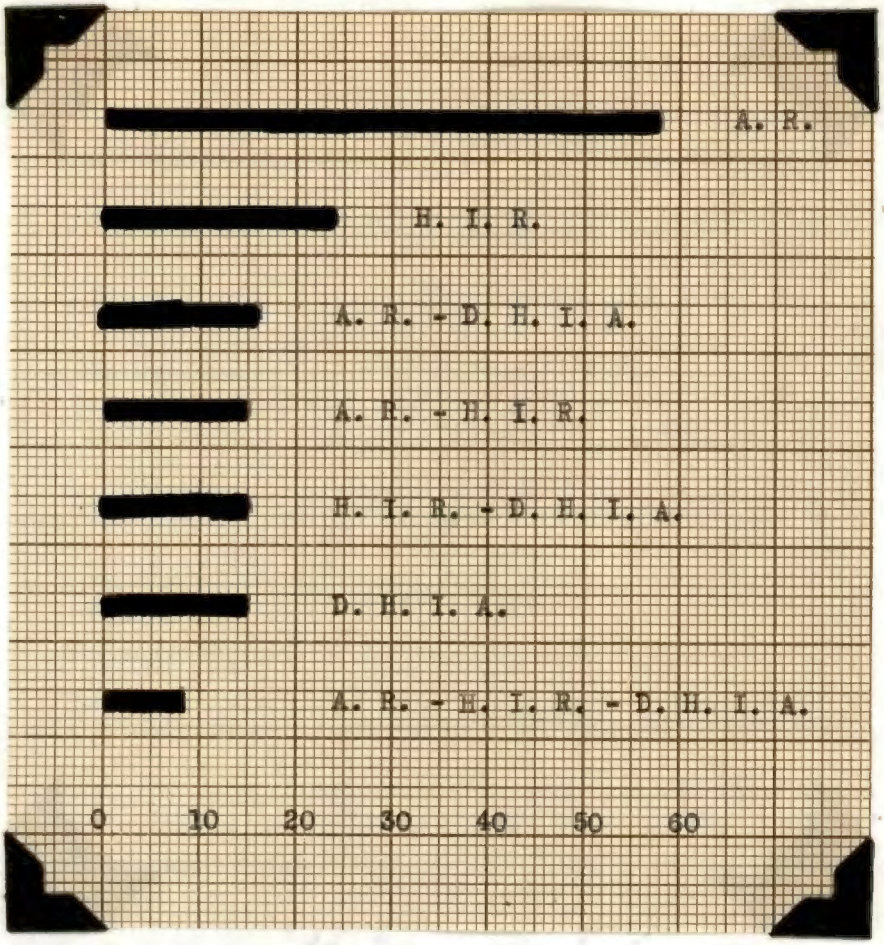


Figure 29. - Number of breeders using the various types of testing and combinations thereof

The breeders were asked to indicate the type or types of testing they carried on. All farms indicated that they were testing, the type and combinations used are shown in Figure 29. In this graph, A. R. is Advanced Registry or Registry of Merit testing, H. I. R. is Herd Improvement Registry testing, and D. H. I. A. is Dairy Herd Improvement Association testing.

Method of Calf Raising

In an attempt to find out the most popular method of raising calves, the managers were asked to state their first, second and third choice of the following calf feeding methods; (A) Nurse Cow, (B) Home grown grain and skim milk, and (C) Prepared Calf feeds.

For their first choice, 74 farms indicated that they preferred home grown grain and skim milk, 27 preferred nurse cows, and 16 the prepared calf feeds. For second choice, 33 preferred prepared calf feeds, 31 the home grown grain and skim milk and 14 nurse cows. From these results it would seem that the use of home grown grain and skim milk was by a great margin the most popular method of raising calves, while prepared calf feeds are second and nurse cows the third most popular among the dairy cattle breeding establishments.

Raising Feed

The managers were asked if they felt that a breeding establishment with plenty of acreage should be sufficiently diversified to raise all the feed they can, both grain and roughage. One hundred and twenty-one of the managers answered this question in the affirmative, while only 15 answered in the negative.

Second Mail Questionnaire

As has been previously stated, a second and more detailed mail questionnaire was sent to those managers who indicated a willingness to answer an additional questionnaire.

Of these, 85 were returned for a 73% response of the number sent. These questionnaires were returned from 25 states all over the country. The states returning the largest numbers were Pennsylvania 12, New York 11, Massachusetts and Michigan with 7 each, and New Jersey with 6. All breeds were again represented in the following proportion; Guernsey 33, Holstein 27, Jersey 15, Ayrshire 9, and Brown Swiss 1. Some of the largest and most successful breeding establishments of the country sent in this data, as well as a number of other smaller establishments.

The material covered by the two mail questionnaires included the following topics:

1. Acres in farm, in crops; in pasture.
2. Breed of cattle; number in herd, number milking; number of young stock, herd bulls and young bulls.
3. Relative importance of testing and showing; type of testing done.
4. Method of raising calves.
5. Should a breeding establishment with plenty of acreage attempt to raise all the feed it can, both grain and roughage?
6. Average daily production; rates of feeding grain, hay and silage; kinds of special feeds.
7. Methods of milking and reasons for methods used.

8. Type of bedding; bedding materials best suited to the breeding establishment.
9. Use of bull exercisor; use of artificial insemination.
10. Age of breeding heifers; feeds used in wintering heifers; hay preferred for heifers.
11. Innoculation for white scours and hemorrhagic septicaemia; age of calf before turning on all day summer pasture; age of silage feeding; kind of hay preferred for calves.
12. Crop rotation followed; rate and frequency of liming; method of handling manure; crops raised; use of soiling crops; special hay treatment; practicability of cash crops and what crops make the best cash crops.
13. Construction material of barns; type of stalling; buying equipment from one or several lines of manufacture.

Dairy Herd Management

Herd Production

From the amount of milk produced daily and the number of cows in milk at the same time, the average milk production of each herd was computed. The average production of all the herds was 29.7 pounds of milk daily. This it seems is a very good average production. The range was from 15.3 pounds to 50.0 pounds of milk daily.

Rates of Feeding

The managers were asked to state their rates of feeding grain, hay and silage as well as any kind of special feed they used. In grain feeding, 30 farms fed at the rate of 1 pound of grain to 3 pounds of milk and 21 farms fed at the rate of 1 to 3½. The average of all farms was 1 pound of grain to 3½ pounds of milk produced.

In hay feeding, 23 farms fed at the rate of 15 pounds daily, 12 farms fed 12 pounds daily and an equal number fed 20 pounds of hay daily. The range was from 5 to 30 pounds daily, the average being 15 pounds of hay daily. Silage was fed at the rate of 30 pounds daily on 19 farms and 25 pounds daily on 18 farms. The range in silage feeding was from 10 to 50 pounds of silage with an average of 30 pounds.

Beet pulp was the most common special feed used to supplement regular feeds, and a large number of farms indicated the use of beet pulp. Soybeans, beets, wet brewers grain, molasses, bran, dextrose sugar, sprouted grains, and ground kelp were also mentioned as special feeds used on the breeding establishments.

Type of grain mixing

In a study to determine what type of grain mixtures were the most popular it was found that 35 farms fed mixtures of home grown grains and high protein supplements, 24 farms fed grain mixtures that were mixed to their own formula by a local mill, 19 farms fed ready mixed feeds, and 8 farms bought the ingredients and mixed their feeds on the farm. The first

group includes those farms that used home grown feeds, principally barley and corn, to cut into ready mixed feeds, as well as those that buy high protein supplements to be mixed with home grown feeds.

Feeding Alfalfa

It was desired to learn the proportion of feeders who thought that alfalfa was a good enough feed to be fed as the sole source of dry roughage to dairy cows. It was found that 49 of the breeders specified that they would like to feed cows on alfalfa as the sole dry roughage, while 27 stated that they did not like this method of feeding. The objections were in varying degrees, some stated that they preferred an occasional feed of another kind of hay, some preferred the alfalfa mixed with another hay, and some preferred another hay altogether.

Method of Milking

Figure 30 shows the relationship between the number of breeders using the different methods of milking and the use of combination of two methods. It is noticed that hand milking is a great favorite among the breeders, with machine milking next. The use of combine milkers is still very limited due probably to the high initial cost.

The breeders were asked to give brief reasons for their preference as to method of milking and this made a very interesting study. For hand milking the most common reasons given were that hand milking was better for the udders, prod-

used more milk, checked the spread of disease, gave a better labor arrangement and that some cows would not respond well to machines. Some other reasons were that hand milking developed show udders, insured more thorough milking, gave a better check on the animals, produced cleaner milk, gave more persistent milking, was more economical, and gave a longer life to the cows.

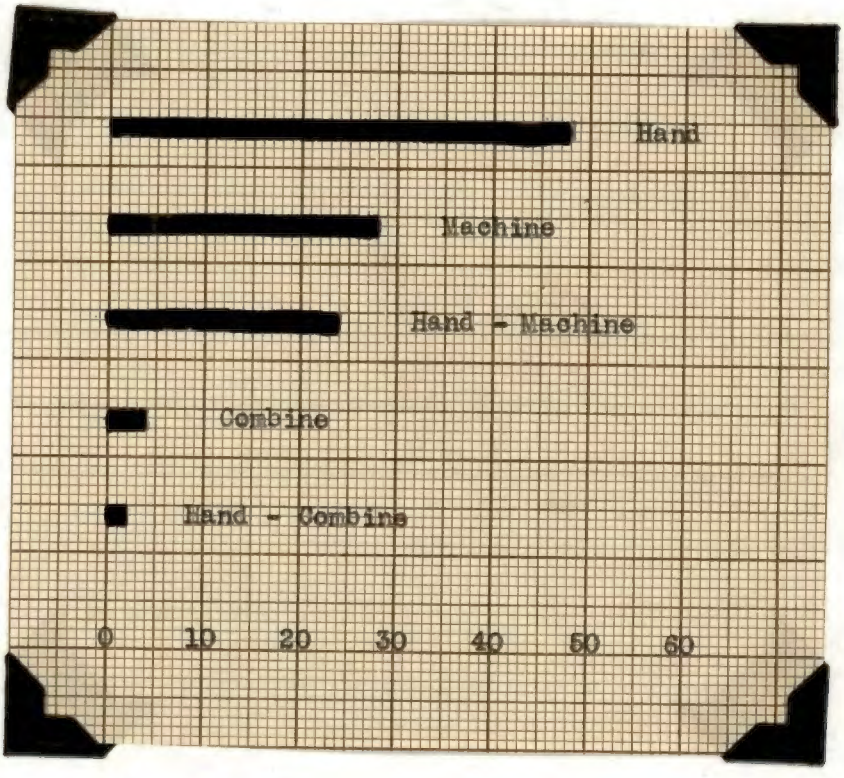


Figure 30. - The number of establishments using the various methods of milking and combinations thereof.

The most common reasons for the use of machines were less labor required, greater sanitation, less expensive, and steady, uniform operation. Other reasons given were that it was hard to get good hand milkers, there was greater speed

and adaptability, fewer odors in the milk, and greater simplicity. Two breeders indicated that they used combine milkers for the advertising value, and one went so far as to state that he milked only a few cows in the combine and the rest of the rather large herd by hand.

Type of bedding

The breeders indicated that straw, shavings, cut fodder, peanut hulls and sawdust were the most popular types of bedding in use. Peat moss and chopped scrap hay were also mentioned.

Considering the value of the manure, the breeders indicated that straw, chopped fodder, peanut hulls and shavings made the best bedding. Ground corn cobs, oat hulls, coconut shells, sawdust, buckwheat hulls, and chopped scrap hay were also mentioned.

Bull exercisers

Only sixteen of the 85 breeders indicated the use of any type of artifical exercisor for their herd sires. It is to be imagined that practically all provide ample exercise yards or paddocks for the bulls. Only three breeders made it a practice to turn two bulls together for exercise. The use of a "merry-go-round" was the most common artificial exercisor. Other forms of exercise were leading, tread-mill, barrel or tire in the paddock for the bulls to butt, and attaching the bulls to a cable.

Raising Calves

The breeders were questioned on several points in calf raising. First it was attempted to discover the extent to which innoculation was used to combat white scours and hemorrhagic septicaemia. Only ten of the breeders innoculated regularly for white scours, all of whom also innoculated regularly for hemorrhagic septicaemia. However, an additional 21 breeders used the hemorrhagic septicaemia innoculation on all calves, thus indicating that hemorrhagic septicaemia was apparently much more dreaded than white scours.

The breeders were asked to indicate the age at which they believed calves should be turned out on all day summer pasture and to be fed grain and hay in supplement. The age of 6 months was the most popular reply, the range being from 6 weeks to 15 months and the average being 10 months.

The question as to what age silage was fed to growing calves brought forth some interesting results. Fifty breeders indicated that they fed silage to young calves (under 8 months of age) and in general 3 to 4 months of age was the most popular time to start. Twenty breeders indicated that they did not feed silage until the calf had become a yearling (over 10 months of age) and only 6 breeders indicated that silage was withheld altogether until milking age.

The question of what kind of hay made the best calf hay was decisively expressed when 44 of the 85 breeders

indicated a preference for a mixed clover and timothy hay. Nineteen breeders preferred alfalfa hay, and a good many of them stated that it should be early cut and not too bright. Seven other breeders stated that practically any early cut hay was all right for calves. Other hays suggested were Johnson grass, timothy, oats, lespedeza, clover, and mixtures of alfalfa and timothy, alfalfa and clover, and oats and vetch.

Growing Heifers

Questions were asked concerning several important points in the methods used in growing heifers, the first concerning the age at which heifers were bred. It was found that the age of 18 months was the most popular age of breeding heifers, as 33 of the breeders bred at this age. The smaller breeds used 15 to 16 months more frequently (see Table IV). The range was from 15 months to 20 months and over. A number of breeders specified that they bred heifers according to size rather than age.

A study of the types of feed used in wintering heifers also showed very interesting results. Heifers are almost universally grown on pasture during the summer. However, in winter other types of feed must be used. The combination of hay, grain and silage was by a great majority the most widely used, being employed on 42 of the 85 farms. The use of hay, grain, silage and fodder was used on 11 farms and hay and grain used on 9 of the farms. Other com-

binations in use were hay, grain and fodder, and hay and silage. Hay was used on 3 farms as the sole feed for wintering heifers.

When questioned as to the type of hay preferred for growing heifers, the managers indicated that mixed timothy and clover was again favored on the majority of the farms, 47 managers stating a preference for this type of hay. Twenty-four breeders showed a preference for alfalfa. Other hays mentioned in answer to this question were oat hay, peavine hay, lespedeza, timothy, red top, and several mixtures of grass and legume hay.

Table IV was compiled from data which would permit a breed comparison. The questionnaires were divided according to breed of cattle and the various points tabulated and averaged. From this table we see that milk production for the various breeds is quite in order. The comparison of grain feeding would indicate that the larger breeds make more efficient use of roughage and require less grain. It also indicates that the smaller breeds are able to breed heifers earlier. The late breeding age of Ayrshires, is however, somewhat surprising.

Farm Management practices

Crop Rotation

As was noticed in the summary of the farms visited, a simple three or four year rotation of corn, small grains, and hay was the most popular type of rotation followed.

TABLE IV

BREED COMPARISON OF AVERAGE PRODUCTION, RATES OF FEEDING, AND AGE OF BREEDING HEIFERS.

Breed	No. of Herds	Average Daily Production (February)	Rate of Feeding			Age of Breeding Heifers Months
			Grain 1# grain per ---# milk	Hay Pounds per day	Silage Pounds per day	
Holstein	27	38.8	3.98	16.2	29.7	17.4
Guernsey	33	27.0	3.43	15.2	25.6	17.9
Jersey	15	22.8	2.98	14.3	21.7	16.0
Ayrshire	9	28.0	3.40	11.1	29.1	19.2
Brown Swiss	1	25.5	4.09	14.0	15.0	17.0

Twenty-seven of the 85 farms returning questionnaires followed this rotation, and at least 15 more followed rotations quite similar to it. One farm grew corn each year on its land, but used all the manure on this land as well as a large amount of fertilizer. Some farms included two years of corn in their rotation. Others included two years of small grain. Several rotations provided for cash crops such as potatoes or truck crops.

Liming and manuring

The rate and frequency of liming was studied in the questionnaire. It was found that liming is very much of an individual proposition among the breeding establishments, dependant on the region in which they were located and the type of soil that prevailed on the different farms. This was particularly true of the rate of liming. The rates varied so much that it was useless to tabulate.

An interval of 3 to 4 years in applying was most prevalent, but the average of all farms was about 5 to 6 years. Twelve of the farms indicated that they tested their soil regularly and applied lime at the rate indicated by the results of the test.

The great majority of the farms indicated that weather permitting, the manure was hauled onto the land almost daily. No study was made as to what crops used the manure.

Crops Raised

An interesting study was made from the question as to what crops were grown on the breeding establishments. The roughages, hay and silage were most persistenly grown carrying out a previous indication that the cropping system is usually designed primarily to produce roughages. Hay was grown on 79 of the farms and silage on 75 of the farms. Of the grains, corn and oats were the most popular. Corn was grown for grain on 52 of the farms and oats on 58 of the farms. Barley, wheat and soybeans were about equal in popularity as crops for breeding establishments, the first two each being grown on 27 farms and soybeans on 24 farms. Fifteen farms indicated that they grew cow beets or mangles.

Soiling Crops

The breeders were asked to indicate whether or not they grew and fed soiling crops or "green feeds". Of the 85 farms reporting, 42 grew and fed soiling crops while 39 did not grow them. Soybeans, oats, Sudan grass, green corn, and alfalfa were the most commonly used soiling crops. Kale, barley, clover, wheat, millet, vetch, cow peas, and combinations of oats and rye, oats and cow peas, oats and vetch, and rye and wheat were also mentioned. The main use for soiling crops was to supplement pasture during dry seasons.

Special Hay Treatments

When questioned as to the use of special hay treatments, 55 farms indicated that they used no such method, while 22 farms answered in the affirmative. Chopping was the most

popular form of special hay treatment, while artificial drying, grinding, baling in the field, and the use of a cut crop keeper were also mentioned.

Cash Crops

One of the most interesting questions asked the managers was that regarding whether or not they believed that a breeding establishment with plenty of acreage should attempt to grow some cash crop, and if so what crops made the best cash crops in their locality. Of the 85 farms, 59 indicated that cash crops should be grown while only 22 indicated that they should not be grown by breeding establishments. Wheat and potatoes were most prominently mentioned as good cash crops. Garden truck, soybeans, sweet corn, cabbage, hay, fruit, cotton, tobacco, beets, lumber, oats, and corn were also popular as cash crops. Hogs, poultry and sheep were also mentioned.

Buildings and Equipment

Wood was the main building construction material on the breeding establishments that returned questionnaires. Concrete, brick, tile, cinder block, stone and stucco followed in importance in the order in which they are mentioned.

The great majority of the establishments indicated that they used stanchions, tie stalls, and box stalls. Only 7 of the 85 farms stated that their cows were not milked where they ate and slept.

Concerning the method of purchasing farm and barn equipment, 56 of the managers indicated that they felt it advisable to buy entirely from one line of manufacture, while only 28 farms indicated that they purchased equipment from several lines.

Discussion of Results

It would not be correct to assume that from these results a perfect dairy herd and farm management system could be compiled, for as it has been already stated that farm management, and dairy herd management as well, are individual propositions and must be made to suit the conditions of each establishment.

These results can, however, be taken as an indication of the prevalent practices on the breeding establishments of the country and worthy of consideration when arranging a management system for a farm and dairy herd.

It seems unnecessary to give a detailed discussion of the results of all the points covered. The number of farms dealt with was large enough to assume that those practices which were in the majority are the predominating practices on the breeding establishments of the country.

SECTION B

EXPERIMENTAL INVESTIGATION

Comparison of Methods of Raising Dairy Calves Under Six Months of Age.

Purpose

The object of this investigation was to compare three methods of raising young dairy calves from the standpoint of growth and cost. The three methods selected to be compared were (1) whole milk feeding, (2) nurse cow method, and (3) commercial calf meals.

The number of calves at the University dairy was somewhat limited as to calves of a suitable age to be used in this experiment. It was necessary to use some calves of such an age that they would reach the age of 200 days before the test period was over, while others were taken from birth at such times that would not permit their being run a full 200 days.

The calves were divided into three groups. An equal division of the calves was not possible because of the limited number of calves available for the work. On completion, each group contained three calves. The history of the groups were as follows:

Group 1 - Commercial calf meal group - This group was made up of two Holstein and one Jersey heifer calves. The two Holsteins were equal in age being 82 days old at the start of the experiment. The Jersey calf was 123 days old

at the start of the experiment. These calves had been raised on nurse cows up until the time they were placed on the experiment, thus being of more than sufficient age to be placed on calf meal, based on the usual practice of weaning calves to be grown on calf meal at 30 days of age. The Jersey calf was small for her age.

Group 2 - Whole milk group - At the beginning of the experiment this group contained two Holstein calves, one male and one female. The bull calf was 42 days old at the start of the experiment while the heifer was 24 days old. Both calves had been bucket fed on whole milk from the time they were removed from the cows at a young age. The third calf in the experiment was a Jersey heifer added to the group after the beginning of the experiment. Due to the necessity of maintaining the equilibrium of the herd management system, this calf was fed for the first month on a nurse cow and then changed to bucket feeding.

Group 3 - Nurse cow group - At the beginning of the experiment this group contained two Jersey bull calves 22 and 54 days old respectively. Both of these calves were raised on nurse cows entirely. The third calf in this group was a Jersey heifer calf which was placed in the group as soon as it was removed from its dam.

Feeding Methods

The feeding of the calves was intended to similate the method of feeding followed by breeders who used these

methods. Feeds were approximated and the amounts recorded regularly.

Group 1 - Commercial calf meal - For this group, a commercial calf meal prepared by a local mill was selected, and fed according to the usual recommendations for calf meal feeding. These are that the calf be fed whole milk for the first month while at the same time inducing the calf to eat as much grain as possible. Milk feeding was stopped at one month of age and the calf permitted to eat only the calf meal. The meal was fed twice daily, the object being to keep feed before the calves at all times. This was supplemented by the regular calf mixture which was fed to the other groups. Hay, of course was also fed. Silage was fed in limited amounts to this group all during the experiment.

The composition of the calf meal was, of course, unknown, as the feed was a "closed formula" feed. The ingredients listed on the tag were fine ground oats, linseed oil meal, wheat flour, yellow corn meal, dried blood and salt. The meal was ground to a very fine consistency. Through the first part of the experiment the calf meal was fed in the form of small pellets. During the later months, however, the same feed was fed as a ground feed. The pellets proved more successful as the calves seemed to like them better. The ground meal was very fine and dusty and dry in the calves mouths.

Group 2 - Whole milk fed - The calves fed on whole milk were, with the exception of the Jersey heifer calf, removed from their dams at an age of four or five days and

placed in a separate pen. The calves were fed twice daily. They were stanchioned, first fed their milk, and while still fastened were fed their grain. They remained in the stanchions until all or most of the grain had been consumed, then were allowed to be free to consume the hay which was placed in the mangers when they had cleaned up their grain. Silage was fed once a day in limited amounts after the calves were two months of age. The amount of milk and grain fed was gradually increased as the age and size of the calves increased. They were started at about 3 to 4 pounds of milk daily and increased to a maximum of 10 pounds daily. Grain was started at about ½ pound daily and increased to a maximum of four pounds daily. The milk fed averaged 3% butterfat. The grain mixture was a home mixed ration which consisted of

200 pounds corn and cob meal
150 pounds ground oats
100 pounds wheat bran
50 pounds linseed oil meal
5 pounds salt
5 pounds ground limestone

The Holstein bull calf was weaned at 153 days of age and fed calf meal.

Group 3 - Nurse cow fed - These calves were allowed to nurse cows twice daily. Two calves per cow were permitted. The cows were turned in to the calves twice each day and removed as soon as the calves were finished. The calves were

managed in such a way that they received nearly equal portions of the cows' milk which amounted to a maximum of about 10 pounds per calf per day. The cows used as nurse cows were in all cases cows which had been removed from the milking herd because of infections of mastitis.

The grain fed to these calves was the same home mixed ration that was used in the case of the whole milk group. Grain was kept before these calves at all times and no special amount fed. The calves ate it very liberally. Hay was offered twice daily after the cows had been removed. Silage was fed twice daily after the calves were two months of age. The two bull calves were weaned at 132 and 164 days of age respectively, and fed calf meal. The hay used for all groups during this experiment was of only fair quality. During the first two months a rough Sudan grass hay was fed, and during the remainder of the experiment a fair quality mixed clover was fed.

Recording data

All calves on hand prior to the start of the experiment were placed on their assigned experimental rations one month in advance of the start of the data recording. All calves taken into the experiment after the beginning were placed on the experimental ration at once without preliminary feeding.

Data was recorded from December 3, 1936 to May 5, 1937, inclusive. Weekly data was kept after January 4, 1937.

TABLE V

COMPARISON OF METHODS OF CALF RAISING
AMOUNTS OF FEED AND COST, PER ANIMAL

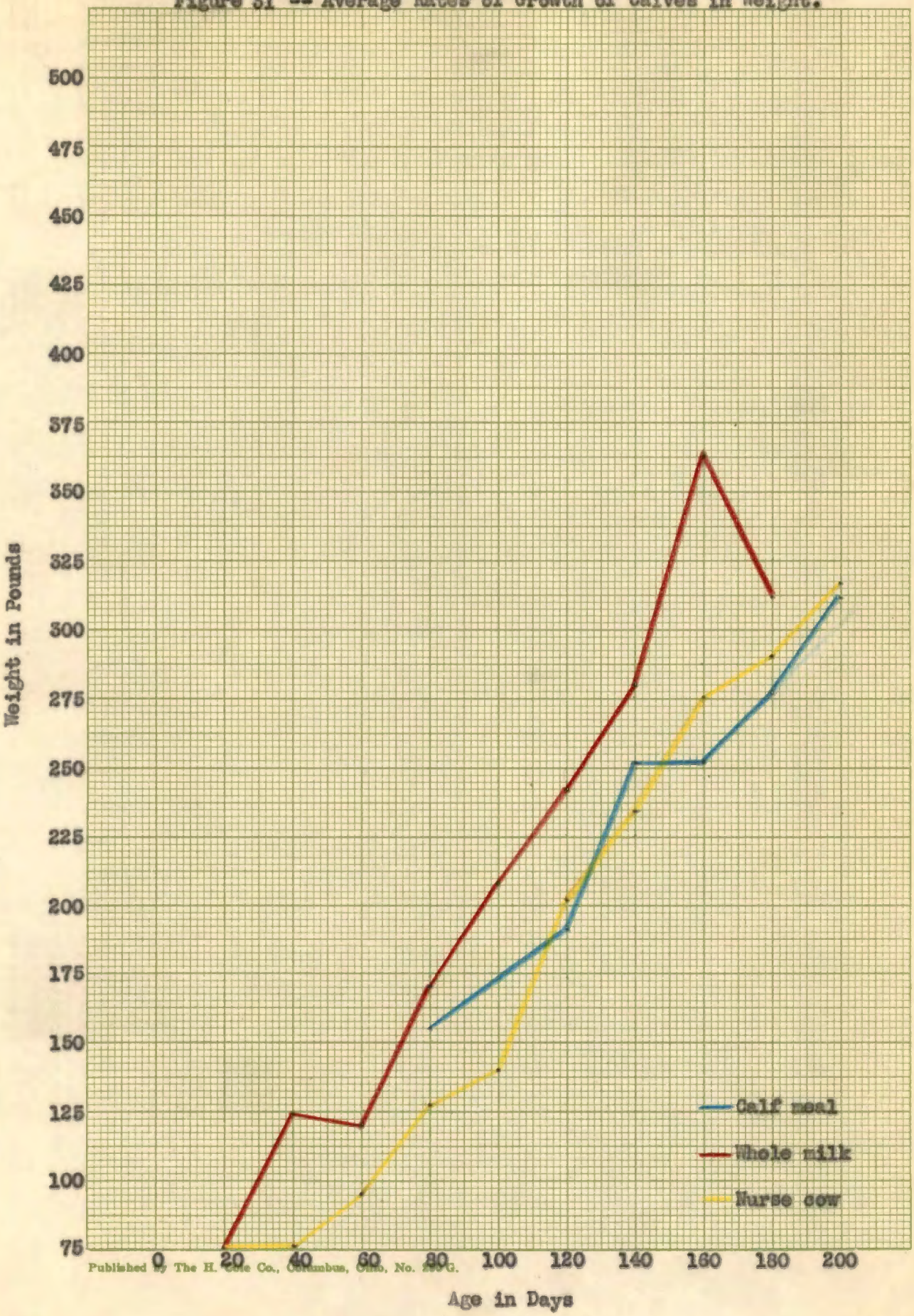
	Groups		
	1 Calf Meal	2 Whole Milk	3 Nurse Cow
Length of experiment, days	154	154	154
Number of animals in group	3	3	3
Feed consumed (pounds)			
Grain	509	316	333
Calf Meal	230	8	56
Milk	-	834	Cow
Hay	601	419	326
Silage	338	122	169
Cost of Feed Consumed			
Grain	10.18	6.36	6.66
Calf Meal	8.65	0.03	2.10
Milk	-	18.93	14.75
Hay	6.01	4.19	3.26
Silage	1.01	.37	.51
Total feed cost, per animal	25.85	29.88	27.28
Cost per day	.167	.194	.177
Cost per pound gained	.1275	.1320	.1310

TABLE VI

AVERAGE GROWTH RATES FOR THE THREE GROUPS OF CALVES.

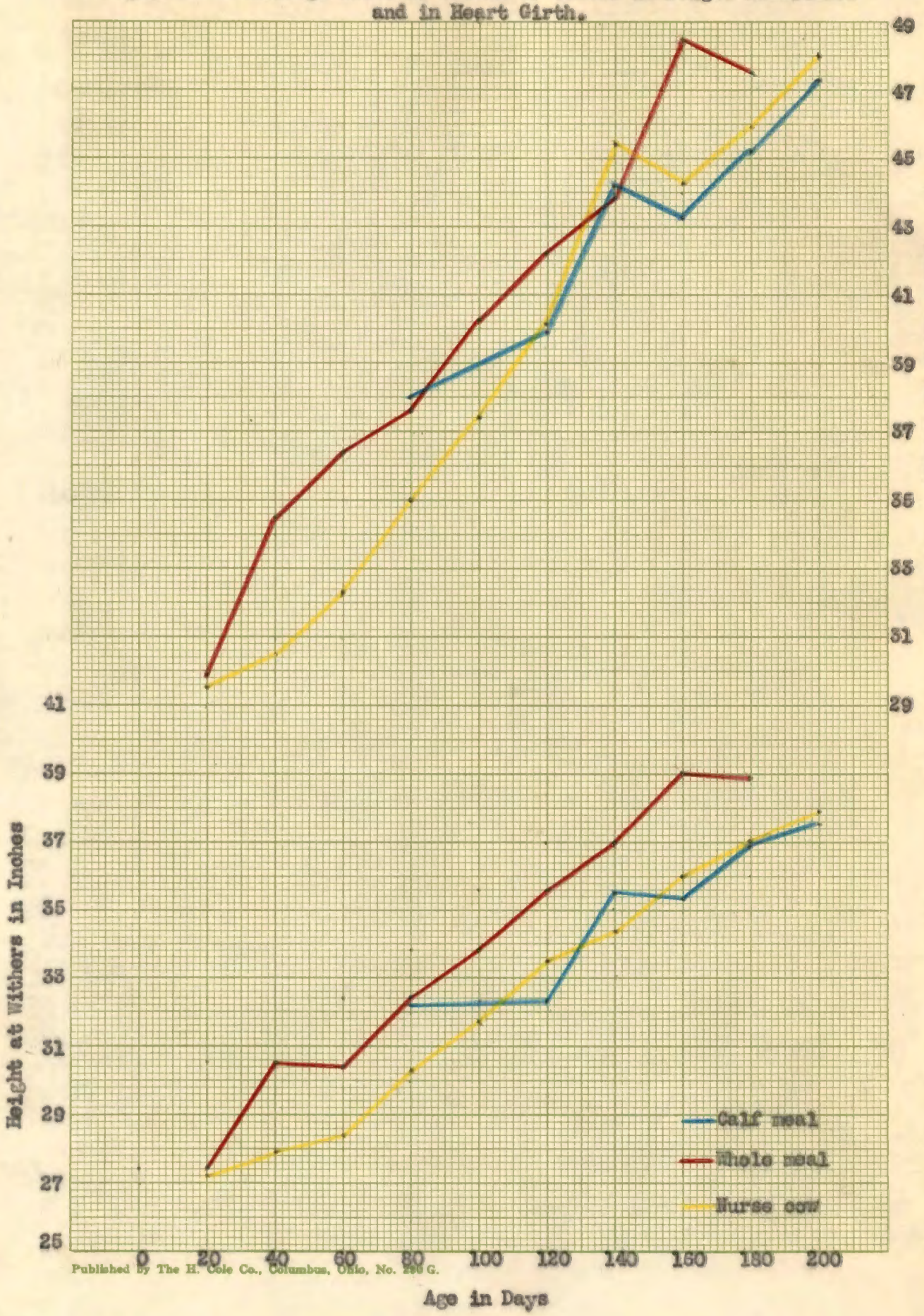
Age in Days	20	40	60	80	100	120	140	160	180	200
Calf Meal	Key									
	Weight			154		191	252	252	277	312
	Height at withers			32.20		32.30	35.50	35.33	36.90	37.50
	Heart Girth	0	0	38.00	0	39.92	44.25	45.25	45.20	47.30
	Estimated weight			176		204	272	256	299	332
Whole Milk	75	124	119.5	170	208	242	279	361	312	
	27.40	30.55	30.42	32.40	35.80	35.60	37.00	39.00	38.91	
	29.87	34.50	36.40	37.60	40.25	42.20	43.90	46.50	47.50	
	96.5	131	137.5	173	209	237	270	348	325	
Nurse Cow	74.5	76	95	127	140	202	229	275.5	290	317
	27.21	27.92	28.40	30.30	31.70	33.50	34.38	36.00	37.00	37.85
	29.50	30.50	32.30	35.00	37.20	40.12	45.38	44.25	45.90	46.00
	96.5	104	115	146	167	206	256	274	296	33.70

Figure 31 -- Average Rates of Growth of Calves in Weight.



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Figure 32 -- Average Rates of Growth of Calves in Height at Withers and in Heart Girth.



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Data covered the height at withers (three readings made and averaged), the heart girth, weight as estimated by heart girth measurement (National Oil Products heart girth weight estimating tape was used), and the actual weight. Photographs were made the first week of each month of each of the calves. A scaled background was provided so that size of each calf might be made from the picture.

Results obtained

The results obtained are shown in Table V and VI and in the Graphs in Figures 31 and 32. The irregularities found in some of the average figures are not in any case due to irregularity in the growth of the calves. Two factors were in the main responsible for these variations. These are: (1) Averaging growth figures for calves of two breeds and two sexes when the groups are not balanced as to breed and sex, and (2) averaging figures when complete material is not available in all groups in all ages. (As was previously stated, some calves were too old at the beginning to get figures for the younger ages, while other calves were too young to complete the experiment in the limited time. A definite example of this variation is pointed to in the graphs in Figures 31 and 32 for the whole milk group of calves. The irregularity at 60 days of age on all the graphs was the fact that in the 20 and 40 day ages figures were only available for one Jersey heifer calf, while at 60 days of age the average was for this calf as well as a Holstein heifer and a Holstein bull calf. Likewise, the drop at 180 days was

due to the inavailability of data on the Jersey heifer and Holstein bull calves.

These data indicate that raising calves on commercial calf meal was the cheapest method. However, cost data on one month of milk feeding is not available, and the calf meal used in this experiment was comparatively inexpensive. The use of the nurse cows for calf feeding in the University herd, although proving to be more costly than other methods, is particularly advantageous in making use of brood cows no longer satisfactory for use in the milking line. As to the effect of this kind of milk on the calves, it was noticed that there was greater trouble with common scours in the calves that nursed these cows, and also even though they were in good condition, their hair was not so sleek and attractive as the calves that were fed normal milk. This might indicate that such milk may cause minor digestive disorders in the calves.

Growth in the whole milk group was exceptionally good. The calves were at all times in good condition without being overly fat. The graphs indicate that though this method was more expensive, the growth at all times was superior to the growth obtained by the other methods.

Discussion of Results

The results of this experiment showed that the whole milk feeding method produced the best growth of the three methods of calf feeding that were tried, but at the same time it was the most costly.

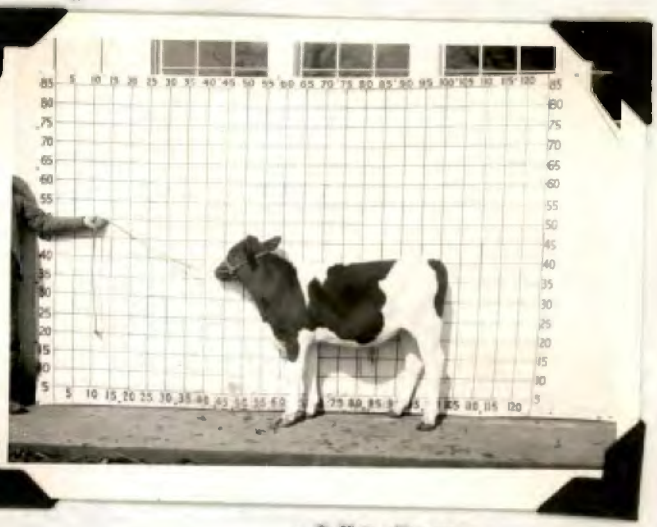
This experiment would be well worth repeating under conditions where skim milk is available and where there are a sufficient number of calves available to give more extensive data.

During the progress of this experiment, the use of photographs proved to be an excellent method of supplementing data of this type.

Calf 314
Whole Milk Group



42 Days



132 Days



75 Days



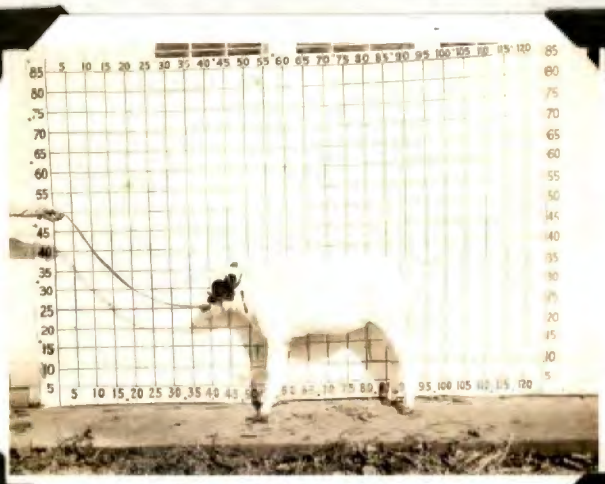
168 Days



104 Days

Figure 33 - Photographic Record of typical calf in whole milk group

Calf 312
Calf Meal Group



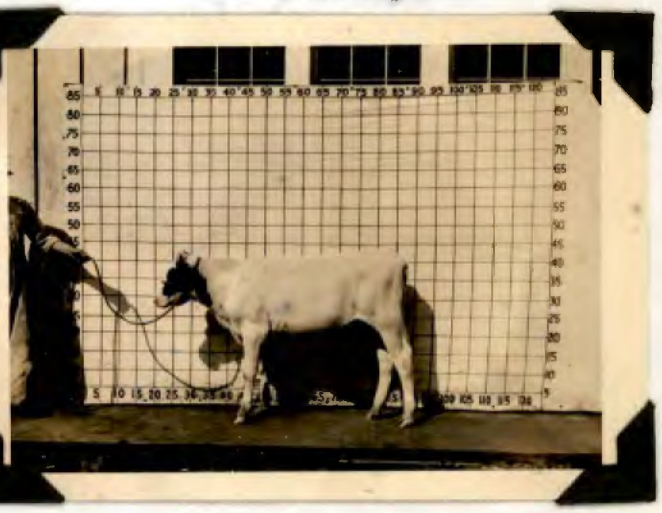
82 Days



173 Days



116 Days



209 Days



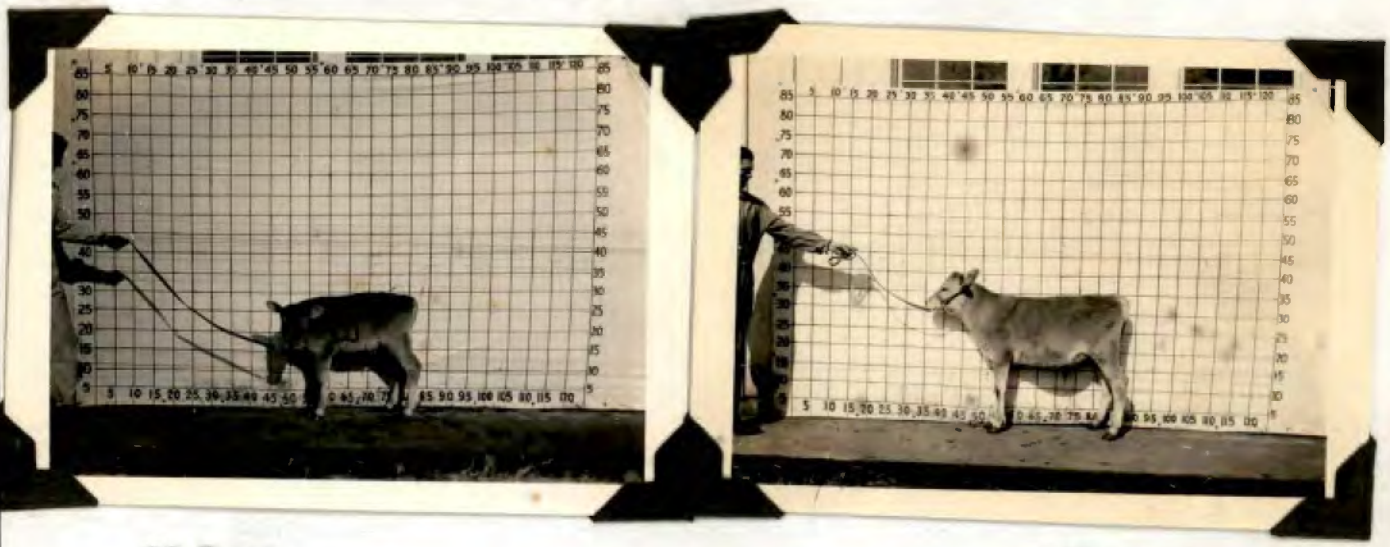
145 Days



237 Days

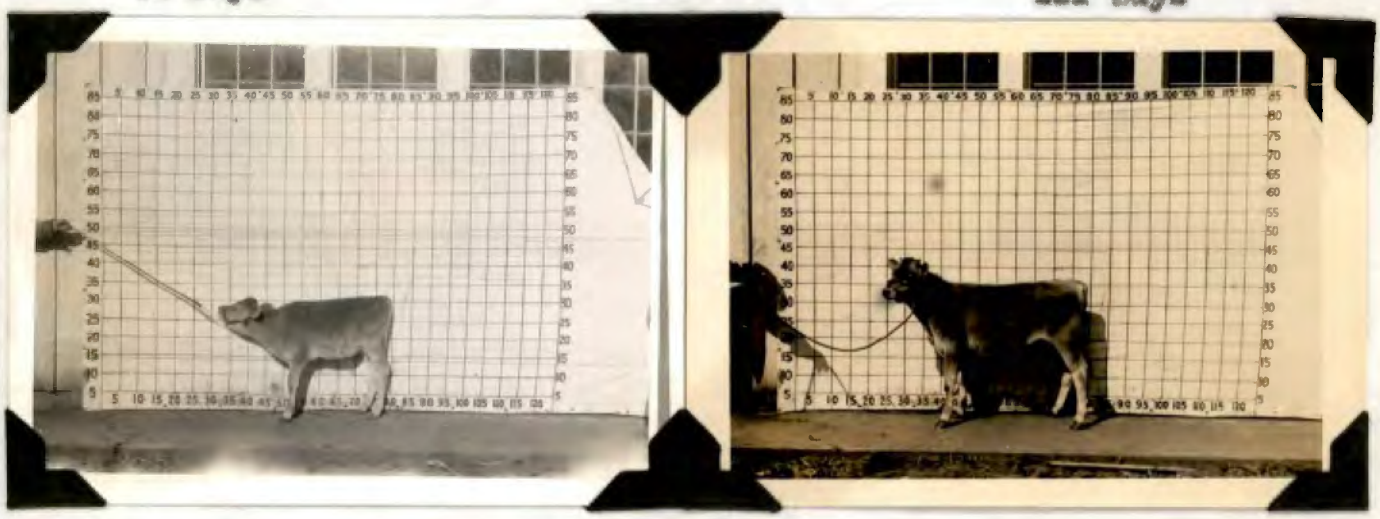
Figure 34. - Photographic record of typical calf in calf meal group.

Calf T-61
Nurse Cow Group



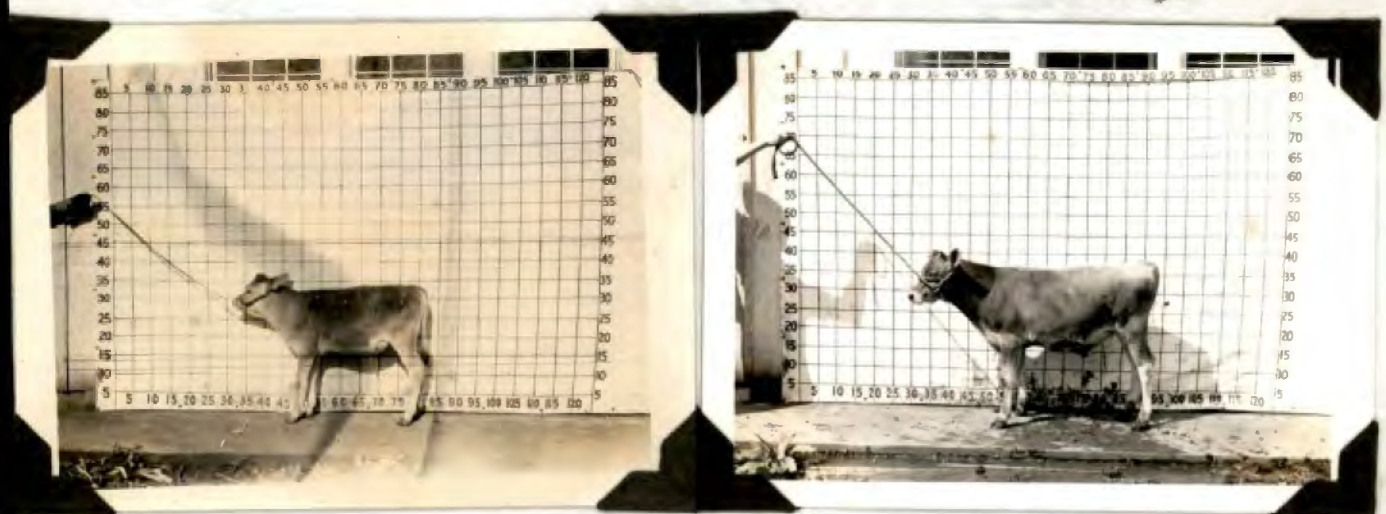
22 Days

111 Days



54 Days

147 Days



83 Days

168 Days

Figure 35. - Photographic record of typical calf in nurse cow group.

THE EFFECT OF SUDDEN CHANGES IN THE SKIM MILK DIET OF A CALF ON THE DIGESTIVE EQUILIBRIUM.

Purpose

So many times breeders have been heard to express an opinion that any quick change in the diet of a calf, particularly in the milk, will meet with disastrous digestive disorders which cause a loss in the rate of growth of the calf and a stunting in the ultimate growth obtained. It was decided to test the truth of this theory in the project which is to be described here.

This project can better be termed a demonstration rather than an experiment as only one animal was used. The purpose was to study the effect of sudden changes in the skim milk diet of a calf as indicated mainly be the condition of the bowels as well as the appetite, condition of hair and alertness in eye and ear.

Plan

A Holstein bull calf was removed from the University dairy herd to a point close to the University creamery where a supply of skim milk was available. The animal was one month of age at the time and had been raised thus far on a nurse cow.

The calf was then fed on fresh skim milk at a temperature of 100° F. The regular herd calf grain mixture (as given in the previous experiment) was fed in normal amounts as was a good quality mixed clover hay. All feeding was done twice

daily at 7:30 A. M. and 5:00 P. M. Fresh water was kept before the calf at all times, being changed at each feeding. All grain and hay were fed in a manger erected in the calf's pen. All milk feeding utensils were thoroughly washed and sterilized once a day and the feeding bucket rinsed completely after each feeding.

The only varying factor in the calf's ration was the type of skim milk fed. This was altered between fresh skim milk, reconstructed skim milk, and pasteurized skim milk in the order to be indicated later. The fresh skim milk was taken daily direct from the seperator, placed in a can and set at a temperature of about 90° F. in the milk storage room to be gradually cooled to 40° F. The reconstructed skim milk was made up by mixing skim milk powder and water at 125° F. at the proportion of 1 pound of powder to 9 pounds of water. This was mixed daily and then placed in the milk storage room to cool. A high grade powder was used. The pasteurized skim milk was taken after having been pasteurized at 143° F. for 30 minutes and cooled to 40° F. It was likewise held at 40° F. in the milk storage room. All milk was heated to 100° F. before feeding and fed at this temperature. Heating was done by immersing a steam hose directly into the milk and applying live steam.

The calf was fed fresh skim milk until his condition indicated that the digestive system was normal, and on the next feeding was given reconstructed skim milk. (All changes were made on the evening feeding, thus the calf received one

type of milk in the morning and a different type in the evening). After this change, this type of skim milk was fed for several days and the condition of the calf noted. When the calf was again normal, it was changed back to fresh skim milk and again observed for a period. The changes that were then used were in the following order: fresh to reconstructed; reconstructed to fresh; fresh to pasteurized; pasteurized to fresh. The complete procedure was then repeated. The average length of the observation periods after each change was 5 days.

Recording data

With the exception of the milk fed, no attempt was made to record the amount of feed fed. A daily record was kept of the amount of milk fed and type, and whether normal or less than normal feedings of hay and grain were made, as well as the condition of the bowels, appetite and general condition of the calf. During the 48 days the calf was on the test it gained 80 pounds.

Results obtained

The first change, before the demonstration actually started, from the nurse cow to fresh skim milk, loosened the bowels of the calf considerably, tho not to an alarming degree. The appetite for hay and grain was poor at the start, probably due to the fact that the calf had not been used to eating these in large amounts. It was necessary to reduce the amount of milk, hay and grain fed until the appetite was restored. It required 10 days to get the calf to a normal

condition in order that the first change of the demonstration might be made.

After the first change from fresh skim milk to reconstructed skim milk the bowels were noticed to be loose on the following day, but the condition was cleared up by the next day and did not reappear. The appetite and general condition of the calf was entirely normal.

The same loosening of the bowels was noted in the first change from fresh to reconstructed skim milk at the end of the first series. These were the only appreciable changes from normal conditions of the bowels, and at no time were they serious enough to cause alarm. The appetite and general condition of the calf was very good at all times.

During the last three days, two changes were made each day and still there was no change in the condition of the calf to indicate any digestive disorders. Of 13 changes made during the demonstration only two produced minor loosening of the bowels and none produced a condition that would give definite indication of an appreciable digestive disorder.

Discussion of Results

The results obtained in this demonstration would seem to indicate that no ill effect resulted from sudden changes in the skim milk diet of a calf. However, it cannot be assumed on the basis of this work that this would hold true in all cases. It seems reasonable to believe that the common belief of the ill effects from these changes has been over-

estimated and in many cases it would be practical to make such a change in the feeding of a group of calves.

An interesting sidelight to this work was noticed in that a mild case of rickets was produced in the calf. This no doubt was not due to the feeding method employed, but rather to the fact that the calf was penned up without exercise or exposure to sunlight during the course of the experiment.

COMPARATIVE EFFICIENCY OF PRACTICAL HERD TESTS IN DETECTING MASTITIS.

Purpose

Mastitis is one of the most economically important of all of the diseases common to dairy cattle. Decreased milk production and discarded milk cause enormous losses to the dairyman. It has been estimated by good authorities that twenty-five percent of all the cows culled from dairy herds are sold because of udder trouble.

The two main causes of mastitis are badly infected cows and unsanitary stable management, the former being the most potent source of the infectious organisms and the latter the greatest means those organisms have of spreading through the herd.

The practical dairyman is, of course, interested in knowing whether or not his herd is infected and if so the degree of the infection and what animals in particular are the worst offenders. The dairyman thus is vitally interested in a test, or series of tests which will point out the infection in his herd. These tests must be accurate enough to be the basis of culling and for use in control methods.

There are a number of tests designed to indicate mastitis infection and the degree in which it exists. Physical appearance of the udder and the use of the strip cup are simple tests, the brom-thymol-blue and brom-cresol-purple are p h indicator tests; oxygen production, percent chloride, percent of lactose are analytical tests; microscopic counts of lucocytes, body cells, and streptocci are

microscopic methods, and there are other methods that go into cultural and post mortum examination procedures.

Obviously dairymen cannot slaughter their cattle to locate the disease, nor can they have well equipped laboratories in which to conduct the tests. They must have practical tests which can be run at regular intervals in the barns and without too great an expenditure for equipment.

Several tests meet the requirements of practicability. They are the physical examination of the udder, strip cup, brom-thymol-blue, brom-cresol-purple and either brom-thymol-blue or brom-cresol-purple paper tests. It was the purpose of this investigation to compare the efficiency of four of these tests in indicating the present of mastitis and to check the results thus obtained by comparison with a microscopic count of the luccocytes in the milk. This, it is believed, will give a fairly accurate estimation of the accuracy of these tests in indicating mastitis.

Plan

As some forms of mastitis reoccur in cycles, this experiment was laid out to cover a period of examination of over one month's duration. The four tests chosen for this comparison were the brom-thymol-blue, the brom-cresol-purple, the brom-thymol-blue paper test and the strip cup test. As was mentioned before, microscopic counts of the luccocytes in the milk were also made as a check.

The procedures used in making the various tests were as follows:

1. Brom-thymol-blue test: A stock water solution of the indicator was made up according to the following formula:

0.1 grams dry indicator (brom-thymol-blue)
3.2 c. c. N/20 Na O H
21.8 c. c. Water

The solution was then neutralized to a p h of 7.0. The stock solution was then diluted at the rate of 1 part of solution to 9 parts of distilled water.

To 6 c. c. of the milk to be tested, 2 c. c. of the diluted solution were added, and after thorough mixing the color was noted. If the mixture was a light yellowish green the milk was negative, if a light greenish blue the milk was suspicious for mastitis, and if a deep green or blue, the milk was positive for mastitis.

2. Brom-cresol-purple test: A stock water solution of the indicator was made up according to the following formula:

0.1 grams dry indicator (brom-cresol-purple)
3.7 c. c. N/20 Na O H
21.3 c. c. Water

This solution was standardized to a p h of 6.8. The stock solution was then diluted in the same proportion as was the brom-thymol-blue solution.

To 6 c. c. portions of milk, 2 c. c. of the diluted indicator were added in marked test tubes. These were stoppered with cotton plugs and incubated at 37° C. for 24 hours. At the end of the incubation period the results were read. If the color was a purple or deep blue the milk was

considered negative; if a light blue it was suspicious and if a green or any shade of yellow it was positive to mastitis.

3. Brom-thymol-blue paper tests: The paper used in running this test was made up by the author though a number of commercial forms are available on the market. A stock alcohol solution of the dye was made up according to the following formula:

0.3 grams dry indicator (brom-thymol-blue)
25 c. c. 95% alcohol
75 c. c. distilled water

A heavy, rough absorbant type of paper was cut into strips and soaked in the undiluted solution. This was then allowed to dry in the air and was again cut into usable sized pieces.

A stream of milk was milked directly from the teat onto the piece of paper. If the color of the paper remained yellow the milk was negative, if the color changed to a greenish yellow the milk was suspicious, and if the paper turned a deep green the milk was positive to mastitis.

4. Strip cup test: A metal strip cup was purchased for this test. It is simple in construction being made of a metal cup with a handle, with a removable top. One half of the top is solid while the other half holds a fine mesh metal screen. In the strip cup test three or four streams of milk were milked onto the screen and observation made for the presence of lumps, flakes or strings of milk. If no lumps, flakes or strings were noticed, the milk was negative, if only a few small flakes were noted, the milk was suspicious,

All other appearances on the screen were considered a positive reaction.

5. Microscopic Lucocyte count: Samples of milk were taken to be counted. One loop full of milk was spread over one square centimeter on the microscope slide. This was dried in the air and fixed by drawing several times quickly through a flame. After this the slide was washed in xylol to remove the fat, stained in methylene blue for one minute, washed with water and decolorized with alcohol. After drying, cedar oil was applied and the slide viewed under the oil emersion objective of a microscope. The lucocytes take a deep blue stain and are very easy to count. Twenty fields were counted and averaged, then multiplied by 300,000, the conversion factor for the microscope used, and the resulting figure was taken as the number of lucocytes per cubic centimeter. A count of less than 500,000 was considered negative, from 500,000 to 1,000,000 was suspicious, and over 1,000,000 was considered positive for mastitis.

Figure 36 shows the equipment used in making this test. On the left, by number 1, is the strip cup. At number 2 is the paper, and number 3 represents the brom-cresol-purple test equipment which includes cotton, incubator, test tubes, wire basket and indicator solution. Number 4 shows the tubes and solution necessary for the brom-thymol-blue test, and number 5 shows the microscope, slides, guide, loop, and stains necessary for the microscopic count.



Figure 36. - Equipment used in the 5 tests conducted.

The procedure for running the tests may be outlined briefly as follows:

1. The sixteen cows milking in the main milking of the University herd, were divided into four equal groups. On every other day tests were run on these cows in such a manner that each group received a different test on any one day, and the tests rotated through the groups in such a manner that all groups had received all tests in 8 days. This procedure was repeated 5 times, so that at the conclusion each group had had each test run on it at regularly spaced intervals.

2. A group of 5 cows was selected at random from the herd and on the alternate days from those on which the tests were to be run on the four groups as outlined above, these cows had all the tests applied upon them.

Luccocyte counts were made during the last half of the experiment at times corresponding to the running of the brom-cresol-purple tests.

Results Obtained

A total of 2432 tests were run on the sixteen cows over a period of 40 days. The results of this work are shown in table form in Table VII. In each group of figures, the first represent the total number of negative reactions to the specific test, the second the total suspicious reactions, and the third, the total positive reactions. Likewise in each group of figures the top line represents the right rear quarters, the second line the right front quarters, the third line the left front and the fourth the left rear quarters. An example follows:

	N	S	P
RR	19	0	0
RF	10	9	0
LF	11	8	0
LR	12	7	0

A maximum of four of the luccocyte counts are indicated in the last column. The symbol "IMM" indicated an innumerable or uncountable number of luccocytes.

By totalling the number of negative, suspicious and positive reactions for each test an interesting correlation was noted. As was expected the correlation between the brom-

thymol-blue and the paper tests was very similar. The brom-thymol-blue test gave 51% negative, 33% suspicious and 16% positive, while the paper test gave 49% negative, 32% suspicious and 19% positive.

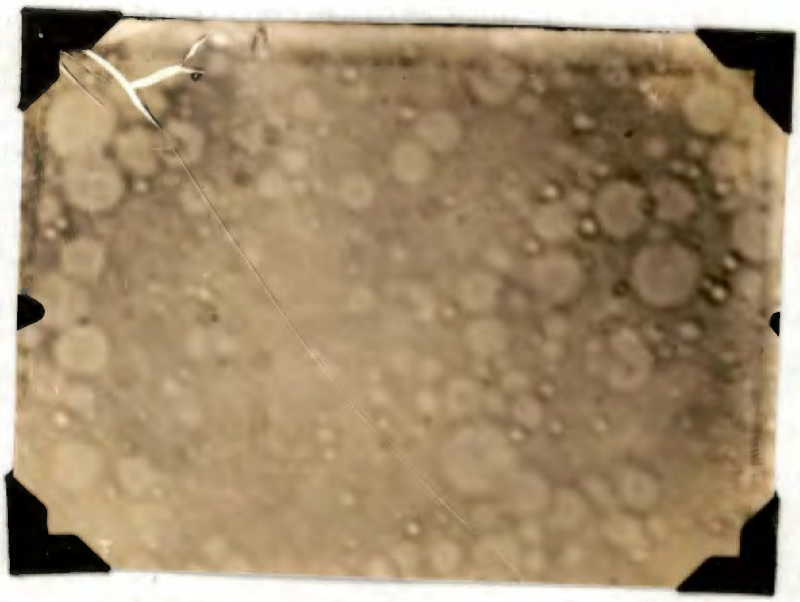


Figure 37. - Microphotograph of clear field of milk magnified 1000 times.

The brom-cresol-purple test gave only 12% negative, 23% suspicious and 65% positive, while the strip cup test gave 94% negative, 1.5% suspicious and 4.5% positive.

The study of these percentage reactions is very interesting. As was stated above, a close correlation was noticed between the brom-thymol-blue test and the paper test. However, the brom-cresol-purple test showed a high percentage of positive reactions, while the strip cup test gave an abnormally high percentage of negative tests. In the case of the strip cup, these results were as would be expected, but the brom-cresol-purple test gave a larger percent of

TABLE VII.

TOTAL NEGATIVE, SUSPICIOUS, AND POSITIVE MASTITIS REACTIONS BY TESTS AND BY QUARTERS OF THE COWS.

Cow No.	Brom-Thymol-Blue	Brom-Thymol-Blue Paper	Brom-Cresol-Purple	Strip Cup	Lucocytes per c. c. (in Thousandths)
	19- 0- 0	16- 3 - 0	4- 9- 6	19- 0- 0	75- 90- 45-195
T-14	10- 9- 0	13- 5 - 1	6- 8- 5	18- 0- 1	150- 60-120-330
	11- 8- 0	12- 7 - 0	4-10- 5	19- 0- 0	390-105-120-285
	12- 7- 0	11- 7 - 1	3-11- 5	19- 0- 0	195- 60- 60-525
	N S P				
	8- 7- 4	6- 9 - 4	0- 0-19	18- 1- 0	1005-1140-1375-3000
	1- 0-18	0- 1 -18	0- 0-19	17- 2- 0	2160- 930- INN-4290
81	9-10- 0	6-10 - 3	0- 5-14	17- 1- 1	360- 285- 480- 105
	14- 5- 0	16- 2 - 1	0- 3-16	19- 0- 0	780- 480- 345- 420
	14- 2- 0	14- 2 - 0	2- 1-13	16- 0- 0	90- 45-255-765
243	14- 2- 0	15- 1 - 0	2- 3-11	16- 0- 0	75-240-1395-210
	2- 3-11	1- 7 - 8	0- 1-15	15- 0- 1	150-645-1155-765
	10- 5- 1	11- 2 - 3	2- 2-12	14- 2- 0	240- 90- 885-420
	7-12- 0	6-13 - 0	0- 1-18	19- 0- 0	240-280-300- 75
249	4-12- 3	7-10 - 2	0- 5-14	19- 0- 0	255- 90-585-225
	16- 2- 1	14- 5 - 0	1- 3-15	19- 0- 0	240-495-390- 75
	9-10- 0	14- 5 - 0	1- 0-18	19- 0- 0	180-750-150-930
	1- 9- 9	1-11 - 7	1- 3-15	18- 0- 1	90-285-450-105
230	7-10- 2	8- 8 - 3	2- 8- 9	19- 0- 0	180-300-465-120
	5-12- 2	7- 9 - 3	2- 7-10	19- 0- 0	315-690-150-270
	13- 6- 0	8-10 - 1	1- 7-11	19- 0- 0	270-315-300-255
	N S P				
	0- 2- 3	0- 2 - 3	2- 1- 2	5- 0- 0	915-630
T-8	0- 1- 4	1- 1 - 3	1- 1- 3	5- 0- 0	1215-435
	0- 0- 5	0- 0 - 4	0- 0- 4	0- 0- 5	INN-INN
	0- 3- 2	1- 2 - 2	2- 1- 2	5- 0- 0	930-300
	4- 1- 0	4- 1 - 0	2- 2- 1	5- 0- 0	1125- 30
T-35	4- 0- 1	4- 1 - 0	3- 0- 2	5- 0- 0	1740-210
	5- 0- 0	5- 0 - 0	2- 0- 3	5- 0- 0	495-330
	5- 0- 0	5- 0 - 0	0- 5- 0	5- 0- 0	1020-135
	5- 0- 0	5- 0 - 0	1- 1- 3	5- 0- 0	210-180
245	0- 0- 5	0- 1 - 4	0- 0- 5	4- 0- 1	1065-1950
	0- 4- 1	0- 3 - 2	1- 0- 4	3- 0- 2	660-INN
	1- 3- 1	3- 1 - 1	0- 2- 3	5- 0- 0	1200-465
	0- 4- 1	2- 3 - 0	0- 1- 4	3- 0- 2	1110-1065
289	4- 1- 0	5- 0 - 0	2- 1- 2	5- 0- 0	120- 90
	1- 3- 1	0- 3 - 2	2- 0- 3	4- 0- 1	315- 740
	3- 0- 2	0- 3 - 2	0- 0- 5	5- 0- 0	525-1095
	2- 0- 0	0- 2 - 0	1- 1- 0	2- 0- 0	
285	2- 0- 0	0- 2 - 0	1- 0- 1	1- 0- 1	No counts
	2- 0- 0	1- 1 - 0	1- 1- 0	2- 0- 0	
	2- 0- 0	1- 1 - 0	1- 0- 1	2- 0- 0	
	4- 1- 0	5- 0 - 0	0- 1- 4	5- 0- 0	270-0
287	4- 1- 0	2- 2 - 1	2- 1- 2	5- 0- 0	810-240
	2- 1- 2	2- 1 - 2	2- 2- 1	5- 0- 0	285-615
	5- 0- 0	4- 0 - 1	0- 2- 3	5- 0- 0	450-255

TABLE VII.
(Cont.)

Cow No.	Brom-Thymol-Blue	Brom-Thymol-Blue Paper	Brom-Cresol-Purple	Strip Cup	Leucocytes per c. c. (in Thousandths)
	0- 1- 3	0- 0- 4	0- 0- 4	1- 0- 3	
236	3- 1- 0	0- 4- 0	1- 1- 2	4- 0- 0	No Count
	3- 1- 0	1- 3- 0	1- 2- 1	4- 0- 0	
	1- 2- 1	1- 2- 1	2- 0- 2	4- 0- 0	
	4- 1- 0	4- 0- 1	0- 1- 4	5- 0- 0	360-195
292	4- 1- 0	5- 0- 0	0- 1- 4	5- 0- 0	135-105
	4- 1- 0	5- 0- 0	0- 1- 4	4- 0- 1	375-630
	4- 1- 0	5- 0- 0	0- 1- 4	5- 0- 0	105- 45
	5- 0- 0	5- 0- 0	1- 2- 2	5- 0- 0	180- 45
283	4- 1- 0	4- 1- 0	2- 1- 2	5- 0- 0	270-555
	5- 0- 0	5- 0- 0	0- 1- 4	5- 0- 0	315-195
	4- 1- 0	2- 3- 0	1- 1- 3	5- 0- 0	495-240
	0- 3- 0	0- 0- 3	0- 0- 3	3- 0- 0	
264	0- 0- 3	0- 0- 3	0- 0- 3	3- 0- 0	No Count
	0- 0- 3	0- 0- 3	0- 0- 3	3- 0- 0	
	1- 2- 0	0- 0- 3	0- 0- 3	3- 0- 0	
	3- 2- 0	0- 3- 2	1- 2- 2	3- 0- 2	255-165
99	5- 0- 0	1- 4- 0	1- 1- 3	4- 0- 1	285-270
	1- 4- 0	0- 5- 0	1- 4- 0	5- 0- 0	660-480
	3- 2- 0	0- 5- 0	1- 1- 3	4- 0- 1	330- 555

positives than was expected.

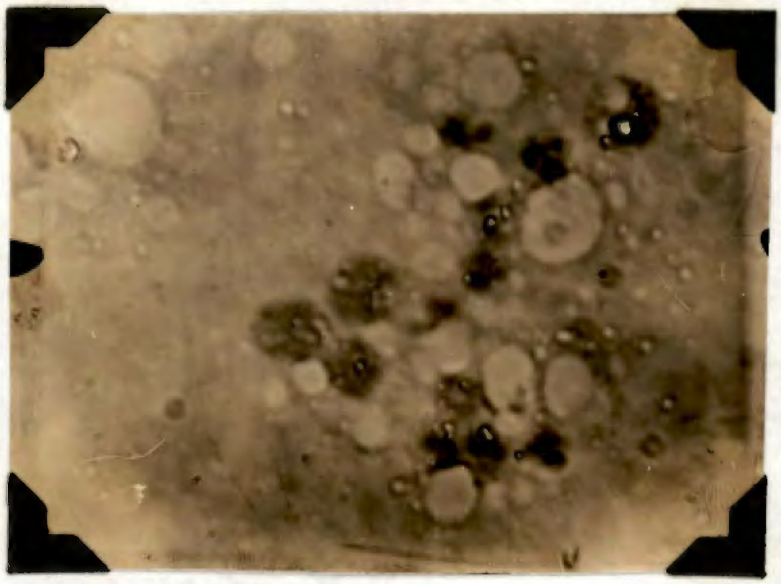


Figure 36. - Field of milk showing a number of luccocytes. Microphotograph made at a magnification of 1000 times.

In studying the correlation of these results with the luccocyte counts it was found that this test gave 72% negative, 12% suspicious and 16% positive. These results are just midway between those attained by the brom-thymol-blue and paper test on one hand and the strip cup test on the other, and are quite in reverse of the results produced by the brom-cresol-purple test. On the whole, they would seem to similate the results of the brom-thymol-blue and paper tests more closely than any of the other tests.

Discussion of Results

On the basis of these results the brom-thymol-blue test and brom-thymol-blue paper test gave the closest correlation with the luccocyte count. If the luccocyte count is

accepted as the most accurate single test, it would naturally seem that these tests would make the most efficient practical herd tests for mastitis.

The strip cup reactions were quite normal in indicating that test to be the least efficient of all the tests. It is noted that many cases of mastitis would not be shown on the strip cup test because a large proportion of the cases do not produce lumpy, flaky, or stringy milk. The strip cup does, however, have its place in practical herd management in detecting milk that is unsaleable, but should not be relied upon as a test for mastitis.

The results of the brom-cresol-purple test are inexplanable and additional research on this test may prove it to have a better correlation than is indicated by these results.

Additional research on this problem would be well worth while in order that the correlation may further be determined. Further investigation may point to a combination of several tests which would give the most efficient indication of the presence of mastitis.

SUMMARY AND CONCLUSIONS

1. The majority of the dairy cattle breeding establishments of the country operate not only large breeding herds, but large acreages of land as well. The chief aim of the farming system is to produce all the roughage and some of the grain needed in feeding the breeding herd.

2. Breeding establishments usually manage their herds in accordance with sound and practical dairy herd management practices and have as their aim in addition to this the breeding and improving of their herds and the sale of improved breeding stock.

3. Efficiency in operation is sought, but is not in all cases accomplished. In most cases, the owners have sufficient interest in their farms to disregard losses as long as their aims are being accomplished. Owners are usually willing to reinvest profits in their farms. As breeders they are frequently able to produce outstanding animals through skillful matings which are impossible in average dairy farm operation. The most progressive breeding establishments are in the hands of wealthy men, and they are due much of the credit for the improvement of our dairy cattle.

4. There are several satisfactory methods of raising calves. These may include skim milk feeding, whole milk feeding, calf meal feeding and the raising of calves on nurse cows. The most satisfactory method for a particular breeding establishment is to a great extent determined by the conditions on the individual farm.

5. In a series of tests using the brom-thymol-blue, brom-cresol-purple, brom-thymol-blue paper, strip cup and luccocyte count for detecting mastitis, considerable variation was found in the results indicated by these tests. Further investigation should be conducted in order that the most accurate test or series of tests in the detection of mastitis may be determined.

6. While the owner of the average dairy farm is also its manager, in the case of the breeding establishment the owner usually employs a professional manager.

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