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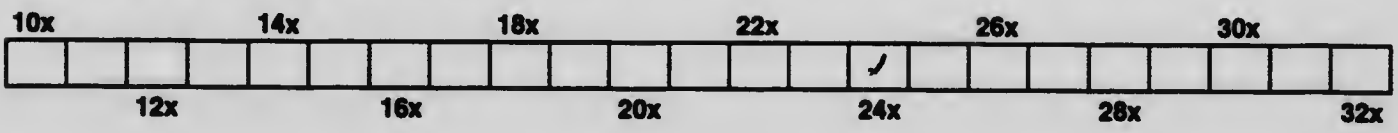

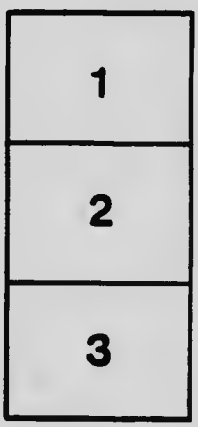

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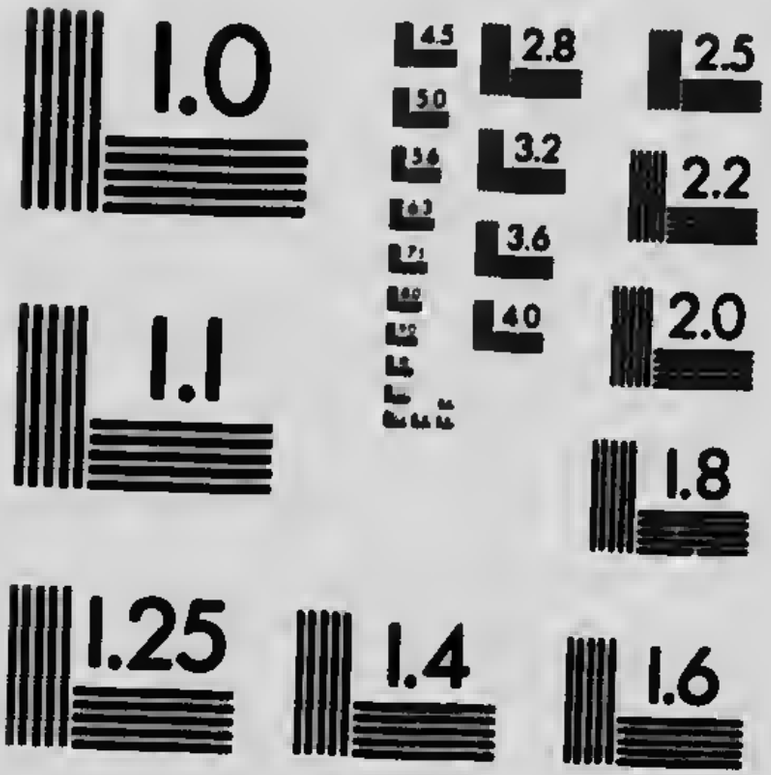

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BULLETIN 253 AUGUST, 1917

Ontario Department of Agriculture

ONTARIO AGRICULTURAL COLLEGE

DAIRY CATTLE

A. Leitch, H. M. King, and J. P. Sackville.

THE ECONOMY OF DAIRY FARMING.

The dairy cow is the most economical producer of human food of all our farm animals. No other animal can turn into so much money the great range of animal foods, roughage and concentrates, grown on the average farm. The product of no other farm animal, when sold off the farm, removes so little of the fertilizing constituents or plant food from the soil. She is the only farm animal that every day yields a marketable product within twenty-four hours of the time her food is fed. It has been proven by careful experiments that a cow yielding thirty lbs. of average milk per day will in one week produce 26¼ lbs. of dry matter, all of which is edible and immediately available for human consumption. In the same time a fattening steer gaining two pounds per day, on approximately the same feed, will produce only 10½ lbs. of edible dry matter. It has also been shown that from 100 lbs. of digestible matter in the food, that the dairy cow produces 18 lbs. of digestible solids suitable for man; the pig, 15.8 lbs.; poultry, as eggs, 5.1 lbs., as meat, 4.2; lambs, 3.2 lbs.; steer, 2.8 lbs., and sheep, 2.6 lbs., clearly demonstrating that the dairy cow easily leads all farm animals in economy of feeding operations.

With this great advantage in economy of production, it is quite easy to discern why the dairy cow tends to supplant the meat-bearing animals in regions where land is high priced and population dense. She gives the greatest financial returns from the feeds grown on the farm, and therefore enables the owner to get the necessary added returns from his high-priced land. Still easier is it to see why the dairy cow has supplanted the meat-bearin animals where land has become impoverished. Here she enables the farmer to get the greatest financial return from what little his land does produce and at the same time returns to the soil practically all the plant food taken out by the feed she eats.

In spite of her great superiority over other animals, in the use she makes of her food, there are some factors in the dairy industry that restrain or limit the spread or increase of dairying to the greater exclusion of other lines of live stock production. First importance is the greater amount of labour entailed. Roughly speaking, it takes seventy-five hours to milk a cow for an ordinary lactation period. This amount of labour has no counterpart in other branches of farming. It is extra work above feeding and other care. It must be done twice a day every day she milks, no matter what conditions of weather, what rush of work, or what social duties prevail. Therefore, as a business, dairying does not appeal to the farmer who can make a reasonable living or income otherwise. Again, there is an enormous bulk of dairy products derived from cows that are not strictly dairy cows.

This butter and milk comes from a large number of small herds at the time o year when cows are fed the cheapest, in spring and summer. These herds cheaply wintered on the roughest and most unmarketable foods grown and, important, are milked with the least expensive labour, the farmer's own famil those times of the year when labour is at its greatest demand. These herds the beef herds or general farming herds of the country, and although the contr tion of each to the butter market is small the sum total is a very large am of butter that has an appreciable effect in keeping down the market price of bu fat, which is in the final analysis the controlling factor in the price of all d products.

In the course of history of a new country, such as ours, the growth of da ing is obviously slow. But steady growth is inevitable as according as popu tions increase, lands become more valuable through proximity to great markets

Holstein Cow—Young Springwood.

Bred and owned by Ontario Agricultural College. Record at five ye old: 20,110 lbs. milk; 819 lbs. butter fat; 1,024 lbs. butter. The highest known record on twice-a-day milking.

become impoverished through bad cropping systems, and the dairy cow introduce herself as the great stabilizer of lands and peoples, the one animal without whos help the human race could not exist.

BREEDS OF ONTARIO DAIRY CATTLE.

AYRSHIRE.

The Ayrshire breed of cattle originated in the County of Ayr, which is in Southwestern Scotland. The early history of Ayrshires reveals the fact that they were developed under adverse conditions. Much of this district is rough and hilly, feed was scarce, pastures scant, and little care was given to live stock. These conditions resulted in the development of a hardy, thrifty type of cattle, as only the more vigorous animals were able to exist. The native stock was improved by crossing with other breeds, and by the selection of the best of these. It is claimed that Dutch cattle were first used with a view of increasing the milk

Ayrshire Bull—Hobsland Sunrise (Imp.)—39427—(10687).
First in class and Junior Champion, Toronto, 1913. First in class at Ormstown and Ottawa. First and Champion at local shows, 1914. Owned by the Ontario Agricultural College, Guelph, Ont.

Ayrshire Cow—Milkmaid of Orkney, 39834.
Canadian 4-year-old Butter Fat Champion. 14,883 lbs. milk; 596 lbs. butter fat. Bred

flow, later Shorthorn and Alderney blood was infused which improved the breed in respect to smoothness of form and quality of milk.

The color and general characteristics of this breed are quite distinct. Red and white, or brown and white, is the prevailing color, the two colors are distinct and do not blend to form a roan. The very striking feature of the Ayrshire is the rather long, large horns which, as a rule, curve outwards and upwards and, in most cases, slightly backwards.

The size of the Ayrshire is medium, ranking between the Jersey and Holstein Friesian. Mature cows will weigh about 1,000 lbs. and upwards, and bulls approximately 1,500 lbs.

Cows of this breed have produced very good yields of milk, but as a breed

Ayrshire Cow—Lady Jane, 30886.
Silver Cup Winner in Mature Class, 1916. 19,405 lbs. milk; 786 lbs. butter fat. Bred and owned by A. S. Turner & Son, Ryckman's Corners, Ont.

they are noted for a good uniform production of fairly good quality of milk, rather than for remarkable records. Coupled with this, they are economical producers, responding well to good feeding and management and, even under conditions that are not the most favorable, they will make a reasonably good showing.

Ayrshires were brought into Canada early in the 19th century by the Scotch settlers. Since that time numerous importations have been made, and we find the Ayrshire distributed fairly well over the Dominion, more particularly in Eastern Ontario and Quebec.

Holstein-Friesian.

This breed is said to be one of the oldest in existence. Originating in North Holland and Friesland, they can be traced back for over two thousand years, continuously occupying this territory and always famous for dairy purposes. Very little, if any, foreign blood was introduced in the development of this breed, improvement being brought about by good care in feeding and management and careful selection.

These cattle have been known both in Europe and America by several different names—"Holland Cattle," "Dutch Cattle," "Holsteins," "Dutch Friesian," "Netherland Cattle," and "Holstein-Friesian." These are all the same breed. The names "Dutch," "Holland," and "Friesland" refer to cattle from Holland,

Holstein Bull—Hill Crest Ormsby De Kol.
Sire, Sir Admiral Ormsby; Dam, Rauwerd Countess De Kol Lady Pauline, whose A.R.O. record is over 29,000 lbs. milk in one year. Bred and owned by G. A. Brethen, Norwood, Ont.

Holstein Cow—Toitilla of Riverside, 12254.
Canadian Champion Mature Cow in R.O.P. 24,094 lbs. milk, 1,058 lbs. butter in one year. Owned and developed by Jos. O'Reilly, R. R. No. 9, Peterborough, Ont.

and "Holstein" is the name given to cattle of practically the same breeding and type from the Province of Holstein in Germany. Considerable confusion was caused by this diversity of names, during the time of the early importations to America, and to overcome this the breeders and importers decided upon the name "Holstein-Friesian."

CHARACTERISTICS.—In size the Holstein-Friesians are the largest of the dai breeds. Full grown cows will weigh from 1,100 to 1,400 lbs. The bulls at m turity are very large and heavy, often attaining a weight of 2,500 lbs.

The accepted color of this breed is black and white, in any proportion. The two colors are seldom mixed, the outlines of the markings being usually fair distinct.

The introduction of the Holstein-Friesian into America dates back to la in the seventeenth century. These were brought over by the early Dutch settle into New York. About one hundred years later more importations were ma from Holland. Since then they have increased rapidly by importations and breeding, and are now pretty well distributed over United States and Canada.

Having been bred for so many years especially for dairy purposes, it is on natural to expect large development in all those parts that relate to milk produ tion. Speaking generally, they are noted for their large flow of milk, not a fe very high milk records have been made by members of this breed. During t past few years more attention has been given to weighing the fat content of t milk, with the result that Holstein milk from the standpoint of quality is no looked upon more favorably than it was some time ago.

JERSEYS.

The native home of the Jersey is on the Island of Jersey, being one of t Channel Islands owned by Great Britain. The origin of this breed is more or le speculative. It is believed, however, that they are descended from the cattle Normandy and Brittany in France. The cattle from these countries were su posed to have some characteristics in common with the Jerseys as we know the to-day, this is particularly true of the fawn and dark color.

The Island of Jersey, being small in area, containing less than 30,000 acre lends itself to keeping the herds pure, and the Islanders have taken advantage this. As early as 1763 laws were enacted prohibiting the importation of any oth breed of cattle, except for slaughtering purposes. With a view of further impro ing and protecting the breed, the Royal Jersey Agricultural Society was organize early in the nineteenth century and, by means of careful selection, the bre rapidly improved in quality and uniformity of type.

The Jerseys have been referred to as the aristocrats among dairy cattl The foundation for this may probably have its origin in the fact that we ha records of cattle resembling Jerseys being brought from France and the Chann Islands into England to decorate and add dignity to the estates and parks of t nobility. The establishing of these herds in England has had much to do wi the development and improvement of the Jerseys.

Jerseys were introduced into the United States, notably Connecticut, ne York and Pennsylvania, about the middle of the nineteenth century, and in Canada a few years later. Since that time numerous importations have been mad and these form the basis for the herds now in existence in Canada and in t United States.

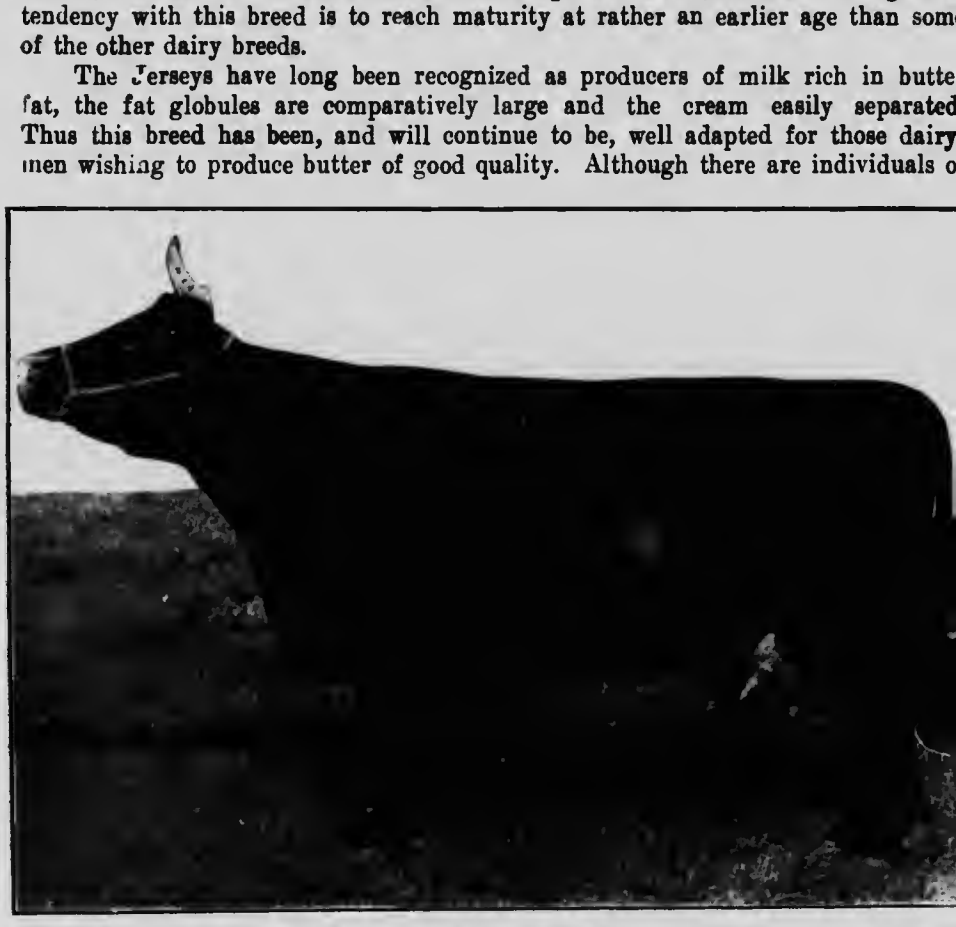
CHARACTERISTICS.—The color of the Jersey is variable, running from a lig fawn to a brown, gray, or red fawn. In some individuals the body may be near black. However, the fawn color over the entire body is preferred. In rece years, however, probably less importance has been attached to the color of t Jerseys than formerly.

Jersey Bull—Sultanne's Raleigh.
One of the best examples of Jersey type ever produced in Canada. Owned by B. H. Bull & Sons, Brampton, Ont.

Jersey Cow—Sunbeam of Edgeley.
Canada's Official Butter Fat Champion over all breeds. R.O.P. record: 18,153 lbs. milk, 926 lbs. butter fat. Bred and owned by James Bagg & Sons, Edgeley, Ont.

The Jersey is essentially a dairy animal, and in conformation represents th lean, muscular appearance characteristic of this type. Withal there is a blendin of all parts which gives the breed a general appearance of smoothness. In siz they are the smallest of the dairy breeds, the mature cows ranging from 700 lbs upward to 1,000 lbs. The average weight of one large American herd was slightl over 1,000 lbs. The mature bull should weigh at least 1,300 lbs. The gener tendency with this breed is to reach maturity at rather an earlier age than som of the other dairy breeds.

The Jerseys have long been recognized as producers of milk rich in butte fat, the fat globules are comparatively large and the cream easily separated Thus this breed has been, and will continue to be, well adapted for those dairy men wishing to produce butter of good quality. Although there are individuals o



Shorthorn Cow—Iford Waterloo Baroness (Imp.), 104584.
R.O.P. record at five years: 13,440 lbs. milk, 500 lbs. butter fat. Average productio for four years at 2, 3, 4 and 5 years old: 11,000 lbs. milk, 397 lbs. butter fat. Owned by Ontario Agricultural College, Guelph, Ont.

this breed that have ranked high for quantity of milk, at the same time they ar not characterized by large flow, quality of milk rather than quantity are the meri of this particular breed.

Dual-Purpose.

The dual-purpose type of cattle is understood to represent one midway b tween the two special-purpose breeds, *e.g.*, dairy and beef. What is looked for an animal that will give a reasonable flow of milk and, at the same time, in for and general characteristics, resemble in a general way what is expected in th beef breeds.

Considerable interest has centred around this particular kind of cattle within the past few years, notwithstanding the fact that there is a tendency on the part of not a few breeders of live stock to produce animals for a special purpose. Conditions prevailing in some parts of the Province, coupled with the favorable attitude of some men relative to mixed farming, do not always make it profitable or desirable to keep cattle of the special-purpose breeds, and in such cases the dual-purpose cow seems to fit in very well.

It is rather difficult to say just where the line should be drawn between dual-purpose and special-purpose cattle, or, in other words, to definitely state what really constitutes a dual-purpose animal. Some breeders have emphasized milking qualities and have in their herds individuals that for yield of milk would compare favorably with some strictly dairy-bred animals. Others working with this type

Shorthorn Cow—Golden Rose (Imp.), 104582.
R.O.P. record at seven years: 12,395 lbs. milk, 560 lbs. butter fat. Owned by Ontario Agricultural College, Guelph, Ont.

have sacrificed something in the way of milk and selected animals that conform pretty well to the beef breeds.

The ideal dual purpose cow in type and general conformation is a combination of the beef and dairy animal, not possessing the blockiness and smoothness of form and lacking the wealth of fleshing of the beef animal, and yet showing these characteristics to a reasonable extent. Something of the angular, wedge-shaped form which is accompanied with milking qualities of the dairy cow must be expected. In development of udder and milk vessels, the dual-purpose cow should give evidence of one that will perform fairly well at the pail.

SHORTHORNS.—So far as Ontario is concerned, the Shorthorn breed represents the only dual-purpose animal, very few of the other recognized dual-purpose breeds, as, for example, Brown Swiss, Devons and Red Polls, being bred to any extent.

The development of the dairy Shorthorn which took place in England goes back to about the beginning of the nineteenth century. During this time much valuable work was accomplished in improving the Shorthorn breed. One of the prominent men connected with this work was Thomas Bates, who in his breeding operations not only sought to improve the beef qualities of his herd, but also kept careful records of milk yields, and, in this way, developed a strain of cattle that have ever since been recognized as dual-purpose animals. Such Shorthorn families as "Duchess," "Waterloo," "Wild Eyes," and "Oxford," still famous for their dairy as well as beef qualities, were founded by Bates. From these noted strains or families have sprung many of the present day dual-purpose Shorthorns found in Ontario. In justice to the Shorthorn as a breed, it should be mentioned that even among the Scotch bred Shorthorns are to be found cows that are no mean performers at the pail.

Dairy Shorthorn herds have also been developed in this country that may have no connection with Bates-bred cattle. Careful breeding, the selection of animals noted for a good yield of milk, together with hand milking of cows, have resulted in building up some very creditable herds of dual-purpose cattle in different parts of Canada.

SOME PRINCIPLES OF BREEDING.

Modern science and recent discoveries of certain laws of inheritance have not revolutionized live stock breeding operations of to-day. They have, however, done a great service in freeing breeding of the detrimental influence of certain time-honoured beliefs which, in the light of present knowledge, appear as absolute falseness.

Variation is universal. No two are exactly alike. No matter how closely two animals may resemble one another, there always exist certain minute differences. Experience has shown that within a particular breed, or tribe, or strain, we are likely to have exhibited certain variations which seem to be peculiar to it. Hence, it is essential that in order to gain the greatest success with the breed that is our favorite, we must be well informed as to its history. Then, knowing the history and variations most likely to occur, sound judgment must be used in departing from any of the definite principles of live stock breeding.

It is interesting to note that within comparatively few years a special kind of animal has been produced for practically every utilitarian purpose. This rapid progress has largely come about by breeders keeping always in mind two things—utility, and beauty of form. If the breed we are using is not especially pleasing to our sight, failure is sure to follow. The same thing is true if the breed is lacking in utility. We have no place for the faddist stock breeder.

Observation was the chief asset of early breeders, and from their observations they came to conclusions which, in a measure, were correct. They observed that in ordinary breeding operations, like tends to produce like; also that pedigree counts. It was realized that a certain dependence could be placed on an animal's pedigree, but of the value of this working of heredity they were not sure. It was also considered that in a general sense, in-breeding brings uniformity of type but with it a loss of vigor. Likewise, cross-breeding increases vigor, but destroys uniformity in the herd or flock. With these principles well in mind, it is not surprising that much advancement has been made.

GRADING.—This implies the mating of a common or relatively unimproved parent with one that is more highly improved, meaning a pure bred. This is usually accomplished by using a pure-bred male, because in this way one animal's influence is distributed over the entire herd. Grading is the economical method of improving live stock, and consequently is the method in most general use. The reputation of any breed is made more on the grades of that breed than on its pure-bred representatives. It is somewhat surprising to note the percentage of purity in animals with a few top crosses. The progeny of a grade dam from a pure-bred sire is known as a half breed or 50 per cent. pure blood. The progeny of a half breed from a pure-bred sire is 3/4 or 75 per cent. pure blood. In this way we arrive at 7/8, or 87.5 per cent. pure blood; 15/16, or 93.75 per cent. pure blood; 31/32, or 96.87 pure blood; 63/64, or 98.44 pure blood, and so on. Since pure-bred animals are more prepotent than grades, these percentages are no doubt higher than can be shown mathematically.

CROSSING.—Means the mating of animals belonging to different breeds, and implies that each is pure bred. Although this system of breeding has produced some wonderfully good animals, yet it is generally not a wise course to follow. The great danger lies in the fact that there is always a tendency to keep the cross-bred progeny for breeding purposes and seldom, if ever, do they breed as well as their individual merit woul lead us to expect.

IN-BREEDING.—Three forms of in-breeding are recognized: Mating the sire with his daughter, the son with his dam, and brother and sister matings. With the first two methods we have some idea what the combination will result in, because we get in the offspring a preponderance of the blood of one individual. In the first-mentioned case, there would be a concentration of three-quarters of the sire's blood lines, and in the second three-quarters of the dam's blood lines. Although brother and sister matings have in some instances given good results, the chances for inferiority are greater than with the other methods. It must be borne in mind at all times that we can intensify both the good and the bad by in-breeding. There is ground for the popular objection that in-breeding impairs vigor and fertility, and these factors are sure to be intensified if they were lacking in the original animals. Neither in-breeding nor the reverse will be a success unless the animals are suited to each other, unless we select strictly and rigidly for vigor and high fertility, and are careful to note that there are no weaknesses in common, and as much good as possible. The practice of in-breeding should never be adopted by the novice and seldom by the skilful breeder.

LINE BREEDING.—Line breeding differs from in-breeding merely in degree. The number of ancestors of a line-bred animal in some particular generation, or generations, is fewer than the maximum possible number. It is a mild form of in-breeding, and has been productive of much good when judiciously practiced by experienced breeders. Many of the most noted sires of all classes of live stock have been line-bred individuals. Like in-breeding, however, it is not a safe practice for the average breeder.

VIGOR AND FERTILITY.—Successful live stock production depends a great deal on a proper degree of constitutional vigor in breeding animals. It is essential to long life and heavy production. Together with lack of vigor, imperfect sexual development is one of the most common defects in animals. Fertility is an unseen quality, and one that is most often neglected, yet there is no doubt but that it is a heritable character. It is a relative quality. All, as a rule, produce some offspring. Note the final results as shown in the table below, where the progeny of three cows, each possessing a different degree of fertility, is studied. "A" pro-

duces two calves, one of each sex, then becomes infertile. "B" produces four calves, and "C" six calves before losing their powers of reproduction.

Cow	Total Number of Calves	Females			
		1st Generation	2nd Generation	3rd Generation	4th Generation
A	2	1	1	1	1
B	4	2	4	8	16
C	6	3	9	27	81

It is assumed that the female offspring of the original cows were prolific to the same degree as their dams, and the likelihood is that they would be. The progeny of "A" would never build up a herd, and "C's" progeny would soon dominate. It is true that we can hardly over-estimate the value of the old and tried females in our herds. It is history that the reputations of many of our prominent stock breeders have been made largely on the merit of some few exceptional individuals, either male or female, in their herds which possessed a high degree of constitutional vigor and sexual fertility, and were propotent for these qualities. When our standards are against the highest fertility they are dangerous, if not fatal, to the breed.

NUTRITION.

The process of nutrition, or the use which the animal makes of its food, has long been a matter of careful study and experiment among scientists all over the civilized world. In general the animal body requires food for the following purposes:—

(1) To maintain the bodily functions of the animal—respiration, blood circulation, digestion, etc., and restore waste.
(2) To provide body heat, and keep it at normal temperature.
(3) To provide energy for natural movements of the body, and for external work.
(4) To provide, in the immature animal, material for growth in all parts.
(5) To provide, in the female, material for the production of milk.

Investigation has found that there are different elements or substances which are necessary in foods to supply the above requirements in the animal body. These nutrients, as they are called, are all found in varying proportions in the different fodders and grains grown on farms. They may be divided roughly into classes:—

(1) Proteids or albumens.
(2) Carbohydrates.
(3) Fats.
(4) Ash or mineral matter.

These substances make up the dry matter in the feed.

The proteids or protein compounds are those containing nitrogen. They enter largely into the formation of lean flesh, or muscle, hide, hair, blood and all the tissues of the internal organs, and also into the composition of milk. Protein matter in the food is absolutely essential to life itself in the animal, and no other

nutrient in the food can take its place in the formation of the above parts of the animal body. It is known, however, that proteins can take the place of the other nutrients in the work which they do in nutrition. There appears to be a great necessity for protein in stimulating the various functions of the different organs of the body, and as there is a constant breaking down in the tissues of these organs while they are at work, a constant supply of protein is necessary to supply this waste. In the production of milk, protein plays an important part. About 25 per cent. of the total dry matter in milk is protein in its nature, and in addition to supplying this the protein in the food must supply enough to stimulate the milk-making machinery of the cow's body, as protein is the cell stimulating nutrient of the food. Protein is found in greatest proportion in such feeds as alfalfa hay, and clover hay, wheat bran, cotton seed meal, oil cake, and gluten meal.

Carbohydrates are the starches, sugars, fibres and such allied constituents of the food. Their chief function in the body is to supply heat and energy, and they are also the source of much of the fat stored up in the body by fattening animals. They are divided roughly into two classes, nitrogen free extract, such as starch, sugar and gums, and crude fibre, or cellulose, the more indigestible woody part of the plant or grain. The carbohydrates form the largest proportion of all the nutrients in farm grown cattle foods. Grains like corn, barley and oats, have from 50 per cent. to 70 per cent. of nitrogen free extract, and 10 to 13 per cent. crude fibre, while rough feeds like hay, straw and corn fodder have 35 to 40 per cent. nitrogen free extract, and 30 to 40 per cent. of the more indigestible crude fibre. In addition to supplying heat and energy to the body, the carbohydrates provide much of the energy for manufacturing milk, and also the material necessary for the milk sugar, and also much of the butter fat in the milk.

The fats in the food play the same part in the process of nutrition as do the carbohydrates. They also are the source of heat and energy in the body and supply to some extent the fat laid on by the animal when gaining in weight. In the case of dairy cows, fat in the food is also the source of part of the fat found in the milk. While fats have the same function in animal nutrition as carbohydrates, it is stated that one pound of fat is equivalent to about two and one-quarter pounds of carbohydrates for the production of heat and energy.

The ash in the food is the mineral matter that is found in all parts of every plant that is grown. Its use in the animal body is to form bone and to assist in the manufacture of the juices and fluids of the digestive tract of the animal. In the production of milk it also supplies the small percentage of ash found therein.

In addition to the above nutrients all feeding stuffs contain greater or lesser amounts of water, ranging from about 10 per cent. in the case of grains and cured hay, to 90 per cent. in the case of roots and green soiling and pasture crops. This water is of no greater feeding value than that from a well or stream, but the degree in which it is present determines largely the succulence and palatability of the feed, as is seen most easily in roots and green crops of all kinds. In the animal body water is found in every tissue, organ and fluid, and, as is well known, is absolutely essential to life itself, while best results from feeding of any animal depends upon a plentiful supply every day. Water forms about 87 per cent. of the total bulk of milk, and its use is therefore of prime importance in dairy cattle feeding.

To determine the proper amount of each of the different nutrients that should be fed for the profitable production of milk, has been a profound study by many live stock investigators and scientists for the past fifty years. To such a success

has this been carried that it is now pretty well determined just what amounts of the various nutrients are necessary for the animal under nearly all conditions. Moreover, the analysis of rations fed by successful feeders, who feed from experience and judgment only, show that their rations correspond very closely with those advised by investigators, as the result of experimental work. It is true there is considerable variation in the digestive and productive ability of individual cows of the same breed, size and bodily condition, so that it is impossible to lay down exact amounts to be fed of the various nutrients in the feeds. It is true also that exact figures cannot be given of the amounts and digestibility of the various nutrients in all classes of feed stuffs at all times. These vary considerably with weather at harvesting, stage of maturity, and storage conditions of the farm crops and feed stuffs being fed. These factors must be taken into consideration by the feeder himself, who must, in addition, study the likes and capacity of his individual animals if he is to make the best use of the results of the work of investigators along feeding lines.

Feeding Standards.

The investigation work mentioned above has culminated in what are commonly called Feeding Standards. In milk production a feeding standard is a table showing the approximate amount of the various nutrients a cow of 1,000 pounds live weight should receive in her feed, to produce varying amounts of milk daily, to give best results. All kinds of feeding stuffs have been analyzed so that the proportions therein of the various nutrients, protein, carbohydrates, fats, ash and water are pretty well established. At the same time the animal cannot digest or assimilate all of those various constituents of the different food stuffs. But it has been established by much experimenting about what percentage of the various nutrients, in each of the different feeds, is digestible. For instance, it is known that oats contain about 11.4 per cent. of protein, or 11.4 pounds protein in 100 pounds of oats. It is also known that about 77 per cent. of this protein, or 8.8 pounds is digestible, so that oats are said to contain 8.8 pounds digestible protein. Red Clover, on the other hand, contains 12.3 pounds protein in 100 pounds; just 50 per cent. of this, or 7.1 pounds, is digestible. So it is seen that though 100 pounds oats contain less protein than 100 pounds of red clover hay, the oats have actually more protein that is available because it is more digestible. In contemplating feeding standards it is necessary, therefore, to take into account only the digestible portion of the nutrients of the different feeds. When applying feeding standards, to milk production, in addition to the nutrients mentioned, the total amount of dry matter in the ration is the important factor. All ruminant animals (those that chew the cud) require a bulky ration in order to keep their large digestive organs properly distended. The dry matter in a ration for dairy cows (that part which gives bulk) must always be considered when discussing rations.

Feeding standards have been propounded by various live stock investigators in Europe and America. The earliest and most simple and complete standard to be presented is called the "Wolf-Lehman Standard," that portion of which, dealing with milk production, is herewith given:—

TABLE I.—DIGESTIBLE NUTRIENTS REQUIRED DAILY B. LKING COWS PER 1,000 LBS. LIVE WEIGHT.

Dairy Cow Yielding.	Dry Matter.	Digestible Nutrients.			Nutritive Ratio.
		Protein.	Carbohydrates.	Fat.	
11 lbs. Milk daily	25	1.6	10.0	0.3	1:6.7
16.5 " "	27	2.0	11.0	0.4	1:6.0
22.0 " "	29	2.5	13.0	0.5	1:5.7
27.5 " "	32	3.3	13.0	0.8	1:4.5

NOTE.—Nutritive ratio is a term used to describe the proportion of digestible protein to digestible carbohydrates and fat in a ration. In making the calculation the fat is multiplied by 2¼ before adding to the carbohydrates.

This Wolf-Lehman feeding standard was for the period of thirty-five years previous to 1907 recognized as the most useful and accurate so far propounded. It was largely used by investigators and practical feeders because of its great simplicity. With tables containing the amount of various digestible nutrients in the feeds at hand, it was a comparatively simple calculation to figure out a ration that would be complete, economical and closely conform to the requirements of the animal.

About ten years ago, however, it was discovered by American investigators that in some respects, and in relation to some classes of live stock, the Wolf-Lehman standards were inaccurate. Some of the recommendations were not properly applicable to American conditions. This was especially true with dairy cattle. It was found that the amounts of dry matter and protein recommended by this standard were too high for economical feeding under American conditions. To determine the true values for such conditions much work has been done by animal nutrition experts on this continent during the last ten years. As a result, valuable information along this line of work has been submitted by Professor Haecker of Minnesota, Profs. Woll and Humphrey of Wisconsin, Prof. Savage of New York, and Prof. Eckles of Missouri. The recommendations of these men, which are much in agreement though stated in different terms, have been drawn upon largely by the writer in submitting herein the following tables showing the approximate requirements for economical rations for cows giving the various quantities and qualities of milk, that are representative of Ontario conditions. On account of the simplicity and ease of application of the Wolf-Lehman standard, the amounts of the different nutrients are stated in that form, except that the fat is reduced to its equivalent in carbohydrates and included in the same column as digestible carbohydrates and fat.

TABLE II.—MODIFIED WOLF-LEHMAN STANDARD.

	Dry Matter	Digestible Protein	Dig. Carbohydrates & fat x 2½
1000 lb. cow giving 3.5% milk—	Lbs.	Lbs.	Lbs.
Cow dry	14.	.70	7.22
Cow giving 10 lbs. milk	16.5	1.25	9.83
" " 15 " "	19.	1.55	11.13
" " 20 " "	21.5	1.83	12.44
" " 25 " "	24.	2.12	13.75
" " 30 " "	26.	2.39	15.05
" " 35 " "	28.	2.67	16.36
" " 40 " "	30.	2.95	17.66
1000 lb. cow giving 4% milk—			
Cow dry	14.	.70	7.23
Cow giving 10 lbs. milk	16.5	1.30	10.09
" " 15 " "	19.	1.60	11.52
" " 20 " "	21.5	1.94	12.91
" " 25 " "	24.	2.28	14.30
" " 30 " "	26.5	2.59	15.72
" " 35 " "	29.	2.91	17.13
" " 40 " "	31.	3.16	18.60
1000 lb. cow giving 4.5% milk—			
Cow dry	14.	.70	7.23
Cow giving 10 lbs. milk	17.	1.33	10.36
" " 15 " "	19.5	1.65	11.92
" " 20 " "	22.	2.00	13.45
" " 25 " "	25.	2.36	15.00
" " 30 " "	27.5	2.66	16.55
" " 35 " "	30.	2.99	18.10
For each 100 lb. increase in weight of cow add	1.4	.07	.72

FORMULATING RATIONS.

In using these tables for computing rations. the following suggestions may be useful:—

(1) That a deficiency of two or three pounds of dry matter in a ration where over 20 lbs. is recommended, is not a serious mistake provided the feeder knows that the whole ration is bulky enough to satisfy the craving of the cow for a full stomach. This lack of dry matter in the ration will often occur where a high grade roughage like alfalfa hay or good silage is being fed, in which case the proper amount of digestible protein or carbohydrates is reached before the quantity of dry matter is high enough.

(2) As a basis of computing a trial ration it is well known that a cow should have approximately one pound of dry roughage (hay, straw, etc.) and three pounds silage (or four to five pounds silage and roots) for each hundred pounds of live weight. If no silage or roots is available, she should have two pounds dry roughage for each one hundred pounds of live weight.

(3) To bring the ration up to the standard, the concentrates or grain feed should be fed at the rate of about one pound of grain for each three to five pounds milk produced, depending on the quality of the milk—the richer the milk the more grain.

Keeping in mind the above recommendations we will proceed to formulate a ration. We will suppose that the feeder has at hand, at a reasonable price, the following feeds: Corn silage, clover hay, oat straw, bran, oats and oil meal. He wishes to feed a standard ration to a 1,100 lbs. cow giving 25 lbs. of 4 per cent. milk per day. According to our standard in Table II the requirements are:—

	Dry Matter.	Protein lbs.	Carbohydrates and Fat lbs.
	24.	2.28	14.80
Add for 100 lbs. extra weight of cow.	1.4	.07	.72
	25.4	2.35	15.00

Turning to the table of digestible nutrients of the different feeds on Table V, we find the feeds of this ration to be composed as follows:—

TABLE III.

In 100 lbs. of	Lbs. Dry Matter	Lbs. Digestible Protein	Digestible Carbohydrates and fat x 2½
Bran	89.9	12.5	48.4
Oats	90.8	9.7	60.7
Oil Meal	90.9	30.2	47.7
Silage	26.3	1.1	16.6
Clover Hay	87.1	7.6	43.4
Oat Straw	88.5	1.0	44.6

FIRST TRIAL RATION FOR 1,100 LB. COW GIVING 25 LBS. 4 PER CENT. MILK PER DAY.

Feed	Lbs. Dry Matter	Dig. Protein	Dig. Fat and Carbohydrates	Nutritive Ratio
Silage 35 lbs.	9.21	.39	5.81	
Clover Hay 7 lbs.	6.10	.53	3.04	
Oat Straw 4 lbs.	3.54	.04	1.78	
Bran 3 lbs.	2.70	.38	1.45	
Oats 2 lbs.	1.82	.19	1.21	
	23.37	1.53	13.29	1: 8.8
Standard	25.40	2.35	15.00	1: 6.3
Additional requirements	2.03	.82	1.71	

The dry matter in this trial ration is nearly up to the standard, but the protein is more than 25 per cent. too low, while the digestible carbohydrates and fat are about 10 per cent. too low. To make this ration more balanced it is therefore necessary to add a protein rich food and, to keep the dry matter and the amount of grain within reasonable bounds, it is necessary to use more protein-rich roughage like clover hay instead of so much poor roughage as oat straw.

Second Trial Ration.

Feed	Lbs. Dry Matter	Dig. Protein	Dig. Fat and Carbohydrates	Nutritive Ratio
Silage..... 35 lbs.	9 21	.89	5.81	
Clover Hay..... 12 lbs.	10.45	91	5.21	
Bran..... 3 lbs.	2.70	.33	1.45	
Oats..... 3 lbs.	2.72	.28	1.82	
Oil Meal..... 1½ lbs.	1.36	.45	.72	
	26.44	2.41	15.01	1: 6.2
Standard.....	25.40	2.35	15.00	1: 6.3
Difference.....	1.04	.06	.01	

This ration approximates the standard so closely that it may be considered well balanced, but since all the nutrients are a trifle high, experience would suggest that about a pound of the grain mixture be taken away and that for a couple of pounds of clover hay there be substituted as much straw as the animal would eat.

Factors Limiting the use of Feeding Standards.

Individuality of Cows.—The application of feeding standards to actual practice must be done with considerable judgment and feeding standards can not be slavishly followed. It is possible to figure rations that are mathematically correct, but the ability of individual cows to make the best use of their feed cannot be mathematically figured. This must be determined by the observation and judgment of the feeder. It is, also, not practicable to figure out rations for each individual cow in a herd, according to standards. The proper way to use the standard is to make up mixtures of the different concentrates (grains, etc.) according to standard for an average cow of the herd, and feed this mixture in proportion to the daily milk yield of the individual cows, then to give each cow all she will eat of the different roughages in about the proportions the standards recommend. If it is found that a cow is not producing up to expectation by this method, it is sometimes wise to reduce somewhat the amount of roughage, still feeding the grain in proportion to milk yield. This also applies to a cow that is getting too fat. Sometimes it is better to reduce the grain and by this method get as large or at any rate a more profitable return.

Palatability and Digestibility of Feeds. -A table of digestible nutrients of different feeds is not an entirely accurate account of the true values of the nutrients for use in the animal's body, for retaining life or producing milk. For instance, an examination of Table III shows that oat straw has about as much digestible carbohydrates and fat as bran, oats or clover hay, in the same dry matter. Now this is perfectly true so far as it goes, but it takes a great deal more of the animal's energy to digest and work up these nutrients in straw, than in the better feeds. This energy must come from the food, so that a pound of carbohydrates in straw is not nearly so valuable as a pound of the same nutrient in clover hay or bran. As a matter of fact, clover hay has nearly twice as much actual net digestible carbohydrates as oat straw, and wheat bran has two and one-half times as much net digestible carbohydrates as oat stra. These factors must be taken into consideration, and care must be exercised that rations be not composed of too much hard-to-digest feeds like the different straws, even though the tables show them to have a large percentage of digestible nutrients. In general, it is safe to say,

that the nutrients of the straw are only about half as valuable as equal amounts of the same nutrients in hay (clover or alfalfa) and only one-third to one-quarter as valuable as the same nutrients in the grains and concentrated feeds. This is due to the excess amount of woody matter, or fibre, in the straws. This fibre is a carbohydrate and is digestible but takes much more energy to digest it than do the other carbohydrates, the starches and sugars, that are present in large quantities in the grains and concentrates. In feeds that are not so mature, and that contain more water, such as silage and mangels there is not so much of this woody fibre and, as they are not so dry, they are more acceptable to the cow, hence called more palatable. The addition of these succulent feeds to rations containing all dry feeds make the whole ration more palatable, and therefore more digestible and, as a rule, are the means of causing a larger increase in milk flow than their composition would seem to warrant. The milch cow always responds to feeds that she can eat with more pleasure. For this reason, the feeder should aim at providing a ration that answers this requirement even at the expense of deviating somewhat from the feeding standard.

VARIETY.—Like the human being, the cow likes and will respond to variety in feeds; that is she likes a number of different kinds of feeds rather than too much of one feed, no matter how perfect that may be for the purpose, from its composition. Variety does not mean changing the feeds from one day to another. It means that in a whole day's ration a cow should have some succulent feed (mangels or silage) some dry fodder (hay and straw) and a mixture of two or more kinds of concentrates. Such variety will give cheaper and better returns than too much of any one kind of feed, even the best alfalfa or clover hay.

CHARACTERISTIC QUALITIES OF DIFFERENT FEEDS.—In addition to having a fairly uniform composition, many feeds have characteristic effect on the health and well being of the animal. These must be known and taken into account in making up rations and feeding same to milk cows. Such feeds as bran and oil cake have a beneficial laxative effect on the digestive system and can always be fed with safety and either one should be found in a heavy daily grain ration on this account. Cotton seed meal, on the other hand, has a tendency to constipate, and must, on this account, be fed with care that there is enough succulent food such as roots and silage, or a goodly share of some other laxative food such as bran or oil cake, to counteract this condition caused by cotton seed meal.

ARMSBY FEEDING STANDARD INVESTIGATIONS.

As has been pointed out, the feeding standards just dealt with have some weaknesses which prevent their precise application to all feeding problems. The outstanding weakness is the difference in the digestibility of the different nutrients in the various classes of feeding stuffs. For example, the total quantity of digestible nutrients in oat straw is not equal in feeding value to the same quantity of like nutrients in wheat bran, because there is much more energy used up by the digestive system in working up and assimilating the nutrients of the former. To find, therefore, the actual net value of a feeding stuff it is necessary to deduct the amount of energy required in digestion from the total energy or food value supplied by the digestible nutrients.

Investigations along this line are being carried out by Armsby, of the Pennsylvania Experiment Station. As this class of investigations is very, very slow, on account of its technical difficulties, only some of the various food stuffs have been analyzed. As will be shown by the following table of foods analyzed, total dry matter and digestible protein are listed just as in the previous tables. But, as shown in the last column, foods are compared on the basis of their net energy, which

is the energy available after the work of digestion and assimilation is provided fo
This net energy is expressed "therms", a term used by chemists to describe
certain unit of fuel or energy value in nutrition experiments.

TABLE IV.—ARMSBY TABLE OF DRY MATTER, DIGESTIBLE PROTEIN AND NE
ENERGY VALUES IN 100 LBS. OF VARIOUS FEEDING STUFFS.

Feeding Stuffs.	Total Dry Matter	Digestible Protein	Net Energy Value
Green fodder and silage:	lbs.	lbs.	Therms
Alfalfa	28.2	2.50	12.45
Clover, crimson	19.1	2.19	11.30
Clover, red	29.2	2.21	16.17
Corn fodder, green	20.7	.41	12.44
Corn silage	25.6	1.21	16.56
Hungarian grass	28.9	1.33	14.76
Rape	14.3	2.16	11.48
Timothy	33.4	1.04	19.08
Hay and dry coarse fodder:			
Alfalfa hay	91.6	6.93	34.41
Clover hay, red	84.7	5.41	34.74
Cowpea hay	89.3	8.57	42.76
Corn forage, field-cured	57.8	2.18	30.53
Corn stover	59.5	1.80	26.53
Hungarian hay	92.8	3.00	44.03
Oat hay	84.0	2.50	36.97
Timothy hay	86.8	2.00	33.56
Straws:			
Oat straw	90.8	1.09	21.21
Rye straw	92.9	.63	20.87
Wheat straw	90.4	.37	16.56
Roots and Tubers:			
Carrots	11.4	.87	7.82
Mangels	9.1	.14	4.62
Potatoes	21.1	.45	18.05
Turnips	9.4	.22	5.74
Grains:			
Barley	89.1	8.87	80.75
Corn	89.1	6.79	88.84
Corn-and-cob meal	84.9	4.53	72.05
Oats	89.0	8.86	66.27
Pea meal	89.5	16.77	71.75
Rye	88.4	8.12	81.72
Wheat	89.5	8.90	82.63
By-products:			
Brewers' grains, dried	92.0	19.04	60.01
Brewers' grains, wet	24.8	3.31	14.82
Buckwheat middlings	88.2	22.34	75.92
Cottonseed meal	91.8	35.15	84.20
Distillers' grains—dried--			
Principally corn	93.0	21.93	79.23
Principally rye	93.2	10.38	60.93
Gluten feed	91.9	19.95	79.82
Gluten meal—Chicago	90.5	33.09	78.49
Linseed meal, old process	90.8	27.54	78.92
Linseed meal, new process	90.1	29.26	74.67
Malt sprouts	89.8	12.86	46.33
Rye bran	88.2	11.35	56.65
Sugar-beet pulp, fresh	10.1	.63	7.77
Sugar-beet pulp, dried	93.6	6.80	60.10
Wheat bran	88.1	10.21	48.23
Wheat middlings	84.0	12.79	77.65

ARMSBY STANDARD FOR GROWING CATTLE.

Age.	Live Weight.	Digestible Protein.	Net Energy Value.
Months.	Lbs.	Lbs.	Therms.
3	275	1.10	5.0
6	425	1.30	6.0
12	650	1.65	7.0
18	850	1.70	7.5
24	1,000	1.75	8.0
30	1,100	1.65	8.0

As the animal approaches maturity it does not require proportionately as much digestible nutrients as it did in the earlier stages of growth. It will be noticed that, though the animal has quadrupled in weight between the ages of three months and thirty months, it requires only 50 per cent. more digestible protein and 60 per cent. more therms of net energy value in food, partially due to the ever-increasing power of the digestive system to assimilate more bulky and coarser foods.

ARMSBY STANDARD FOR MILK COWS.

Live Weight.	For Maintenance.		For each lb. of 4% milk add.	
	Digestible Protein.	Net Energy Value.	Digestible Protein.	Net Energy Value.
Lbs.	Lbs.	Therms.	Lbs.	Therms.
750	.40	4.95	.05	.30
1,000	.50	6.00	.05	.30
1,250	.60	7.00	.05	.30
1,500	.65	7.90	.05	.30

In addition to the above requirements, Armsby recommends that a 1000 lb. cow should receive from 20 to 30 lbs. of total dry matter per day, the amount depending on the amount of milk being produced. For this purpose the writer would advise consulting the modified Wolf-Lehman Standards on a previous page, Table II.

THE USE OF FEEDS.

With the object in view of acquainting the feeder with the peculiarities and values of different feeding stuffs for milk production there is next offered a table showing the composition of those feeds, followed by notes on the individual feeds based on experience and the work of Experiment Stations on feeds for dairy cattle.

TABLE V.—AVERAGE DIGESTIBLE NUTRIENTS IN 100 LBS. OF FEEDING STUFFS.

Name of Feeds.	Total Dry Matter. lbs.	Digestible Protein. lbs.	Digestible Carbohydrates Fat x 2½. lbs.	Nutritive Ratio.
Corn	89.4	7.8	76.5	1-9.8
Corn-and-cob meal	89.6	6.1	71.5	1-11.7
Wheat	89.5	8.8	70.8	1-8.0
Barley	89.2	8.4	68.9	1-8.2
Oats	90.8	9.7	60.7	1-6.7
Peas	85.0	19.7	50.2	1-2.54
Beans	87.2	18.3	56.1	1-3.1
Buckwheat	86.6	8.1	53.6	1-6.6
Gluten meal	90.5	29.7	56.2	1-1.9
Gluten feed	90.8	21.3	59.3	1-2.78
Linseed meal, old process	90.9	30.2	47.7	1-1.57
Cottonseed meal	93.0	37.6	43.0	1-1.14
Dried Brewers' grains	91.3	20.0	45.7	1-2.28
Wet Brewers' grains	23.0	4.9	13.22	1-2.7
Dried Distillers' grains	92.4	22.8	65.8	1-2.88
Malt sprouts	90.5	20.3	49.1	1-2.4
Buckwheat middlings	87.2	22.7	51.22	1-2.25
Wheat middlings	88.8	13.0	55.82	1-4.29
Bran	89.9	12.5	48.4	1-4.0
Clover hay	87.1	7.6	43.4	1-5.9
Timothy hay	86.8	2.8	45.3	1-16.2
Alfalfa hay	91.9	10.5	42.52	1-4.05
Millet hay	86.0	5.2	40.4	1-7.7
Clover (green)	29.2	2.9	15.16	1-5.23
Timothy (green)	38.4	1.5	21.25	1-14.1
Alfalfa (green)	28.2	3.6	13.0	1-3.6
Millet (green)	25.0	1.6	15.07	1-9.4
Oat straw	88.5	1.0	44.6	1-31.8
Rye straw	92.9	0.7	40.5	1-58.0
Wheat straw	90.4	0.8	36.1	1-45.0
Barley straw	85.8	0.9	41.45	1-46.0
Oat hay	86.0	4.7	40.5	1-8.62
Oat forage (green)	25.0	2.6	12.35	1-4.75
Blue grass (Kentucky)	34.9	2.8	21.5	1-7.7
Pasture grass	20.0	2.5	11.2	1-4.5
Corn stover	59.5	1.4	32.77	1-23.4
Corn fodder	81.7	3.0	50.67	1-16.7
Corn silage (well matured)	26.3	1.1	16.6	1-15.0
Corn silage (immature)	21.0	1.0	12.3	1-12.3
Turnips	9.5	1.0	64.5	1-6.4
Mangels	9.4	0.8	6.62	1-8.2
Sorgum (green)	24.9	0.7	15.4	1-22.1
Whole milk	13.6	3.3	14.57	1-4.4
Skim milk	9.9	3.6	5.55	1-1.5
Buttermilk	9.4	3.4	5.12	1-1.5
Whey	6.6	0.8	5.37	1-6.8
Beet pulp (dry)	91.8	4.6	67.	1-14.6
Beet pulp (wet)	9.3	.5	6.9	1-13.8

CHARACTERISTICS OF FEEDS.

It is impossible within the scope of a work of this size to give in detail all the investigation work with the different feeds for dairy cattle, but an endeavour will be made to summarize the experiments in conjunction with facts gleaned from the experience of feeders so that the average dairyman may be assisted to feed his cattle to best advantage, knowing the qualities and costs of the feeds at hand.

Farm Grown Grains.

Corn.—This grain, though comparatively low in protein, is extremely rich in easily digestible carbohydrates and fat. It is palatable and easily masticated, but, on account of its low protein content and heavy nature, it should not form more than half of the grain ration. It is valuable in a ration if mixed with bran, oats, or brewer's grains, all of which tend to lighten up the ration and give more bulk for the same weight. The Maryland Experiment Station finds that cows gave, in a year, 33 per cent. more milk and 45 per cent. more butter on a ration consisting of wheat, bran, gluten feed and corn than on the same quantity of cornmeal, the rough feeds being the same in both cases. Where the roughage contains plenty of clover or alfalfa hay, corn may be fed in larger quantities than in a ration with timothy or other low protein hay. The Illinois Experiment Station found that a ration consisting of eight pounds of gluten feed and cornmeal, with clover hay and silage, produced 40 per cent. more milk and butter fat than eight pounds of cornmeal alone with timothy hay, a little clover and silage. Corn, on account of its palatability and high digestibility, is valuable as a part of the grain ration when fed with bulky high protein concentrates and clover or alfalfa roughage. If fed in the shape of corn and cob meal, corn gives better results if other bulky concentrates are not available, as the cob tends to lighten up the heavy cornmeal. On account of the high percentage of easily digested carbohydrates and fat, corn is a valuable supplement for feeding with skim milk to growing calves. The Iowa Experiment Station found that 1.3 pounds corn meal with 1-10 pound of flaxseed gave better gains on calves fed skim milk than 1.2 pounds of linseed, and equally as good gains as 1.5 pounds of oats fed with skim milk.

Barley.—This grain, found on nearly every Ontario farm, can be fed to advantage, within certain limits, for milk production. The Ontario Agricultural College found that barley gives almost equally good results as oats when fed as half the grain ration, with bran. Like corn, barley contains a large proportion of easily digestible carbohydrates, but contains 10 per cent. more protein and about half as much fat. It is also of a heavy nature when ground, and is better made lighter by the addition of bran, oats or brewer's grains. On account of its tendency to heat the animal, it is usually not wise to feed just previous to freshening or immediately after, especially if the cow's udder is swollen or inflamed.

Wheat.—Wheat is usually of too high a price to feed in any quantity for the production of milk. If of poor quality to sell, however, it may be fed to advantage. The Maine Experiment Station found that wheat was of equal value with corn, pound for pound, for the production of both milk and fat, while Danish experiments show that wheat is nearly equal to a mixture of equal parts oats and barley, for the same purpose. Elevator screenings, containing more or less wheat, some other grains, and black seeds, were experimented with by the Experimental Farm at Ottawa in 1914. It was found that screenings containing 65 per cent. wheat and 25 per cent. other grains, balance weed seeds and chaff, was equal to a mixture of bran 4 parts, gluten feed 2 parts, oil cake 1 part, cottonseed 1 part, when fed as one-third of the daily grain ration, the other two-thirds of which was the mixture mentioned above. Where the screenings consisted largely of black seeds and other offal it was found that, owing to the unpalatability and bitter taste, many cows would not eat their grain even though the screenings were only one-third of the grain ration. The value of wheat screenings depends on the proportion of weed seeds therein.

OATS.—Owing to the large quantity of oats grown on Ontario farms, this grain occupies a commanding position as a feed for dairy cattle of all ages. It contains a larger proportion of protein than any other farm grown grain except peas; it has a larger proportion of hull than other grains which, when ground, adds the lightness and bulk so desirable in rations for producing milk, and they have a flavour and palatability that makes it peculiarly acceptable to all classes of live stock. No other single grain is so satisfactory and safe for feeding purposes. Experiments of the Wisconsin Station show that oats produced 10 per cent. more milk and fat than an equal weight of bran when fed with clover hay and corn fodder as roughage. With a roughage ration consisting of timothy hay and corn fodder, which contains less protein than the above, the bran would be more valuable, as it contains a larger amount of digestible protein than oats. The Massachusetts Station reports that fed with 3.2 pounds of bran and 14.5 pounds of mixed hay, 4.5 pounds of oats was equal to the same weight of corn meal for milk production.

Oats have always been found a very valuable feed in the rearing of calves. The high protein content accompanied by a large proportion of ash, makes this grain eminently suitable for the growth of bone and muscle necessary in the raising of young animals, while the lightness of the grain aids in avoiding digestive troubles. The Iowa Experiment Station found that with skim milk, 1½ pounds of oat meal made as large, and cheaper gains, than 1.2 pounds of linseed meal, or 1.3 pounds of corn meal, and 1-10 of a pound of flaxseed, when fed to calves over two months old. In a census of breeders of Guernsey cattle, conducted by the American Guernsey Cattle Club, it was found that 60 per cent. used oats as half or more of their rations for raising calves. While the calf is under seven or eight months of age, whole oats give equal satisfaction as ground oats. After that age mastication is not so perfect and ground or rolled grain is preferable.

Although this grain is so satisfactory in milk production, it often happens that the price is too high, caused by the demand for horse feed, and human consumption. In this case, some of the more concentrated feeds, such as oil meal and cottonseed meal, are cheaper sources of protein, while bulk and lightness, combined with high protein content, may be more cheaply procured by using brewer's grains or gluten feed. At the same time, the feed value of oats in this connection usually warrant using at a fairly high price, especially for calves and growing stock and cows being fed on long-time tests.

PEAS.—The price of this grain for the past ten years has prohibited their use as a general feed for milk production. Peas, however, are one of the best stimulants of the milk producing faculty, and in spite of the high price are used in feeding cows for high milk and butter fat records. This grain contains a very high percentage of protein and is rich in fat, carbohydrates and ash. They are easily digested but on account of their heavy nature when ground, they must be lightened up with some fibrous grain, such as bran or oats.

BUCKWHEAT.—This grain is not fed to any great extent in Ontario. It is more suitable for fattening purposes than for milk production. At the same time, where this grain is available it may be fed to advantage as part of the grain ration, taking the place of part of the corn, barley or oats. When fed in large quantities it is supposed to injure the quality of the butter. Buckwheat bran, the hull of the grain, is practically worthless for feeding cows, but the buckwheat middlings, or that portion immediately within the hull, has been found to be equal to a mixture of equal parts corn and bran, when fed as part of a balanced ration. The middlings, however, are not particularly relished by cattle, and if fed in too large quantities have the same effect on the butter as the buckwheat itself.

RYE.—This is probably the most unsatisfactory of all farm-grown grains for milk production. It is not much relished by cattle; it tends to produce a hard, dry butter, and is a more frequent cause of digestive troubles than any other of the cereals. Neither has it the feeding value of the other grains. However, if available at a low price, it might help to cheapen the ration, by partially replacing some of the other grains.

EMMER.—The South Dakota Experiment Station reports that emmer is 12 to 15 per cent. less efficient for the production of milk than either barley or corn meal. This grain appears to have no injurious effect on the product of the dairy or the health of the animals, and as it is bulky in nature can be fed with safety as part of a ration.

VARIOUS BY-PRODUCTS AND CONCENTRATES.

BRAN.—This is the best-known and most widely used of all by-products, for milk production. In addition to supplying a large amount of protein and ash, it is mildly laxative in its nature, it is light and open in character, and may be fed in any amount with safety, either alone or in combination with other grains, to dairy cattle of any age and condition. Bran is about equal in value for milk production to a like weight of oats and barley, and is only slightly behind oats alone. It is especially valuable to feed with rich heavy carbohydrate grains, such as corn, rye, and barley. On account of its beneficial effect on the digestive system, it is particularly valuable for cows just before and after calving, as part of the heavy grain ration necessary to heavy milking cows on test, and to growing animals. Although becoming high in price, this feed will occupy first place for some time to come as the most important concentrate in milk production and in rearing dairy animals.

MIDDLINGS OR SHORTS.—This feed is a little richer than bran in most of the valuable nutrients, but its heavy, sticky texture, detracts considerably from its value as a feed, when fed in large quantities. It is not so valuable, therefore, for giving bulk and openness to a grain ration. However, when it can be purchased at about the price of bran it will yield good returns when fed as part of the meal, with oats or barley. There is quite a variation in the various grades of middlings, some of them being principally finely-ground bran adulterated with mill sweepings and dust. This is of less value than bran for feeding purposes. Good wheat middlings, or shorts, are fine and flour-like in texture and lighter colored than bran. They are not so suitable for feeding calves as bran, on account of their sticky nature.

DRIED BREWERS' GRAINS.—These grains are largely the residue from barley, after the removal of the soluble sugars and starch, for the manufacture of malt liquors. They contain nearly twice as much protein as wheat bran, but are lacking in the valuable carbohydrates, such as sugars and starch. The carbohydrates found in this feed are of the more indigestible kind, such as woody fibre, etc. On account of their high protein content, the grains are especially valuable for milk production. The Ontario Agricultural College found dried brewers' grains slightly superior to an equal weight of bran, for milk production. The Vermont Experiment Station reports that dried brewers' grains and bran are equal to a mixture of cottonseed meal, linseed meal and wheat bran. On account of the great amount of fibre, however, they are not quite as satisfactory as bran, when fed as the larger part, or the whole, of the grain ration. They are, however, very palatable and much liked by cows and, on account of their dryness and bulky nature, are valuable to lighten up a heavy meal ration. They may also be stored for a long period, in large quantities, without spoiling.

WET BREWERS' GRAINS.—These grains have a high value for milk production, if fed when fresh. On account of the great amount of water contained, they must of necessity be used almost entirely within easy hauling distance of breweries. About 25 pounds per day, per cow, can be fed if the animals have a good supply of dry hay, little other grain being necessary. They decay and become so foul, however, in a few days that feeding should be done only in concrete or other water-tight mangers, and should never be stored for more than a week at the very most. The odours arising from spoiling grains are the frequent cause of bad flavours in milk and butter.

DISTILLERS' GRAINS.—In this country this feed is largely derived from rye. They are as bulky as wheat bran, contain about as much fibre, but are richer in digestible protein and in fat. They are not as palatable, and on account of a sour taste and smell it is difficult to get cows accustomed to eat them in large quantities. Both the Massachusetts and Vermont Stations report that when mixed with equal amounts of bran they produce about six per cent. more milk than an equal amount of gluten feed, and that when fed alone they produced 12 per cent. more milk and fat than an equal amount of corn meal and bran, and nearly as much milk as a mixture of cottonseed meal and bran. They are worth slightly more than dried brewers' grains, but not being acceptable to many cows, detracts considerably from their feeding value. They are largely used in the make up of many of the patent dairy feeds, and also to some extent by the feeders of high record cows, as a cheap source of protein and to add variety to the rations, a valuable consideration in such a line of work.

MALT SPROUTS.—Though not commonly used, malt sprouts may be fed in limited amounts, if purchased at a reasonable price. The Massachusetts Station reports that they are equal to about 75 per cent. the same weight of gluten feed, when fed to milk cows as part of their grain ration. Great difficulty is often experienced in getting cows to eat them, on account of a bitter taste, and when fed in large quantities they impart a bitter flavour to the milk. As they absorb a large amount of water they should always be soaked before feeding. As a rule, the dairyman would not be justified in feeding them unless they could be procured at less than three-quarters the price of bran and oats.

BUCKWHEAT MIDDLINGS.—If of good quality and containing very little buckwheat bran or hulls, these middlings are a valuable milk producer. The Vermont Station finds that they produce 8 to 11 per cent. more milk than an equal weight of cornmeal and bran. As cows do not relish them when fed in large allowances, they should form only part of the grain ration, with bran, oats or brewers' grains to lighten them up. Fed in this way they have no injurious effect on the quality of the milk or butter. In purchasing this feed care must be exercised to procure bright, floury quality, as they are commonly adulterated with buckwheat bran or hulls which, on account of their woody nature, have practically no feeding value.

GLUTEN FEED.—The best known by-product of corn in this country is gluten feed, which is a by-product from the manufacture of starch from corn. It contains all that is left of the corn after the starch is removed, except the germ. High-grade gluten feed is a very valuable product, containing a high percentage of protein and only a moderate amount of fibre. The low grade gluten feed is not worth so much by a good deal, and buyers should be on the watch in this connection, and should see to it that a satisfactory guarantee as to composition accompanies the feed. Gluten feed is especially valuable for dairy cows in milk, being usually a cheap source of protein and reasonably light and bulky. The Vermont Station finds that gluten feed produced 15 per cent. more milk and butter fat than an equal weight o

cornmeal and bran. As a source of protein, the high grade feed is worth 20 per cent. more per ton than bran, but as it is not so laxative in its nature, it is most valuable in forming part of the ration mixed with bran. There is occasionally sold, in this country, Continental gluten feed which is a by-product in the distillation of alcohol from corn. This feed has nearly the same feeding value as gluten feed, but is not quite so well relished by cows, so it cannot be so profitably fed in large quantities.

GLUTEN MEAL.—This feed is seldom sold in this country. It consists entirely of the gluten of corn without the admixture of the corn bran, as is found in gluten feed. This meal is heavy in its nature, but as part of the grain ration it is almost equal to oil cake in its ability to produce milk.

COTTONSEED MEAL.—Of all concentrates high grade cottonseed meal is the cheapest source of highly digestible protein, and is therefore one of the best stimulants of milk production yet known. Regarding cottonseed meal it must be remembered that it is valuable for a specific purpose, and that is for increasing the protein content of a ration. Cottonseed meal is not suitable for all classes of stock, and for any class of stock it should be used in moderation. Dairy cows or fattening cattle will take two pounds per day, per head, without any injury. It is true this quantity is frequently exceeded, but when a person is feeding three pounds or more of cottonseed meal to a cow per day he is venturing upon dangerous ground. For calves and pigs cottonseed meal had better not be used at all. It is true these animals may be fed very small amounts in their ration, but in this country we do not need to use it, and hence it is not worth while running risks. The danger in cottonseed meal lies in its highly constipating nature. For this reason it is usually unwise to feed it except where considerable quantities of [illegible] roots are found in the ration, or in combination with some other laxative [illegible]ate such as oil-cake or wheat bran. With feeds of this kind it has been fully demonstrated by experience and feeding trials, that good cottonseed meal will displace twice its weight in wheat bran, or dried brewers' grains, with equally good returns in the pail. In general, to form part of a ration, the farmer is justified in paying from 60 to 75 per cent. more per ton for cottonseed meal than for bran, oats, or dried brewers' grains. Cottonseed meal is not, by any means, a constant term. That is to say, there are numerous grades of cottonseed meal on the market. In cold pressed cottonseed cake and in cottonseed feed the per cent. of fibre is nearly as high as the percentage of protein. A good brand of cottonseed meal, containing 40 per cent. or more of protein, is worth nearly twice as much per ton as cold pressed cottonseed cake or cottonseed feed. In fact, the two last-mentioned grades of feed are not worth a great deal more per ton than wheat bran. It is true they contain much more protein and fat, but their percentage of fibre is so high that it cuts down their value very materially. Those who are buying cottonseed meal should pay careful attention to the percentage of protein and of fibre, and not be misled into thinking that because the feed in question has a fairly high percentage of protein it is necessarily a valuable feed. It may have so much fibre that its feeding value is seriously reduced. Cottonseed hulls are but little better than worthless as a concentrate feeding stuff.

FLAXSEED.—Flaxseed, at present, is so high in price that it is not used to any extent for feeding purposes. In some cases where it is grown at home, small amounts are used. It will be noted that flaxseed is extremely high in fat as well as fairly high in protein. The fat is extracted, giving us linseed oil, and the residue is known as linseed meal or oil cake. On account of the high percentage of fat, flaxseed is most commonly used in feeding skim-milk calves, as a substitute for the

butter fat. For this purpose it is better boiled to a jelly-like consistency and mixed with skim-milk for young calves. When calves are eating grain, the flaxseed may be fed dry, either whole or ground, in a tight manger.

Oil Cake, Oil Meal, or Linseed Meal.—These three names apply to the same product. This by-product of flaxseed contains a high percentage of protein and a fair amount of fat. It does not contain so much protein as high grade cottonseed meal, but it does not possess any of the dangerous properties of cottonseed meal, and when fed to stock it tends to bring about a general thrifty condition in the animal. Owing to this fact most feeders prefer linseed meal to cottonseed meal, though it is lower in protein. As a source of protein for dairy cows cottonseed meal is more economical, and it is only on the ground that linseed meal can be fed to any class of animals, and tends to promote thrift, that we can justify paying quite as much per ton for this product as for high-class cottonseed meal. It is usefnl for increasing the protein in the ration of young pigs, calves, dairy cows, and practically every class of stock. This feed is especially valuable for cattle low in condition, and for cows just previous to and immediately after calving. It is also extensively used in fitting animals for show and for the sale ring, as its nse tends to produce mellowness of hair and hide and general evidence of thrift. For feeding to young growing animals in small quantities, with oats, corn, or bran, it is unsurpassed. As a stimnlator of milk flow it is not qnite equal to cottonseed meal, but on account of its wide use as much can be paid for it as for cottonseed meal.

Dried Beet Pulp.—This feed is a by-product in the manufacture of sugar from beets. It is rather high in fibre, though containing a fair amount of protein. When thoroughly soaked with water they provide a succulent food, when roots or silage are lacking. They are worth about two-thirds as much per ton as wheat bran.

Molasses Feeds.—There are a wide range of these sold, both as to name and as to quality. They consist of various products, some high-class, such as cottonseed meal, many others of very low grade, such as oat hulls, cottonseed hulls, and mill screenings, combined with molasses. Many of them contain a very large amount of foul weed seeds, and most of them are sold at prices away above their actual value for feeding purposes. Some of the better quality brands have a useful tonic value if fed in small quantities, and they are often used for this purpose in feeding for high records. In general, the average dairyman is wise in leaving these feeds entirely alone unless he is in a position to judge of the merits of the different kinds.

Dry Roughages.

Red Clover Hay.—On account of its general use, this forage can be considered the most important of the crops fed in the dry rough state, for milk production. For a bulky feed it contains a high percentage of digestible protein. It can be profitably fed to dairy stock of all ages, from calves to cows in full flow of milk. Liberal feeding of red clover hay will enable the reduction in the amount of the concentrated feed in providing a well-balanced ration. The substitution of clover hay for timothy, bluegrass hay, or other grasses, will effect a saving in the amount of meal fed to produce a given amount of fat. For raising young stock, red clover hay provides a well-balanced ration by itself. The quality of clover hay depends largely on the condition in which it is stored. If cut in full bloom, and well saved withont being rained on, or bleached from over-exposure to the sun, it is twice as valuable as that cut when ripe and dry, or unduly exposed to rain and sun. The thicker the stand of clover on the ground the finer will be the growth and also the feeding qnaiity.

ALSIKE CLOVER.—Of much the same composition as red clover, it would be of equal value for milk production except that it is not so palatable and acceptable to the cows. As it does well on damp soil and lasts longer on the ground than red clover, it is usually wise to include a couple of pounds of alsike in the grass seed mixture of all Ontario farms. Threshed clover hay of both kinds have very little more feeding value than barley or wheat straw, for milk cows.

CRIMSON CLOVER.—This plant is grown very little as a hay crop in this country. Where grown, care must be taken to cut it before any of the blooms commence to die, because the small barbed hairs on the blossoms and stems become very hard and wiry when ripe and are liable to mat together in the stomach and cause serious digestive troubles. Crimson clover has a very early spring growth and is valuable as a pasture or soiling crop at this period.

MAMMOTH CLOVER.—On account of its rank, coarse growth and late maturing, this feed has by no means as high value as red or alsike clover. It thrives well on poor and light soils but yields only one cutting per year.

ALFALFA HAY.—Good alfalfa hay is beyond doubt the best roughage for milk production. It is very rich in available protein and of high palatability. In composition it compares very favorably with bran, but having a higher percentage of fibre, which affects the digestibility of the other constituents, one is hardly justified in saying that it is equal to bran in producing milk. It has been thoroughly proven that good alfalfa hay can replace with profit a considerable part of the concentrate or grain allowance in any ration not containing alfalfa. The Ohio Station found that twelve pounds of alfalfa, when fed with corn silage and six lbs. of corn meal, per day, produced as much milk as six pounds of corn stover and nine and a half pounds of a rich mixture of cottonseed meal, bran, and corn meal. The New Jersey Station found that 14 lbs. of alfalfa replaced 8½ lbs. of wheat bran, dried brewers' grains and cottonseed meal, 7 lbs. of corn stover and 5 lbs. of corn silage with almost equally good results in milk and fat. In experiments made in the feeding of alfalfa hay in place of grain or concentrates it has been generally found that with cows of only moderate production, milk can be produced very cheaply where alfalfa hay is plentiful. It was noted, however, that the animals did not maintain the highest degree of health, due possibly to the non-supply of high digestible carbohydrates and the high percentage of fibre. With heavy milking herds it has been proved that larger and cheaper production and better health is maintained by the feeding of some concentrates in addition to the alfalfa. In deciding just how far to go along the line of alfalfa feeding, the farmer must take into account the productivity of his cows and the price of alfalfa hay as compared with protein-rich concentrates. Alfalfa is also especially valuable for young dairy stock and dry cows. It should, however, be harvested just as it is commencing to bloom, to produce the best quality of hay. The second cutting in this country is usually of a little better quality than the first, most likely on account of generally better weather for curing at that time, and also to some extent on account of the more fine and leafy nature of its growth. Although alfalfa has not all the magic properties sometimes ascribed to it, the dairyman who can grow it successfully, or buy it cheaply, has at his command the best roughage for his purpose.

SWEET CLOVER.—White sweet clover when cut early is a valuable roughage for milk production, and, to some extent, as a pasture crop. It is not quite so palatable as alfalfa or red clover, on account of a slight bitter taste, but cattle can be easily accustomed to its use. This crop will usually thrive well on poor soils. The yellow variety is neither as prolific nor as acceptable to animals as the white, and its growth is not to be strongly advised.

Pea and Oat Hay.—This is a variety of hay whose high standard of value is not generally recognized. It is rich in protein and very much relished by stock. Where clover meadows have failed to come through the winter safely, the growing of this hay is strongly to be advised. as it will greatly assist in providing a large amount of cheap succulent roughage for winter feeding. It should be cut when the peas are in full bloom and the oats in the milk stage.

Timothy.—This widely known hay has not equal value with the clovers for the feeding of cows in milk. However, on account of its palatability, the relish with which all stock consume it and its prevalence, it is valuable for calves and young stock generally. It is rather low in protein to stimulate milk flow, but it contains a large proportion of digestible carbohydrates. Its use, therefore, in a ration entails the addition of some protein-rich concentrate, such as oil meal, to balance it properly.

Canadian Blue Grass.—The hay is plentiful in some parts of Ontario, and is a valuable feed for growing and fattening stock and, as a milk producer, is somewhat superior to timothy. It is valuable as a nutritious early pasture that stands drought reasonably well, but as a hay crop it does not yield heavily and there is usually no aftermath.

Kentucky Blue Grass.—As a hay crop, Kentucky blue is about equal to Canadian blue, for feeding purposes. As a pasture grass it is one of the very best, especially early in the season. It should be included in every permanent pasture mixture on account of its dense early growth.

Millet.—The different varieties of millet and Hungarian grass are grown usually as catch crops where, on account of adverse conditions, it is impracticable to grow other crops. When sown thickly so that the growth is not too coarse, and cut a little on the green side, millet makes a valuable hay that ranks just a little better than timothy for milk production and for young and dry stock. Millet, on account of its rapid growth, is a valuable soiling crop to cut green for supplementing dry pastures, as it can be sown late enough to reach its greatest growth during the month of August, when pastures are poorest, when clover, peas, and oats have become too mature, and corn has not yet reached sufficient maturity to be profitably fed.

Straw and Chaff.—The noticeable feature of the composition of straw is the extremely high percentage of fibre. As a result, when we feed animals largely upon straw they have to handle a very large amount of what may be called inert or comparatively useless material. While this is true, it is also true that straw may be used as part of the bulky ration to good advantage, when other bulky fodders are scarce or very high in price. It must be remembered that if straw is used in the ration of dairy cows in milk it will be necessary to feed a good deal more meal than when hay is fed, so that sometimes what we may gain in saving hay may be more than lost through the extra amount of concentrates used. For store cattle or dry cows straw can be used to much better advantage than for cows which are milking or cattle which are being fattened.

Of the different kinds of straw buckwheat supplies the most protein, but it is so extremely high in fibre that it is seldom regarded as a satisfactory feed for stock, except in extreme cases. Everything considered, oat straw is the most satisfactory for all classes of stock.

Barley straw is practically equal to oat straw so far as composition is concerned, but barley straw is not so palatable as oat straw and the awns or beards of the barley render it objectionable.

Wheat straw and rye straw are both rather low in feeding value and should not be used for feed if oat straw is available. The chaff of oat and wheat straw have a much higher value for feed than the straw itself and if at hand in any quantity can be fed with a considerable saving in hay or other high class roughage. Pea straw has a high feeding value, but coming from the modern thresher it is usually very dusty, which detracts from its palatability.

Corn Fodder.—Because of the large tonnage that can be harvested from an acre, and the comparative ease with which it can be cured, corn fodder is one of the most valuable roughages at the command of the Ontario farmer. When well matured, and cut and cured with the ears on the stalks, corn fodder has a value, in the late fall and early winter, equal to timothy hay for milk production, and the profitable growth of young stock. As it becomes dried out in winter it is much improved by cutting a few days supply into a large heap, which, on account of the heat generated, spreads the moisture through the dry butts, leaves and cobs, and softens up those parts so they are more readily eaten and digested than if fed whole. In the feeding of uncut fodder, the butts of the stalks which contain valuable material are usually left ıeaten. While for practically all purposes the same corn put in the silo would give better results, where corn is grown for fodder it is advisable to plant thicker than where grown for silage. The thicker sowing will produce a smaller growth of stalk and more leaves and a slightly higher tonnage per acre.

The Pennsylvania Station reports that corn fodder is nearly equal, pound for pound, with timothy hay for the production of milk and fat when both were fed with a grain ration of equal parts oats and bran. The Utah Station found that corn fodder would replace nearly half the alfalfa in a ration of 21 pounds of alfalfa hay, with bran and wheat or corn meal, producing practically as much milk and butter fat.

The main value of fodder corn lies in its ability to cheapen a ration by replacing part of the more high priced hay with equal results in milk production and growth. It must not be forgotten that corn fodder or silage, no matter how good, will not economically replace in a ration the entire amount of hay or other high class roughage.

Corn Stover.—Corn stover consists of the cured corn stalks after the removal of the ears. As might be expected, this feed has not as high a value as good corn fodder which contains the ears. The fact that this crop is usually allowed to mature to a greater extent than fodder corn, often being frozen before cutting detracts also from its feeding value. In spite of these conditions, corn stover has a feeding value much greater than straw. Henry of Wisconsin, found that one ton of uncut corn stover was slightly superior to one-third of a ton of mixed clover and timothy hay, and nearly equal to one-third of a ton of clover hay. He also found that cutting the stover increased its value, as less of the coarse parts of the stalks was wasted.

Corn Silage.—This feed occupies a high place in the feeding of dairy cattle in Ontario conditions. To such an extent is this so, that the writer feels confident in asserting that without corn silage dairying, as generally conducted in Ontario, could not, at present prices for dairy products, be profitably conducted. The great amount of actual feeding material that can be raised per acre, the efficient manner in which the silo stores and cures the feed, the convenience of the silo for feeding at all times of the year, give silage its great economic value. In addition it is important to know that silage, being a succulent food, is cooling and laxative in its action, helping greatly to keep the digestive system of the cow in good condition, and being an appetiser it helps the animal to consume larger quantities of food

than she otherwise would. These are important considerations, especially in milk production.

Experiments conducted in most experiment stations in Northern United States and Canada, confirm the finding that for milk production corn silage is worth from 8 to 12 per cent. more than an equal amount of dry matter in good corn fodder. The Maine and Vermont Stations both reported that from three to three and a half pounds of silage is equal to a pound of mixed hay in replacing part of the hay in a ration. The Utah Station found that where cows were getting alfalfa hay and grain that one-third of the alfalfa hay could be replaced by silage at the rate of about three pounds of silage to one pound of alfalfa, and equal production of milk could be maintained. This also gives corn silage a value per ton about one-third of that of alfalfa hay, in replacing part of the more high-priced roughage. Owing to its rather low protein content, and high water content, corn silage is not a perfect ration by itself, its main usefulness being in its efficiency in providing a bulky succulent, appetizing roughage that will take the place, at a lower cost, of part of the more costly roughages, such as clover, timothy, and alfalfa.

It is now known definitely that silage from well matured corn has a much higher feeding value than silage from green immature corn. The writer found, at the Ontario Agricultural College, that, for milk production, silage from White Cap Dent corn, in the firm dough stage, was worth nearly $1.20 per ton more than corn from Southern Sweet on which the ears were just forming. As there was a difference of only one-half ton per acre, in the yield of silage, this was a clear demonstration of the value of the well matured varieties of corn. It is also pretty well established that reasonably thick planting of corn for ensilage, say up to one-third bushel per acre, will produce much more feed of nearly equal value, than will the thin planting such as is practised where corn is grown for grain.

Oats, Peas and Vetches Silage.—Silage from a mixture of oats, peas and vetches has proven of very high value, in those localities where corn cannot be successfully matured for silage. This applies particularly to the New Ontario district. The Nova Scotia Agricultural College reports very highly on this feed and considers it equal in value to corn silage for milk production. Although the yield per acre is large, it does not quite equal corn in this respect, and on that account can scarcely be recommended for general use in older Ontario.

Silage From Other Crops.—The ensiling of other crops, such as rye, clover or alfalfa, has been attempted with varying degrees of success. It has been found that clover and alfalfa deteriorate greatly in feeding value during the ensiling process, particularly in their protein constituent, nor has the ensilage from these crops been found always palatable and acceptable to cattle. It is fair to assume that these crops are more useful when harvested and cured in the usual way.

Rye silage has been tested with no great degree of success, both at the Guelph College and at the Vermont Experimental Station.

The refuse from canning factories, such as corn husks and cobs, and the green straw from peas, can be ensiled with success, and have been proven most satisfactory for dairy cows, but on account of their bulky character their use is limited to the districts immediately surrounding the factories.

Roots.—These foods belong to what are known as succulent foods; that is to say, all the members of the group of roots contain a very high percentage of water. The high percentage of water reduces the value of one hundred pounds of any of these foods, but the solid material which they furnish is usually very digestible and very palatable. In addition, these succulent foods tend to keep the digestive

organs of the animal in better condition and consequently they have a value outside of their actual feeding value. All practical feeders recognize the importance of succulent foods as a means of keeping animals in healthy, thrifty condition. While the dry matter in roots is somewhat more valuable than in corn silage, on account of the greater amount of the latter that can be raised from the same land, with less labor, the production of milk generally speaking is not so profitable from roots as from silage. However, it is safe to say that the addition of some roots to a ration for cows adds much to its palatability and succulence, and allows the cutting down of the concentrate allowance to some extent. Generally speaking, mangels are the most satisfactory for feeding cows in milk. Their actual feeding value is no greater than turnips, but they have not the same bad influence on the taste of the milk that is attributed to turnips. When hay is scarce, or high priced, mangels or turnips are useful for mixing with cut straw, to add palatability and to increase the consumption of the straw. In this way the amount of dry matter needed in the ration can be provided at a smaller cost than if necessary to feed large quantities of hay.

For feeding cows on official test, roots have an especially beneficial action. Their laxative, succulent nature, and their ability to whet the appetite to the consumption of heavy rations, lend them a very high value for this purpose. The red beet that is closely allied to the table beet is preferred for this purpose.

Potatoes.—This crop is nearly always too high priced for feeding cattle. In addition, when fed in large quantity, they have an injurious effect on the flavor of milk and texture of butter. They are occasionally useful in feeding to sick cows, as they are sometimes readily eaten when everything else is refused.

Preparation of Foods.

It is often interesting to know to what extent such preparation of feeds as grinding or rolling grain, cutting hay or straw, cutting or pulping roots, soaking or cooking the various feed stuffs, can be profitably carried on. In the first place these operations demand the expenditure of labour and power, and the use of increased equipment. All of these commodities are expensive now-a-days, so that there is required a much increased feeding value in food being so prepared to justify the increased expenditure. For feeding cows, the hard brittle nature of most of our farm grains, and the tough leathery hulls on the others, practically demand the grinding or chopping of such to increase palatability and ease of digestion, and also to reduce to a minimum the amount that is liable to pass through the system undigested. The only noteworthy exception to the above is the feeding of oats to calves. The calf has a wonderfully efficient system of mastication that can quite readily handle the tough oat hull and hard oat kernel.

The practice of cutting hay has very little justification, unless it be of poor quality and it is desired to mix it with silage or roots to increase its consumption. The cutting of hay makes it dusty and therefore less acceptable to the cows, which fact is quite evident to all who have seen the enjoyment with which the cow always consumes good long clover or alfalfa hay. Cutting hay detracts from its feeding value, and adds to the cost of feeding operations.

Where only a limited amount of straw is being fed, there is little necessity of incurring the expense of cutting, but where it is necessary to feed a large amount, greater consumption of this roughage can be accomplished by cutting and mixing with roots or silage, or both. If this mixture be allowed to stand in the pile to heat for a few days, the straw portion is made more palatable.

The cutting of dry corn fodder, as has been previously mentioned, has much to commend it, in increasing the succulence of the harder drier parts of the leaf and stalk.

The mixing of the various feeds that make up the concentrate mixture is a valuable labor and time saving operation, and enables the feeder to serve out rations that are uniform in composition from day to day.

The soaking or slopping of feeds adds usually no value to the digestibility or feeding value thereof. In the case of dried beet pulp, or malt sprouts, which swell enormously with the addition of water, soaking before feeding will help to avoid digestive troubles. In the case of a sick cow, a bran mash or warm slop is often of value, but beyond these instances the soaking of feed is a waste of time.

The cooking of feed, likewise, has no value in a dairy stable, unless it be the boiling of flaxseed for calf feeding.

GENERAL PROBLEMS IN DAIRYING.

Some of the problems that confront the Ontario dairyman, in addition to those intimately connected with the actual handling of his cattle, are,—the proper system of crops for best results, the comparative advantages of winter and summer dairying, and the extent to which the farmer shall specialize in dairying to the exclusion of other branches of farm production.

Cropping Systems.—One of the first principles that should actuate the dairyman is that of growing all his own roughages, silage, roots and hay. For one reason, these feeds are bulky, and to purchase them would mean large expense in hauling to his farm. The more important reason is that under our conditions these crops can be grown much more cheaply than they can be purchased, while grain crops, or their equivalent in other concentrated feeding stuffs, can be purchased at little more than it costs to produce them in Ontario. This is due to the ability of the Western farmer to produce grain, from his large fields of new and fertile soil, much cheaper than we can here. Accurate farm cost accounts on the College farms during the past two years demonstrated that a crop of clover or alfalfa hay, of less than two tons per acre, could be grown and stored in the barn at about $7 per ton, which same hay would have cost $12 to $14 per ton to purchase. The same land and the same labor produced 60 bushels of oats at about 34c. per bushel, which same oats could have been purchased and stored at threshing time for 37c. per bushel, very little more than the cost of growing them. It is true, however, that the dairy farmer must raise some grain to produce straw, to enable him to seed down to hay and to make better use of the man and horse labour on his farm, than he could make if he were growing roughages only. But, the point is that he should not have his cropping system contain too much grain at the expense of a liberal supply of hay and other roughages. If he keeps in mind that his machine, the large capacity dairy cow, returns her largest profits from the intelligent use of roughages, he will see the necessity of giving attention to his cropping system.

Summer or Winter Dairying.—The solution of this question depends a great deal on the method of marketing the milk, by the individual dairyman. The cheapness with which milk is produced in spring and summer, of course, causes the greatest production during these seasons in all parts of the Province. In districts where the cheese factory absorbs the milk, the farmer will of necessity be com-

pelled to have most of his cows calve in spring, because the nature of the cheese trade of Ontario demands an article produced from grass milk.

In those sections where milk is used for butter making, or for the manufacture of condensed milk, a wider variation of method occurs, though greatest production is even here obtained in spring and summer on account of low cost. It is well worth knowing, however, that cows that calve in the fall will usually produce more in a year than if they freshened in spring. If well fed and cared for in the stable, they will hold out well during the period of high prices for fat, as they are not subject to the same adverse weather conditions, and shortage of feed that usually occurs in summer. In spring, when turned out to grass, they freshen up again with an increased flow, and are dried off for the period of dry weather and labour shortage of the summer. These facts are well worth bearing in mind by those so situated as to be able to conduct their business in this way, and these conditions help to counteract the cheapness of summer dairying. Moreover fall calves can be very successfully raised in winter, when there is more time to devote to them and they will be old enough by spring to turn out to pasture to take care of themselves during the busy season. Those dairymen who are supplying the city milk trade, naturally find it most profitable to have as uniform an output as possible during the whole year, and therefore they have cows freshen at all times. However, the middle of the summer is not a good time to have cows freshen, as pasture and weather conditions are not the best to give the cow a good start in her lactation period. Should a cow not get away to a good start, she will not do her maximum production, even if conditions improve later in the milking period.

Specialized or General Dairy Farming.—This is often called the age of specialization. In most lines of endeavor the advantages of specialization, and the favourable results derived therefrom, are too obvious to admit of criticism. In the business of farming, however, there are so many interesting features over which the farmer has little or no control, such as temperature and moisture conditions, a fluctuating labour supply, uncertainties in the rearing of living animals, inability to create any stable situation in the law of supply and demand, and a characteristic independence in thought and action of his fellow farmers, that extreme specialization in this calling will permit of some argument. To illustrate some of the features of this problem, the writer takes the liberty of presenting a table compiled from the results of an analysis of the business of a large number of farms in a dairy district in a section of New York State where most conditions were like those in many of the dairy sections of Ontario. The table shows the labour income derived from specialized farms where only milk was sold, compared with that derived from farms on which varying proportions of revenue were derived from other sources as well.

Receipts from Crops for each $1.00 received from Stock (Milk).	Average % of receipts from Crops.	Receipts from Stock (Milk).	Receipts from Crops.	Receipts per Cow.	Total Cost of Labor.	Labor Income.
No. Crops Sold—	0	$1,288 00	.....	$79 00	$726 00	$251 00
10 cents to 20 cents.....	14	1,136 00	$178 00	69 00	606 00	476 00
20 cents to 50 cents.....	23	1,282 00	387 00	82 00	584 00	766 00
50 cents to $1.00.....	39	1,093 00	707 00	75 00	675 00	725 00
1.00 and over.....	54	911 00	1,085 00	63 00	753 00	768 00

NOTE:—Labour income is the amount of money the farmer has for his own labour, after paying all running expenses of the farm, and allowing 5 per cent. interest on the capital invested.

This above table indicates the possibilities for greater profit from growing some cash crops in addition to the feeds usually grown for producing milk. Although it is quite evident that many of the farmers in the third and fourth classes used the money received from the sale of cash crops for purchasing other feed, it is evident it was more profitable to use some of land of the farm in growing the suitable cash crop for the locality, than to use it for growing feed for producing milk. It is well to notice also that the growing of cash crops added nothing to the cost of labour for the year. Wise policy would be to grow the cash crop that is peculiar to the neighbourhood, whether it be clover seed, potatoes, fall wheat, alfalfa hay, or sugar beets, etc., rather than devote all the energies of the farm and operator to growing feed for the production of milk. It is of course quite evident that part, at least, of the money from the sale of cash crops must be reinvested in feed if the fertility of the land is to be maintained or improved.

CARE AND MANAGEMENT.

THE MILKING HERD.

IN SUMMER.—Climatic conditions in Ontario cause a sharp division in method between the summer and the winter management of our live stock. Our seasons are such that there are, roughly speaking, five months in which it is possible for animals to gather their own food and seven months in which it is necessary to supply them with sustenance from storage and provide them with a reasonable amount of shelter. Generally speaking, the farms of Ontario have sufficient land to enable the live stock to sustain themselves during the five months of pasturage, but the season during this whole period is not by any means ideal to provide sufficient high quality pasturage, for the fullest returns from the milking herd. Taking into consideration the great efficiency of the dairy cows, in turning rough farm products into a highly palatable human food, and the serious break in the pasturage season, caused by the drought of July and August, the question of the economy of feeding productive dairy cows the year around is sometimes asked. Without doubt such method would economize on land, and would enable the highest standard of production of milk. In this connection experimental work done by the Guelph College, in 1915 and 1916, is illuminating. Fifteen high producing cows were fed in the stable during June, July, August, and September, under the same conditions as obtained in winter. During the same months, thirty-two cows of only average ability were pastured, with some grain in addition. In the case of the stabled cows, the feed was charged at slightly less than the market price for that grown on the farm and actual market price for that purchased. In the case of the pastured cows, the actual cost of pasture, which included rent of land, seed, temporary fencing, and labour of man, horse and machinery in seeding pasture, which was partly spring sown and annual pasture, was charged. It is worthy of note that both groups of cows averaged the same number of days from freshening time to the beginning of the test, and the same percentage of cows in each group calved during the test, so that the factor of length of lactation periods was eliminated. The returns from each group are seen in the following table:

Group.	Lbs. milk in 4 months.	Daily average per cow.	Lbs. fat in 4 months.	Daily average per cow.	Value of grain.	Value of roughage.	Value of pasture.	Total cost of feed.	Cost of 100 lbs. milk.	Cost of 1 lb. fat.
15 Cows Stabled.....	56296	30.8	2193	1.2	187.85	298.36	.....	486.21	.86c.	.22c.
32 Cows Pastured	81650	20.9	3372	.86	178.11	.....	190.17	368.28	.45c.	.11c.

It is therefore quite apparent that from the standpoint of feed costs alone, it is more economical to pasture cows in summer than to feed in the stable. If labour had been also taken into account, the results would have been much more marked in favor of the pastured cows.

During the past two decades the best principles of winter stock feeding have become well recognized, and the practices thereof have undergone great improvement. Such is not the case with the summer feeding which is, in general, in about the same situation as it was twenty-five years ago. This condition is due first to the general lack of available labour at this season, and second, to lack of realization of the importance of the two scanty months of July and August in their relation to the more plenteous pasture periods, both before and after, and in their relation to the economy of the whole season's feeding operations. Any solution, therefore, leading to the betterment of summer feeding conditions must take cognizance of those two most important factors, and also, to a limited extent, the value and necessity of economizing in tillable land in some instances where high priced land is being farmed.

To dwell at length on the lack of available labour for live stock purposes during the harvesting season is unnecessary here. This fact is painfully evident, especially during the present crisis in agricultural production. Sufficient is it to say that during July and August farm labour is worth, on its production basis, from two to four times as much as at any other time of the year. At ordinary values for labour the direct profits on live stock products are small enough now. A solution of the question, therefore, demands the conservation of manual labor at this time, even at the expense of some other commodity. This means that the animal must gather most of its own feed and scatter its own manure, though it may use a little more land, a commodity still comparatively cheap and plentiful in most Ontario communities.

It is in consideration of the second factor that the weakness of ordinary pasture system is disclosed. Most farms have a plentiful supply of pasture for the period ending the 25th of June, and again during the period beginning August 20th, and extending until the end of the pasture season. Particularly is this so, as the usual practice is to pasture the second growth of meadows and the fall rains regenerate the natural pasture. Between the two periods of plenty is the critical time of the year in live stock production. The natural pastures inevitably dry up, even good clover pastures do likewise, because the red clover plant is the first of all our cultivated plants to feel the effects of heat and drought. This is plainly seen in those years where there is a wet month of May followed by a dry June when,

in spite of the good start, the clover crop is light in the fields to be cut for hay. In clover pasture the effect is worse, because the clover is not sufficiently fine in its growth to form a mat to shade the ground. At the beginning of July and August the milk flow and the growth of animals are usually at their highest point. If they are allowed to fall off abnormally, as they usually do under ordinary pasture conditions, a direct heavy loss is occasioned at once, and worse still, no matter how abundant feed may later become the normal production is never again attained that year, so the loss is really a cumulative one. The writer feels confident in the assertion that the usual falling off in milk flow alone, during the one month of July of dry, unsupplemented ordinary pastures, causes, on the average, a loss of 30 per cent. in the year's milk yield.

For those farmers so situated that their land is expensive and farms are small, carrying a large stock, a system of summer feeding that economizes on land is to be recommended. For such, a system of soiling is useful. This consists of sowing a number of crops that will provide a succession of green fodder to be cut and fed to the cattle during the dry season. The best crops for this purpose are one and a half bushels oats, one-half bushel peas, to the acre, sown in two or three patches about two weeks apart, then a patch of millet or Hungarian grass, or on good warm soil a patch of sorghum or sugar cane, and some early maturing flint corn for early fall feed. The total acreage devoted to these crops should provide at least one-half acre to each head of stock to be fed and of this acreage half could be devoted to the peas and oats. To supplement this green feed, red clover can be used before the first cutting of peas and oats, and the second crop of clover will also be found to fill in a week or two in August. This method will be found to provide enough feed to supplement the pasture and keep up the milk flow, but, as is quite evident, will require much labor to cut and haul this feed, which makes the system inapplicable to most farms. A more economical method, as far as labour is concerned, is the feeding of silage in summer, which has the advantage of convenience in feeding as compared with soiling. When it is borne in mind that a ton of silage will give a cow thirty pounds a day for two months, it is easy to estimate the additional acreage necessary to provide enough for the herd for the period of summer shortage. The ideal method of handling is to provide a small silo for summer feeding, as silage spoils least on top of a small silo during the warm weather, but if this is not practicable, the additional acreage of corn can be grown and the excess filled into the silo in the late fall after the silo is partly fed out. If the corn has been well shocked the late filling will make excellent feeding during the winter and there will be good silage left in the bottom for summer use. This method also involves considerable labour, not only in feeding but also in the extra cost of cultivating and storing the extra corn.

These two systems just outlined, while valuable in many cases, are, on account of the labour involved, not applicable to the most farms, particularly under present conditions. A betterment of pasture conditions seems the most generally useful advice now. A study of the question of pasture for dry weather demonstrates that the essentials are, (first) a thick, fast growing mat on the ground, and, (second) a crop that will spring up readily after being eaten off, and, (third) a crop whose growth of leaf and stalk is least injured by summer drought and the trampling of hoofs. The first essential can be provided by the thick sowing of any crop that is leafy in its growth, the second essential by those crops that, having a quick habit of growth have no early growth of a thick main stalk, but are leafy from the ground up, the third essential is provided by those

crops that once having a good start are not seriously affected by heat or dry weather until the seed forming period begins. An examination of the different farm crops discloses that the three spring grown cereals, wheat, oats and barley, come the nearest to fulfilling the three essentials just mentioned. In addition the composition of the young growth of these plants is much similar to that of the early starting natural grasses.

Keeping all the above factors in view, the College Farm has tested, and now recommends the following pasture mixture, that has given exceptionally good results during the past two seasons. This mixture consists of one bushel each of wheat, oats and barley, and seven lbs. of red clover, per acre. This mixture is sown immediately after the spring grain seeding is finished, which is about May 15th or a little later. In about one month this thick mixture is usually about six to seven inches high, at which time the cattle are turned on to the pasture. On being eaten off, the plants immediately commence a rapid and thicker growth. To such an extent is this true that if the plants are not allowed to head out the growth will continue until well on in August, or early September. It is also well established that red clover will make a more certain catch when seeded with a pasture mixture than in any other way, for the reason that the young plant is not too much shaded and the trampling in dry weather keeps the soil tightly compacted with a slight mulch of dry earth on top.

During the season of 1915, seventy-five head of cattle, all over one year old, were maintained on twenty-eight acres of this annual pasture, eight acres of old natural pasture and thirty acres of third year sod, sixty-six acres in all, from first turning out in May until August 20th when about thirty-five head were removed to some second growth clover. During 1916, a very dry and hot summer, seventy-seven head were pastured on thirty-four acres of this annual pasture and thirty-six acres of permanent pasture, from the last of May to August 25th, without feeding one pound of silage or other coarse feed, and the milk flow of dairy cattle and growth of beef cattle and young stock were kept at normal during that time. On the last mentioned date about half the cattle were removed to some second growth clover, but the annual and permanent pasture carried at least half the stock the balance of the season.

From the results herein obtained, there can be no hesitation in recommending this pasture mixture to better live stock feeding conditions in summer, to any farmer. The seed itself is found on every farm. On nearly every farm, some tillable land is nearly always used for pasture that will give much better returns under this mixture than as grass or clover pasture and, moreover, a good catch of clover is assured for hay the following year.

Permanent Pastures.—We have in this Province a large area of rough land and steep hillsides, all unfit for cultivation, but that produce a large amount of fine natural pasture ideal for milk production. This is the best use to which this land can be put. It is evident, however, that good tillable land will not give the best returns if left to grow natural grasses, because much greater growth can be obtained from such land by growing mixtures of grasses and clovers that give a stronger and more vigorous growth throughout the summer season, than do the natural grasses. Good mixtures for this purpose must contain some clovers, which give a high protein content to the pasturage, and also those grasses that give quick early growth in spring, and that last well through dry weather. Where land has grown alfalfa, this seed can be used to good advantage, as it will stand pasturing by cattle reasonably well. Red clover and alsike, on account of their general use

and ease of catch, should also form part of a permanent pasture mixture, and white clover, if seed can be procured, lasts for a long time under pasturage. A good permanent pasture mixture would consist of:

4 lbs. Red clover.	2 lbs. Tall oat grass.
2 " Alsike.	2 " Meadow foxtail.
2 " Alfalfa or white clover.	2 " Kentucky blue grass.
2 " Orchard grass.	3 " Timothy.

This amount would seed one acre. The best combination of pasturage for any stock farm would consist of two-thirds of an acre of good permanent pasture, and two-thirds of an acre of the annual pasture previously mentioned, for each head of cattle one year old and over. This amount, with the use of second growth on meadows for pasture, will supply the farmer with sufficient pasture without necessitating the use of soiling crops or even silage during any ordinary summer.

Grain Feeding on Pasture.—It is evident to all dairymen that cows reach their maximum milk flow during the late spring and early summer, because the fresh green grass is of the ideal composition for milk production, and is usually plentiful enough to supply all the wants of the animal with the minimum amount of labour and time in grazing. Under these conditions, the addition of grain will not stimulate the flow of milk to any profitable extent. While the change from stabling to pasturing is being made, however, the feeding of a small amount of grain will be found profitable. This tends to create a less violent change from dry feed to the watery immature grass, of which it is rather difficult for the cow to consume enough bulk to properly supply the necessary dry matter to fill all her needs. In addition to grain, a small amount of silage will often be acceptable at this time, but it is difficult to get the herd to eat any dry roughage unless it be extra good clover or alfalfa hay. As long as the pasture is plentiful and green, the feeding of grain will not be found to return immediate profit with cows of ordinary capacity. It will help, however, to build up the system to better withstand the shortage later on, and for this reason the feeding, to cows of better than ordinary productiveness, of a small concentrate allowance is to be recommended, as soon as pastures commence to show the least indication of failing. During the heat of summer, when flies are bad, the feeding of grain will be a great help in carrying the cows through these adverse conditions, with the minimum of shrinkage in milk flow. For this ration, bran, cottonseed meal, oil meal, and oats or barley, are the best concentrates, as the three former are usually then at their lowest price during the year. From one to two pounds per day of a mixture is sufficient feed while pastures are reasonably good, with a maximum of four pounds in hottest weather, which would be all that could be fed profitably. If the milk flow continues to decrease abnormally, it is a sure indication that the supply of roughage or pasture is short. This can be improved by more pasture, soiling crops, or silage, rather than by increased grain feeding.

Water in Summer.—A plentiful supply of clean fresh water is an absolute necessity in getting good results from the herd in summer. If a creek or spring is not available in the pasture, the herd will have to be supplied from a well. A well in the pasture with a windmill and pump is found to give good satisfaction if the machinery is regularly looked after and oiled. Where it is necessary to water near the barn, the cows should be allowed to drink their fill twice a day at the very least, and in hot weather three times, if it is at all practicable to get them to the water. Where a water system is installed in the stable, the cows can drink with most comfort and least annoyance when they are put in to milk.

SALT.—While on green pasture, cows will consume a great quantity of salt. This is best fed by putting a small handful in the manger once a day while the cows are inside If the pasture is close to the buildings, where it can be renewed often, an old trough will do nicely for salting, and the cows can help themselves at will.

SHADE.—In summer, shade is almost an absolute necessity in our climate. The cow becomes heated from pasturing in the open and pestered, to more or less extent, by the flies. When she wishes to rest and chew her cud, she should have a comfortable place to do so, where she can cool off and where the flies will not bother her so much. She will show her appreciation of this comfort by a good response at the pail. Pasture should always, therefore, be arranged with a view of providing shade.

THE MILKING HERD IN WINTER.

Weather conditions usually compel a gradual change from pasturing to stable conditions. While the dairyman wishes to make the most of the pasture that is usually plentiful in the fall, to leave the cows out in the cold and rainy weather, especially at night, is not profitable. This causes a serious shrinkage in the milk flow that would be avoided by keeping the cows in the stable and feeding some hay, silage and grain. When the nights become frosty and cold, it is advisable to keep the milking cows in the stable all night. Even if feed is plentiful in the pasture the cold nights cause a shrinkage in the milk flow that can, in this way, be avoided. In this case it may be unnecessary to feed much in the stable, the comfort of the cows being the main purpose in keeping them stabled. While the herd is being stabled at night and pastured by day, it is difficult to keep the animals clean. To avoid this as much as possible, some bedding is necessary. For this purpose sawdust, shavings, or cut straw are the most efficient. In addition, cows should be fed, milked, and turned out as early in the morning as possible, because it is when they lie down the second time that they become the worse fouled.

WINTER FEEDING.—Experienced dairymen have often noticed the enormous capacity for food that all animals possess when first stabled in the fall. This is a natural instinct inherited from the days of the wild cattle, when it was necessary that all animals accumulate as large a store of body fat as possible to tide them over the shortage of feed and rigorous climate of winter, and in the case of the breeding cow to put her in the best possible condition for maternity in the spring. As cows that have milked well throughout the summer are never in very high condition in the fall, liberal feeding is required at this time to maintain at normal the milk flow, and also to provide the food necessary to improve the bodily condition that the above mentioned instinct demands. Good dairymen find it profitable to provide well for both the above conditions, realizing that until she has reached good condition the cow is likely, if not well fed, to use the most of her feed to attain that object rather than to produce milk. Moreover, when she reaches good condition her maintenance cost will be less for the balance of the winter, than if she be low in flesh. It is well, therefore, to feed most liberally, with the best quality of feed, for the first two months of the stabling period, and if economy becomes necessary the herd of all ages are naturally able to stand it better towards spring. This applies particularly to the best use of hay and straw. It has been the writer's experience that it is better to feed good hay in fall and early winter, and when the herd is in good condition they will eat straw and poorer hay with more relish and, therefore, with better results. Where nearly all the cows calve in spring, before pasture starts, it is wise to retain some of the best hay for use when the

cows freshen. But it will always be found profitable to feed well with some of the best feed on hand, early in the stabling period.

Feeding Two or Three Times a Day.—It has often been noticed that a cow on pasture likes to be reasonably full before she quits eating and lies down to chew the cud. She desires, also to have a considerable period of time to perform this necessary operation. It is advisable under winter conditions to follow as nearly as possible the method the cow herself would employ if left to her own devices. In the usual dairy herd, this points to the practicability of feeding only twice a day. This method gives the cattle a good spell to lie down quietly and chew the cud during the middle of the day, which they would not get in the short winter day if fed at noon. In addition, while labor is scarce, a longer time during the middle of the day for other work on the farm will always be found advantageous. In pure-bred herds, where cows are being tested for official records, and particularly

Interior Ontario Agricultural College Dairy Stable.

where milking is done more than twice a day, it is better to feed three times or even oftener, as a greater consumption of feed can be induced in this way.

Order of Feeding.—The order in which the different parts of the ration are fed in the day, depends much on the amounts of the various classes of feeds being fed. Where a large amount of silage and roots, and only a moderate amount of good hay, are used the best plain is to divide the succulent feeds into two feeds, morning and evening, and feed the hay in one feed, preferably right after the silage and roots in the morning. At this time it is more convenient to replace in the mangers the hay that inevitably is thrown out while the cows are eating. The meal ration is best fed on top of the silage, at both feeds. If straw, or poor hay, is being fed, these are best used at the last feed in the day so that the cows have a better chance to work them over during the long night period.

Regularity in Feeding.—Owing to her highly nervous organization, the dairy cow reacts very quickly to any sudden change in the daily routine of stable work, and such changes invariably cause a decrease in the milk flow for that and succeeding days. Therefore, regularity in all feeding, tending, and milking operations, is one of the most important features of successful stable management. Even though the herd may have the ability for high production and there be fed an abundance of the right kind of food, a herd will not produce profitably without regular care and attendance. The dairyman who has the best possible combination of these three factors is always the most successful.

Milking.

Milking should be done regularly, at the same time each day, and periods between morning and evening milkings should be of nearly even length as is possible. The cows should also be milked quickly and all the milk drawn at each milking. Slow milking induces in the cows a tendency to hold up their milk, so that it is difficult to get them milked cleanly. If the milk is not all drawn at each milking, the cows are not properly stimulated to produce their maximum and they dry off more quickly. The quality of the product depends largely on the thoroughness and cleanliness of the milking operation. The cows should be free from manure, particles of bedding and loose hairs. This can be accomplished only by keeping the cows brushed every day, and by brushing again the hind quarters just before milking. Wiping with a damp cloth, just before starting to milk, the flanks and udder will cause dirt particles and hair to adhere to the skin and prevent them dropping into the pail. The cleanliness of the cows can be greatly improved by clipping the hind quarters, flank and udder, at the beginning of the stabling. Milking should always be done with dry hands. Wet hand milking is a most filthy operation, as it causes dirt from the teats, in solution, to drop into the milk from which it is impossible to strain it. Cows with sore teats should be left till the last, to avoid spreading the contagion to other cows. If it is too painful to milk sore teats with dry hands, a little vaseline on the teats is to be preferred to wet hand milking, while the vaseline will have a beneficial action. A narrow mouthed pail will catch less dirt than the ordinary milk pail, and after a little practice will be found as easy to use.

The milking of heifers should have particular attention, as the habits of the cow's whole life are determined in the first lactation period. If the heifer is restive, it is better to spend a little time and use a little patience and kindness and milk her without tying her feet, which should be done only as a last resort. If it becomes necessary to tie her feet she will always be a risky cow to milk, and after every calving, thereafter, she will need to be tied, when a little more determination and patience at the first would have made her a quiet cow.

It is not always practicable to have the period between milkings, and it is not essential, that milkings be twelve hours apart, to get the maximum results from an ordinary dairy herd. Cows milked at ten and fourteen hours interval will produce satisfactorily, if the work is done regularly at the stated hours. It is well to remember that the milk after the long interval is invariably lower in butter fat test than that after the short interval. This factor must be taken into account by men supplying milk to the retail trade, where uniformity in the quality of the milk is an important consideration. Cows in official record work, whether milked two, three, or four times daily, should always be regularly milked at equal intervals, in order to keep the fat test of all milkings as near normal as possible. The

point at which it is profitable to milk more than twice a day is one that cannot be definitely ascertained. With a grade herd it is doubtful if it would pay to milk more than twice; a little extra milk and some additional butter fat may be obtained by milking oftener, but unquestionably these would not pay for the extra labor involved, especially in the spring or summer season. With pure-bred cows, the small gain in milk and fat added to an already good production would naturally increase the value of the record more than the actual value of the excess product. With such cows, giving upwards of fifty pounds per day, thrice a day milking might prove profitable, and if sixty-five pounds per day is reached it becomes necessary to do so. Very few cows have given more than seventy-five pounds per day on twice a day milking, and it appears physically impossible for a cow to give more than eighty pounds under this method. At the same time where regularity in care and milking and an abundant supply of suitable feed is supplied, the right kind of cows will make very large and creditable records from twice a day milking, as the following records from the Ontario Agricultural College dairy herd will show:

Name of Cow.	Breed.	Age.	Lbs. Milk in 1 year.	Lbs. Fat in 1 year.
Young Springwood	Holstein	5	20,110	821
Blackie	Holstein—Grade	13	17,019	640
Molly Rue Rattler	Holstein	3	16,975	640
Molly Rue	Holstein	6	16,466	602
Margaret Cornucopia	Holstein	10	14,978	554
Iford Waterloo Baroness	Shorthorn	5	13,410	502
Fairy Duchess	Shorthorn	4	9,573	384
Flora Hope	Shorthorn	2	7,773	318
O.A.C. Minnie	Ayrshire	8	12,531	477
O.A.C. Glennie	Ayrshire	8	9,384	401

No doubt each of these cows would have made larger records had they been milked three or four times per day with the same care and attention which they received. These records give an indication of the possibilities of twice-a-day milking in official record work, and help to remove the idea from the minds of beginners in this work that it is useless to attempt it unless it is possible to so arrange the work of the farm as to milk oftener.

The Milking Machine.

The statement that the milking machine has now become a practical proposition, can now be made with considerable confidence. Practically all the standard makes of machines sold in this Province, the cheaper ones as well as the more expensive, are giving good satisfaction in the hands of a great many dairymen. There are, however, many instances where each make has not been successful. Analysis of the results that have been obtained by a great many dairymen show that success or failure depends upon the ability of the operator, and not on the make of the machine. All machines are somewhat complicated, and somewhat delicate of adjustment, so that to be successful the operator must exercise some mechanical ability, and strict care and attention to the needs of individual cows. Without these the milking machine has always proved a failure. It can hardly be said that the machine will get as much milk from the cows as good hand milking,

but, properly handled, it will give better results than the average hand milking, and there is no doubt of its being a great economiser of labor and time. The machine has its place on the farms of dairymen who milk more than ten cows, it being doubtful economy to invest so much money for a smaller herd. It may also be doubtful economy to instal the machine in a herd of pure breds where much official test work, involving milking three or more times per day, is being done.

Regarding the quality of the milk from the machine, it is safe to say that where the machine is kept scrupulously clean it will produce nearly as clean milk as the most careful hand milking. Where the machine is not kept clean it produces the most impure milk imaginable, being full of the bacteria that cause the most destruction to the keeping quality of the product. These bacteria found in the unclean parts of the machine are more harmful even than many of those which fall into the pail during hand milking. Mechanical ability, incessant care and cleanliness only, can make a success of the milking machine.

Cleaning and Grooming.

Apart from appearances, brushing and grooming have a direct value and influence on the production and thrift of the herd. Brushing and grooming, by removing dust and dead hairs, contribute much to the comfort of the cow which, in a highly organised animal, is an important financial advantage. Keeping the skin and hair in a clean active condition also helps any animal in making better use of its feed. Moreover, cleanliness of the skin contributes much to the cleaner quality of milk, which adds to its value greatly. If cows are kept free from manure, the work of grooming a herd into a clean condition every day is very small. With a stiff corn brush one man can sufficiently groom at least two cows a minute. If a currycomb is necessary, an old horse currycomb, on which the points are slightly worn down, is more satisfactory, not being as severe on the cow as a new comb.

The proper use of bedding contributes much to the ease of keeping cows clean. In general, short or cut straw is preferable to long straw, which tends to mat under the bellies, or be kicked into the gutter, leaving bare of bedding the place under the cows' hind feet, from where comes the manure found on the flanks and sides. Cut straw, sawdust, shavings and chaff retain their position better under the movement of the feet, and therefore a smaller amount is necessary to keep the cows clean. Again, if cows are tended regularly, they acquire fixed habits as to lying down at certain times of the day, which gives an opportunity to scatter the bedding just before they lie down. This rarely takes more than a few minutes in any stable, and is time well spent in saving labor and grooming, and in adding to the appearance of the herd. Some men make a practice of tying the end of the switch of a cow's tail with a long string that reached from the ceiling to about a foot above the bottom of the gutter. This keeps the tail out of the liquid of the gutter when the cow lies down, and prevents the soiling of the cow's sides when she switches her tail on standing up. This scheme, of course, can only be used in winter, and where cows are turned out only occasionally.

The proper length of stall for each animal contributes much to its cleanliness. This will be dealt with more fully in the discussion of stables.

Watering.—Whether or not cows in the stable should have a supply of water within reach at all times, is not really important, provided milking cows can get their fill comfortably twice a day and the rest of the herd once a day at least. It is necessary that the water be abundant and pure, and that the cattle can get it

conveniently and with comfort. Therefore, even if it is the common practice to turn cows out of the stable every day, the water supply should be provided in the stable. The cheapest and most simple installation is the use of a continuous concrete manger, which may be used both for feeding and watering. This avoids the expense of piping that is so necessary with a water bowl system and that occasionally gives trouble from freezing in severely cold weather. A drain pipe from the manger is necessary with this system to let out the excess water, but in most stables, this expense is negligible. Water turned into the manger twice a day is often enough for all practical purposes, because under natural conditions a cow requires a fill of water no oftener than this. There is some little time required in sweeping the manger before watering, but even this is negligible, as the bottom of the manger is always smooth, and particles of feed do not adhere to it. A good water bucket system once installed, of course, does not require much attention, except to see that the piping is not allowed to clog up or freeze. Comparing a fountain system that feeds from overhead with one that fills the bowls by gravity from a tank with ball float and valve, each system has its advantage. The former is less liable to be clogged up, but if the valves in any bowl gets stuck when open the stable will be flooded. The gravity system is slower in its operation, but there is less liability of flooding at the bowls. In installing the latter system each bowl should have a check valve that will prevent water once entering the bowl from returning to the pipes, carrying particles of feed and saliva that may cause a clog up or contamination of the water supply.

If water is convenient in the yard outside, watering in a trough is satisfactory except in cold or stormy weather, at which time cows will not drink their full supply. This is an important consideration with milking cows. Driving cattle long distances to water, though sometimes necessary, is not good practice from the standpoint of profitable returns.

Exercise.—Turning cattle out on fine days will give them some valuable exercise, but leaving them out in the cold causes a loss in heat that can only be made up by additional feed. Cattle in a well ventilated stable with an inside water supply will come through the winter in good shape without much [illegible] exercise. Cows in heavy flow of milk are hard worked anyway and the value of outside exercise is problematical. An animal that is going sore on its feed should be turned out regularly.

The Cow at Calving Time.

The condition of the cow at and after calving has the greatest influence on the success of her ensuing lactation period. If she has had at least six weeks' rest since drying up, and has gained up in weight so that she is carrying considerable fat, she has stored up considerable energy both muscular and nervous that will be a much needed reserve to draw on during the strain of calving, and during the exacting continuous nervous strain of milking day after day. It has also been well established that the more fat a cow accumulates in her body before calving the higher will be the percentage of butter fat in the milk for some weeks after freshening. So the expense of feeding a cow well before calving not only creates a much needed reserve of energy, but is directly returned in the product immediately after calving.

In early summer, if a cow is dry all she needs is the good pasture found at that season. If pasture is scarce and dry, she should have as good supplementary feed as the milking cows, though grain feeding is not necessary. In winter, give a liberal supply of good roughage such as the milking cows are getting and laxative

concentrates, such as two or three pounds per day of a mixture of any of the following: bran, oats, oil meal, brewers' grains, corn meal, or gluten feed, care being taken that bran or oil meal be included in the mixture. The feeding of a few roots is advisable at this time. As calving time approaches the most important consideration is to keep the bowels lax. Practically all the usual troubles that follow calving can be traced to constipation at this time, milk fever, chills, loss of appetite, and caked udder among them. If bran and oil meal, roots or silage are found in the ration there will usually be little danger in this respect. It is usually perfectly safe to continue the feeding of bran and oil meal right up to calving and even right after, unless there be undue inflammation of the udder. If the cow is constipated, or even if the manure is hard and dry, a dose of one and one-half pounds of salts and one ounce of ginger should be given before calving, and

Interior Ontario Agricultural College Calf Barn.

repeated if constipation is still evident twenty-four hours after calving. In this connection, a drink of the cow's first milk is a valuable laxative. This old and homely method is to be advised in any case, even if the cow is in the best of calving condition. To have the cow calve in a box stall, by herself, is to be preferred, unless the box stall be much colder than her usual place in the stable, as a chill is to be avoided at this time. If the cow's udder is hard and inflamed, it is a good practice to leave the calf with the cow for a day of two; otherwise the sooner the calf is taken away after it is dry the less the cow will miss it and the easier it will be taught to drink. If the calf is taken away immediately after birth, it should be briskly rubbed dry with straw, or some old rags or sacks. The cow should not be milked out clean for the first four days; rather should she be partly milked out three or four times a day at first. It is popularly supposed that milking out dry

at this time brings on the nervous paralytic affection known as milk fever. Should this disease appear, as it sometimes will, in spite of all precautions, the simple effective remedy is to pump each quarter of the udder full of air, and tie the teats to prevent the air escaping. The equipment necessary for milk fever treatment should be in the hands of every stockman. If the afterbirth be retained, it should be removed by a competent person within forty-eight hours after calving. Although this is a simple operation, it should be done carefully and thoroughly, to prevent bleeding and to entirely remove all particles from the extreme forward parts of the uterus. After the afterbirth is all removed, the uterus should be flushed out with an antiseptic solution. For this purpose a solution of boracic acid or oxalic acid is to be preferred to carbolic acid or other coal tar products, which are harsh in their action and cause undue straining.

After three or four days the cow can be reduced to the normal milking periods, and her feed gradually increased until at ten days after calving she can be safely put on the maximum ration for the milk being produced. It is well, however, not to feed any barley, which is heating, or cottonseed meal, which is constipating, till at least two weeks after calving.

The Herd Bull.

The entire care of a dairy bull must be with the view of keeping his vigor and getting power at their highest point. In addition to the proper kind and amount of feed, he must have sufficient exercise in order that his system may be kept active and vigorous. The dairy bull has much the same large digestive capacity as a cow, so that when he reaches maturity he has the digestive power to lay on fat readily. This excess fat usually slows him up, makes him heavy, and he loses his procreative powers unless he is compelled to take enough exercise to keep down his condition. The feed of the bull, like that of the cow, needs to be of a bulky character, but should not be too coarse and watery as, for instance, a heavy silage ration that would develop too much middle, which in a bull injures his vitality, making him slow and clumsy. Clover hay should form the bulk of a bull's ration, in addition to a small amount of roots, silage and straw. With this kind of feed, a bull may require very little grain, except when he is doing heavy service. At such times, three or four pounds per day of bran, oats and oil meal would pro ample. If clover or alfalfa hay could not be procured, timothy or blue grass hay will give good results, but a little more concentrates, preferably bran, will have to be fed. As a bull has a large body to maintain, he requires considerable total feed. The following rations would be suitable for a bull 1,500 to 2,000 lbs.

Ration 1.—	**Clover hay**	**20 to 25 lbs. per day.**
	Oat straw	**5 lbs. per day.**
	Roots	**20 lbs. per day.**
	Silage	**10 lbs. per day.**
	Grain mixture	**2 to 4 lbs. per day.**

In summer, an equal weight of cut grass, or other soiling crops, could take the place of the roots and silage.

Ration 2.—	**Timothy hay**	**15 lbs. per day.**
	Corn fodder	**10 lbs. per day.**
	Roots	**30 lbs. per day.**
	Grain mixture	**4 lbs. per day.**

For a young and growing bull, usually active at that age, more liberal feeding can be safely done as growth has to be provided for. Even at that age, the roughage should consist largely of hay and straw and roots, rather than silage.

The handling of a bull often causes serious consideration, especially after he becomes old enough to do physical harm. No bull, no matter how quiet, should be trusted, as he may turn ugly at a second's notice, from no apparent cause. It is usually the quiet bull that hurts someone, as the cross bull seldom gets the opportunity. A bull is usually quieter if kept stalled where he can see the cows. He should have a box stall to himself where he has considerable room to move around. As a rule, however, when he gets older it becomes difficult to catch him in the stall. To avoid this, he should be tied with a light rope long enough to reach twice from the ceiling to the floor. One end is snapped to the ring in the nose, the other is passed through a pulley at the ceiling, near the door of the stall, and a weight of a couple of pounds fastened thereon. This weight is just sufficient to keep the rope tight and prevent a loop of the rope at the bull's nose from reaching the floor to be stepped on, while not heavy enough to inconvenience the animal in moving about the stall. At the same time the weighted end of the rope can be grasped on opening the door, to which the bull can be drawn without entering the stall. For exercise, the bull should be turned out in the yard every fine day. The more exercise he gets, the less vicious he will be. If he is difficult to catch in the yard, he can be tied by a rope to a pulley block, running on a rope or wire cable stretched overhead between two posts in the yard, with just enough slack in the rope so that he cannot get his foot through it. If one or both of the posts are in the yard, a stop must be put on the cable to prevent him from walking around the post and tangling him up fast. This is one of the best methods of handling a vicious bull, as he is always under control. If not too highly fed, most bulls of the dairy breed are active enough to take sufficient exercise. A bull over one year old should never be led out without a strong staff. If it is necessary to lead a cross bull, blindfolding him with leather or a folded sack will usually make him quite safe to handle. Dairy bulls, never allowed to get in high flesh and with sufficient exercise, have been known to remain active for service till ten years old or over.

The Calf.

The surest and safest method of improving the milking quality of a herd of cows is to raise the heifer calves from the best cows in the milking herd. It may not always be good practice to raise the heifer that is her dam's first calf; the dam may not turn out a profitable cow and by the time this is found out a certain amount of expense has been incurred in raising a calf that would not otherwise be kept. It is safer to select calves from proven cows, and even then there are many instances that cannot be explained of inferior heifers from heavy milking stock on both sides.

After birth, the calf should be removed from the sight of the cow when less than three days old. Some good dairymen advocate taking them away at birth, but the calf will get a better and more natural start if allowed to suck at will for the first day or two, while the udder of the cow will be benefited, and it is not a serious matter to teach a three day calf to drink from a pail. The usual well known method of using the fingers to teach a calf to drink from a pail has never yet been improved upon. Different, more or less, mechanical contrivances with artificial teats have been contrived, all of which owing to the necessity of washing have been found impracticable and if not kept clean do injury to the digestive organs, through contamination of the milk.

The growth of the calf during the first year will depend much on the start the calf gets the first month. It should, of course, have its mother's milk for the first three or four days. The fresh milk of the newly calved cow contains that product,

colostrum, that is necessary to stimulate the newly born calf's digestive system into action. At the least the calf should have fresh milk till two weeks old, five to six quarts per day being sufficient. If it is desired to change on to skim milk, which is the only really successful method of raising good heifers, the change should be made gradually, substituting every day more and more skim milk for the same amount of fresh. It becomes necessary, of course, to provide in some way the fat a calf must have, but which is lacking in the skim milk. For this purpose flaxseed jelly is best. This is make by simmering a pound of ground flaxseed in three quarts of water, or boiling one pound of ground flaxseed in a gallon of water until a thick jelly is formed. When the change is being made from whole milk to skim milk, a tablespoonful of this jelly should be added to the milk, gradually increasing the amount until at one month old a half cupful may be fed at each feed. The Central Experimental Farms recommended the following mixture, to be fed in much the same way:—

One part ground flaxseed.
Two parts fine cornmeal, sifted.
Two parts finely ground oatmeal, sifted.

Boil and allow to stand twelve hours covered. Begin with one-eighth of a pound per day, when the calf is one month old; new milk for the month previous and no solids. Increase the amount per day as the calf grows older, until one-half pound is being fed.

As the calf gets over three weeks old, it will start to nibble at a little hay. Some good clover, or alfalfa, should then be within its reach at all times, till three months old. At about the same age it will commence to eat a little grain, and for this purpose there is nothing better than equal parts of bran and oats (whole oats preferred) fed in addition to the flaxseed or other food in the milk. In feeding calves, it must be remembered that skim milk must be more carefully fed than whole milk. Lacking, as it does, the natural butter fat, an overdose is almost certain to bring on indigestion and scours. If fed cold, when calves are used to warm milk, the same difficulty occurs. Care must also be exercised in keeping the pails clean and sweet. Sour skim milk can be safely fed after the calf is about three months old, if the calf is gradually made accustomed to it and it be fed entirely. Though skim milk is the best feed on which to rear calves, sweet whey can be used, if the change is gradually made from milk to whey, and the flaxseed or other jelly added the same as to skim milk. Where neither whey nor milk can be procured, the use of hay tea has been found of help. This is prepared by boiling cut clover or timothy until a strong tea is obtained. This is fed exactly the same as milk. Calves may profitably be kept on skim milk or whey till six or seven months old, and if extra size is desired, it may be kept up until ten months.

The pasturing of calves under six months old is not to be advised. The digestive system of the calf requires feed in more concentrated form than does the older animal. Grass, therefore, has so much bulk in comparison with the nutrients supplied, that the calf's system cannot handle it economically until developed by age. Moreover, the thin skin and fine hair of our dairy calves cannot well stand the blistering effect of the sun and flies when pasturing in the open. The calves will do much better if kept in a dry pen or shed, where they can be conveniently fed. If the pen is darkened during the heat of the day, the flies will not cause much trouble. When, however, they have reached the age of six months, and the worst of the heat is over, and pasture plentiful, calves will do well to be turned out, and exceedingly well if the feeding of milk and a little grain (say one or one-and-a-half

pounds each, per day) be continued for a month. Calves that have had a run at pasture during the fall months usually get thin, but seem to feed and grow better during the ensuing winter, than if kept stabled the entire first year.

Until the calf is one year old, the ration should be of good quality hay, roots and meal, rather than too bulky; that is, containing too much silage or corn fodder. A small amount of silage may be fed the first winter, say six or seven pounds a day, at most, to add variety to the ration. Clover or alfalfa hay should form the bulk of the ration, and the grain ration need not be large, but should consist largely of bran, oats, and oil meal, all of which are suitable for young and growing animals. If dehorning is practised, and this operation is to be advised in at least all grade herds, it can be most easily done to the calf. The operation consists in application of moist caustic potash to the small horn or button, about the time it comes through the skin. Care must be observed to keep the potash from contact with the hands and from the eyes of the calf.

The Heifer.

Feeds and Care.—In spring all calves over seven months old can be turned out to grass which is plentiful, and is all the feed required till fall. Beyond seeing that there is plenty of pasture, shade and water, and salt twice a week, no other care is needed till late in the fall, as heifers may be safely left out as long as there is pasturage to fill them up. When brought into the stable the food should be plentiful, but bulky, in its nature in order to develop a large and efficient digestive system. Silage may be fed liberally; oat straw and a moderate amount of hay and roots, fed in comfortable quarters, will supply all the necessities for good growth and development. If a heifer is due to calve in the spring she should have a little grain added to her ration. For this purpose, two or three pounds per day of the grain mixture being fed to the milking herd will do. If the bulky part of the ration is not of very good quality, a little grain mixture can be fed to advantage, especially during the early winter.

Time to Breed.—It is usually not good practice to breed a dairy heifer till she is at least twenty months old. If she is of average size for her breed, if she should be bred earlier she is not likely to make both her normal growth and her best yield of milk during her first lactation, she will likely become stunted in her growth, and always be a small cow on that account. If she be extra large, the heifer may safely be bred to calve shortly after she is twenty-four months old. During the period a heifer is carrying her first calf, she requires occasional handling in order that she may make as little trouble as possible when first commencing to milk. Kind treatment at this time will be well repaid during her future milking life.

COMMON AILMENTS AND DISEASES.

Like all living creatures, the dairy animal is not always in perfect health. Since dairy cattle now live under rather artificial conditions they are no doubt afflicted by more ailments than if living under entirely natural conditions. The old saying "Prevention is better than cure" admits of no more proper application than in the dairy business. Therefore, the aim of all dairymen should be to give that care and attention that will ward off disease, than to depend on his own skill or that of his veterinarian to avoid serious loss from this source. Though the most stringent care cannot always prevent diseases from creeping in, the following of

the simple rules of ventilation and cleanliness, the supply of abundance of good food, admission of sunlight and periodic disinfection of stables, will prevent most of the losses that occur in dairy stables from disease.

A discussion of some of the commoner afflictions of cattle that yield to treatment by the farmer himself, together with causes, prevention and cure, here follows:—

ABORTION.—This disease is of two distinct kinds, mechanical or accidental abortion, caused by a fall, a blow, or a hook from another cow, and contagious abortion, due to the presence of a germ in the genital organs of the pregnant cow. The first kind only occasionally happens, and can be avoided only by care in handling the cows to avoid accidents of this kind. The second kind is the scourge of the dairy business. The germ of this disease has extraordinary vitality, which enables it to remain active in the system of the cow from one pregnancy to another, and great power of resistance, which enables it to survive medicinal treatment that does not have actual contact with the germ itself. Because the germ lives in the womb which is tightly closed except for a few days after calving, it is, of course, impossible to bring the germ in direct contact with disinfectants for the greater part of the year. Therefore, there has not yet been found any course of medicinal treatment to which the disease has appreciably yielded.

The disease usually finds its way into the stable through the medium of a purchased cow that is infected, or a bull that has served an affected cow passing on the infection of healthy cows. The most obvious method of prevention is to avoid the introduction into the herd of either males or females from herds that are infected, and to prohibit the service of outside cows by the herd bull. Should the disease once get a foothold in the herd, the spread of the disease to all the cows is always very rapid, and even with the strictest treatment will take some years to entirely eradicate. There are the best grounds for belief that a cow may carry the affection and yet not abort, being of sufficient resisting power to prevent the disease from operating. It is also believed that when a cow becomes normal, after aborting one or more times, that she still retains in her system the infection, that may be transmitted to other animals. The latest investigation into the disease points to the probability of a heifer calf, born normally from a cow of either of the above kinds, carrying the infection in her system until she herself is of breeding age, when she may abort. The same investigations show that it is possible for a healthy heifer calf to become infected from the milk of an infected cow, and carry the infection until it causes her to abort at the first opportunity. These may explain the lack of success in eradicating the disease that has so far attended the strict methods of isolation, sanitation and disinfection heretofore practised by many dairymen. This would also partially explain the progress of the disease, through practically all badly infected herds; that is, that the infected cows seem to become immune after two or three years, and ensuing outbreaks are usually among heifers and purchased cows.

The only methods of handling an infected herd are isolation of aborting, or about to abort, cows from the rest of the herd, disinfection of stalls and gutters about the infected animals, and burning or burying all discharges and bedding from aborted cows. Added to these is the necessity of flushing of the vagina and washing of the exterior genitals, tail and thighs with an antiseptic solution till all discharges cease. The sheath of the bull should be cleansed with an antiseptic after each service. The best disinfectant for internal work is a three per cent. solution of carbolic acid, phenol or chloral naptholeum, or a ten per cent. solution of boracic

acid, which has the advantage of not being so harsh as to cause severe straining, which sometimes is the result from the first mentioned disinfectants. For external use and disinfection of stalls and gutters, etc., a solution of carbolic acid, zenoleum, or any other like coal tar product, double the strength mentioned above. For use in disinfecting the stables a two per cent. solution of corrosive sublimate will also be found very efficient.

One of the frequent results of abortion is temporary loss of the breeding powers of the female. Good feeding and frequent flushing of the vagina, to expedite the healing of the organs after abortion, is the best treatment for this condition.

Just before going to press the Health of Animals Branch of the Dominion Department of Agriculture have issued the following statement regarding experimental work with this disease:—

The experiments which we have been making in the Health of Animals Branch of the Department of Agriculture, with the object of finding a means of controlling contagious abortion in cattle, have resulted hitherto successfully, and I am permitted by the Minister, the Honorable Martin Burrell, to make them public.

Experiment 1. Four heifers, aged 1 year, were inoculated with our protective vaccine January 26th, 1915. The test of the blood of these heifers showed that one of them was already infected with the bacillus of contagious abortion, and all four were living in a herd in which the disease was known to exist.

The four heifers were bred on the following dates: April 21st, April 23rd, April 23rd, and December 18th, 1915. They all calved, the dates being respectively January 26th, January 26th, January 12th, and September 11th, 1916.

Experiment 2. Ten yearling heifers were inoculated March 20th, 1915, four of which reacted to the test for contagious abortion. They were bred after an interval of three months. (Accurate dates cannot be given in this case, as the herd records were destroyed by fire). All became pregnant; eight carried their calves to full term and produced living offspring; two aborted.

Serum and Vaccine.

Experiment 3. Four heifers, yearlings, were employed to test a method of employing a serum as well as a vaccine. With the first two, the serum and vaccine were used simultaneously; with the second two, the serum was given ten days prior to the vaccine. When tested, the first two had reacted to the test; the second two did not react. The first two were bred December 16th, 1915, and August 25th, 1915, and both aborted—July 12th, 1916 and April 16th, 1916. The second two were bred December 23rd, 1915, and November 9th, 1915, and produced living calves September 20th, 1916, and August 5th, 1916. This experiment was unsatisfactory and gave conflicting results, but shows that the simultaneous method of giving serum and vaccine did not prevent infected heifers from aborting.

Experiment 4. In this experiment an effort was made to find out how far the vaccine treatment would prevent abortion in cows which had previously aborted.

Eight cows were selected, ranging from two to seven years in age. All had previously aborted, one of them three times, the others once. All but one reacted to the test for contagious abortion. None were pregnant when inoculated nor bred afterwards until some weeks had elapsed. The result showed six cows produced living calves at full term; and one proved to be barren and was slaughtered; and one cow reacted when the herd was tested with tuberculin and was slaughtered, having previously aborted.

The method used in this experiment was a double inoculation with a mild vaccine first, followed by a strong vaccine several days later.

Experiment 5. Four cows, aged two to seven years, and four yearling heifers were used. The cows had all aborted previously, one of them twice, the others once. Three of them reacted to the test for contagious abortion. All were treated by the double method, and were bred, after a suitable interval, with the following result: One of the cows, the one that had aborted twice previously, aborted again. All the others produced living calves.

Should Make Application.

These experiments have resulted in obtaining 27 living calves from 34 cows and heifers in badly infected herds. This encourages us to hope that we have a really useful method of procuring immunity to the disease, and we are anxious to enlarge our experience by extending our work to other herds.

With this object we now offer to treat free of charge a limited number of herds in which contagious abortion is present. Owners are requested to make application in writing to the Veterinary Director General, Ottawa, stating the number of breeding females in the herd.

Applications will be dealt with in the order of their receipt.

F. TORRANCE,
Veterinary Director General.

BLOAT.—This ailment is caused usually by a too heavy feed of damp green feed, such as red clover, corn, or rape. The best preventive is to have animals partially satisfied before turning on to such feeds as above, or to drive the animals out before they have had a chance to gorge. In moderate cases a dose of two tablespoons of turpentine in a pint of raw linseed oil will work a speedy recovery. If the case is severe, immediate tapping with a trocar and cannula at a point equidistant from the hook point, loin edge and last rib on the left side. This should be followed by the dose of turpentine and raw oil mentioned above, and light feeding for three successive days. Tying a short piece of fork or broom handle crosswise in the animal's mouth has also been found to give quick relief.

BLIND TEATS.—This trouble arises from different causes, but is usually the result of a growth in the milk channel, following an attack of mammitis or garget. It is sometimes caused from a deep wound such as a barb wire cut. Should the trouble commence while the cow is in full milk, little can be done except to milk with a milk tube, kept clean and sterilised, and when the cow goes dry the growth can be partially removed with a teat bistuory. This operation should be performed only by a competent veterinarian.

BLOODY MILK.—An injury to one or more quarters of the udder, or an attack of garget, are the usual causes of this ailment. Frequent milking of the affected quarter, and bathing with hot water twice daily, usually effects a cure.

COW POX.—This is a common trouble during the spring when cows are first turned out to pasture, and is usually spread from cow to cow by the hands of the milker. The use of zinc oxide, carbolic salve, or even vaseline and sulphur, after each milking, is the best treatment. When the disease first appears, the affected cow should be milked last to avoid spreading to other animals.

FOUL IN THE FOOT.—Sometimes from the presence of dirt between the toes, the animal's foot will become swollen and sore. The foot should then be scraped and washed clean, with a disinfectant, every day, and the foot kept wrapped in a sack containing a gallon of moist bran.

GARGET OR MAMMITIS.—Garget is well known to all dairymen. The natural swelling of the udder at calving time must not be confused with this disease, which may occur at any time in the milking period. Caked udder is another common name for the trouble. The usual cause is a chill due to cold in the udder brought on by draft or by contact of the udder with the cold damp floor or ground. If taken at the beginning, a cure is usually effected by keeping the cow in a warm dry place and dosing her with Epsom salts, or raw oil. Frequent massaging of the quarter, followed by rubbing with sweet oil, castor oil, or lard, is also to be advised. Should the case become severe, fomentations with hot water three times a day will be necessary. The udder must then be rubbed perfectly dry and camphorated oil rubbed in. This is rather severe treatment, and may cause the temporary drying up of the quarter. The worst cases may require the use of a hot poultice of flaxseed. bran, or hot wet rags. The disease, or at least one form of it, is contagious, so that in all cases the milk or fluid from the affected udder should be drawn into a separate pail and destroyed, and the udder disinfected externally with a five per cent. solution of carbolic acid.

INVERSION OF THE WOMB OR CASTING OF THE WITHERS.—The above words describe the condition where the womb, or calf bed, appears in a large mass, inside out, on the outside of the cow's body. It usually follows a difficult calving, and denotes a breaking or tearing of the ligaments that hold the uterus in its proper place in the body. When a cow has once had this trouble, it is liable to occur again

after any succeeding calving. The operation of returning the uterus is a difficult one. To overcome the straining of the cow, tie a quarter-inch rope tightly around the body just back of the shoulder, and another just forward of the hooks. The uterus should then be washed off with clean cold water, with a very small trace of disinfectant. Then the mass can be slowly and carefully forced back into place with the closed fist. An occasional dash of cold water over the parts will reduce the size by driving out part of the blood. To hold the uterus in place after being returned, the lips of the vulva may be stitched for a couple of days. Or, after placing a tight surcingle around the cow's chest, two small ropes may be brought from it over the cow's back, on each side of the tail, crossed or knotted just under the tail and brought down, one on each side of the udder next to thighs, and tied tightly to the surcingle under the chest. Then the cow's hind feet should be raised six inches higher than her fore feet, for about a week. If cows, heavy in calf, acquire the habit of standing back in a deep gutter, the gutter had better be filled up level to avoid bringing on this trouble.

Lice.—These pests are difficult to eradicate in a stable. They often have a good foothold before they are noticed, particularly on animals with long, thick hair. They show their presence by the unthrifty dry appearance of the coat and loosening of patches of hair. Two good washings of the whole animal, with a five per cent. solution of Creolin, Zenoleum, or crude carbolic acid, about ten days apart, will kill most of them. Dusting the roots of the hair thoroughly with a mixture of hellebore and dry cement is also efficacious. If the hair is very long and thick, it will often pay to clip the animal before treating.

Lump Jaw.—This is a hard growth or swelling close to the bone of the lower [illegible] As it is very infectious the animal should be isolated from the other cows [illegible] the swelling bursts. The only known remedy is a dose of two drams of iodide of potash in half a pint of water given every day for seven days. If the swelling does not reduce in that time, repeat the dose. In the case of a valuable animal, treatment may be worth while. An ordinary one might better be slaughtered as soon as the disease is noticed, as the meat can then be used. It is contrary to law to sell meat from an animal in the advanced stages of the disease.

Milk Fever.—Parturient apoplexy is another name for the same disease. This trouble affects only heavy milking cows within a few days after calving. It never attacks a heifer at her first calving, and rarely is it found if the calf is allowed to run with the cow for the first week. It rarely attacks a cow whose bowels are in a laxative condition and which is being lightly fed on laxative foods, and if the cow is not milked out clean during the first three days the disease seldom occurs.

The symptoms are: loss of appetite, uneasiness, and partial paralysis of the limbs, or inability to rise or walk. Soon the cow goes down in an unconscious or semi-conscious condition. As the cow has difficulty in swallowing, she should never be drenched while in this condition, as all or part of the liquid may flow into the lungs and cause almost certain death. Of late, the disease has been found to yield readily to the air treatment. This consists in pumping the quarters full of air and confining the air by tying the teats tightly with tape. This may be done with a bicycle pump, or a rubber atomiser bulb, attached by a piece of rubber tubing to a milking tube, or by the use of a special milk fever outfit of much the same nature, in which the air has to pass through a chamber filled with medicated cotton. The teats should first be partly milked out, then washed off. The tube to be inserted should also be clean and sterilised. Air may be pumped into each teat till

well distended, then the teat should be tied with a tape to prevent its escape. One injection will usually be found sufficient, but it may be repeated if necessary.

PARALYSIS OF THE BOWELS.—This disease sometimes attacks cows during the first few days they are turned out to pasture. It is supposedly caused by lying on the damp cold ground. The cow refuses to eat anything, though she shows no pain at first, and gradually becomes weaker and weaker through lack of feed. In three or four days she will go down, will be unable to rise, and in a day or two will usually die in great agony. Unless taken at its inception, the disease is fatal. Strong stimulants, such as nux vomica, sulphate of iron, and bichromate of potash administered by a veterinary will sometimes work a cure at this stage.

PNEUMONIA.—Inflammation of the lungs, as it is commonly called, attacks cattle only in cold weather. The symptoms are lack of appetite and ambition, rapid breathing and a crackling sound in the lungs, heard when the ear is applied to the chest. The disease is usually ushered in with a severe chill, followed by high fever. A veterinarian had better be called in, and the animal placed in a dry stall, not necessarily too warm, but free from draughts. The animal is not likely to eat, but she may take a bran mash or boiled potatoes. The medicine given should consist of a pint of raw linseed oil at the beginning, followed every three hours by a quart of thin flaxseed gruel and two ounces of whiskey. A good strong mustard blister over the lung, left on two hours, will help relieve the pain. The animal should be kept blanketed and free from draughts till fully recovered.

RETENTION OF THE AFTERBIRTH.—The cause of this disease has never yet been ascertained. It attacks calving cows in all the varying stages of bodily condition, age, and breeding, at all times of the year, and in all weather. It is found after most cases of abortion or abnormal births. If the afterbirth does not come away within twelve hours after calving it will not come away naturally. To avoid the poisoning of the system by the decay of the tissues of the afterbirth in the womb, it is necessary to remove them. This should be done by at least the third day after calving. After providing himself with a pail of warm water, in which is a disinfectant, the operator should strip to the waist, wash his hands and arms in the water, and coat them with some oil, vaseline or lard. The arm should then be inserted in the vagina, and the hand follow up the placenta into the womb until the first attachment is reached. This is a bulbous button-like projection, or cotyledon, from which the placenta can be separated by the finger and thumb. Follow up the placenta until the tissues are all removed from the cotyledons, at all times exercising a steady pull on the end of the placenta hanging from the cow. This is a hard, tedious operation, but should be done with as little roughness as possible, to avoid bleeding at the cotyledons. After removal of all parts of the afterbirth, the uterus must be flushed out with a gallon of warm antiseptic solution. For this purpose a solution of boracic acid is advised as it is not so harsh and causes less straining. A mild solution of carbolic acid, about two per cent., will also be efficient. If there is any discharge, a second flushing out inside of forty-eight hours is to be advised.

RINGWORM.—This is a fungus growth more often found on calves than on mature animals. Treatment consists in painting with iodine, or a couple of applications of sugar of lead and cream, one to four parts by weight. Kerosene oil will often work a cure, but leaves the surface raw, and retards the growth of the new hair.

TUBERCULOSIS.—This disease is much more common in our Ontario herds than is usually supposed. This is due to the fact that animals well fed and cared for do

not show any outward indications of the disease, until the disease has reached the well developed stage. There is no known cure for the disease, and treatment consists only in preventing its spread to healthy animals. The presence of the disease is indicated only by the application of the tuberculin test. Every farmer would be wise to test all his cattle at least once a year. If only a few animals react, they should be disposed of to avoid infecting the balance of the herd. In its first and middle stages the disease does not usually affect the sale of the meat. If quite a number react, so that immediate disposal would cause a severe loss, all possible means should be taken to isolate the reacting ones from the healthy cows, both in the stable and in the pasture. The calves from diseased cows are always born healthy, and, if removed at birth from contact with the mothers, and fed only the milk from healthy cows, they will be as free from the disease as calves from dams that have no tuberculosis.

WARBLES.—These lumps, that develop on the backs of cattle, just under the skin, are the larvæ or grubs of a bot fly that lays its eggs the previous summer. Turpentine, or a mixture of one part sulphur to two parts lard, smeared on the lumps will kill the grubs as soon as they make an opening in the skin. Large warbles can be squeezed out by hand, and destroyed.

WHITE SCOURS IN CALVES.—This is an infectious disease attacking young calves. Though due to the presence of a germ in the digestive tract, it rarely occurs where proper cleanly methods of feeding are practised. The symptoms of the disease are loss of appetite and energy, slight bloating, and an offensive white color to the manure. An immediate purgative of two ounces of castor oil is necessary, and the feed should consist of warm whole milk till the trouble abates. Many dairymen report good success from feeding in the milk a couple of tablespoonfuls of a mixture of one half ounce formalin in twelve ounces of water. Cleanliness and regularity in feeding, however, will always avoid trouble of this kind.

THE MEDICINE CHEST.

The foregoing discussion on the treatment of diseases demonstrates that most of the common ailments can be successfully treated if the farmer has on hand a few of the simple remedies that are recommended for use in this connection. Every stable should be supplied with the following drugs, kept in a locked cupboard, each separate kind being distinctly labeled to avoid mistakes.

10 lbs. Epsom salts 1 lb. Ginger 1 gal. raw linseed oil 1 quart castor oil	Purgatives and laxatives.
½ pint olive oil 1 lb. lard 1 pint camphorated oil 1 lb. vaseline	Applications to udders and teats.
1 pint of turpentine	Bloating.
1 lb. carbolic acid 1 lb. boracic acid 1 gal. Zenoleum, Creolin or Chloral Naptholeum	Disinfectants.
½ lb. Sulphate of Iron ½ lb. Gentian 1 pint whiskey or brandy	Tonics and stimulants.
½ doz. sticks Caustic Potash	For dehorning calves.

In addition to the above, the following appliances for treatment of diseases and the administration of medicines can profitably be included:

Drenching bottle with long neck.
Trocar and Cannula, for bloating.
Graduated measuring glass.
Milk fever apparatus.
Clinical thermometer.
Injection pump, or
6 ft. half-in. rubber hose with gla s funnel.
Hard rubber syringe.
3 milking tubes.
Set of hand clippers.

DAIRY BARNS AND EQUIPMENT.

The dairy farmer does not build new buildings or remodel old ones, on the average, more than once in a lifetime. When the necessity arises, therefore, for a change in the quarters of the live stock, considerable thought and planning must be given to the proposition, because once completed buildings cannot easily be altered, and mistakes and inconveniences must be put up with for many years. Careful consideration must be given to the following features of a new or remodeled building:—

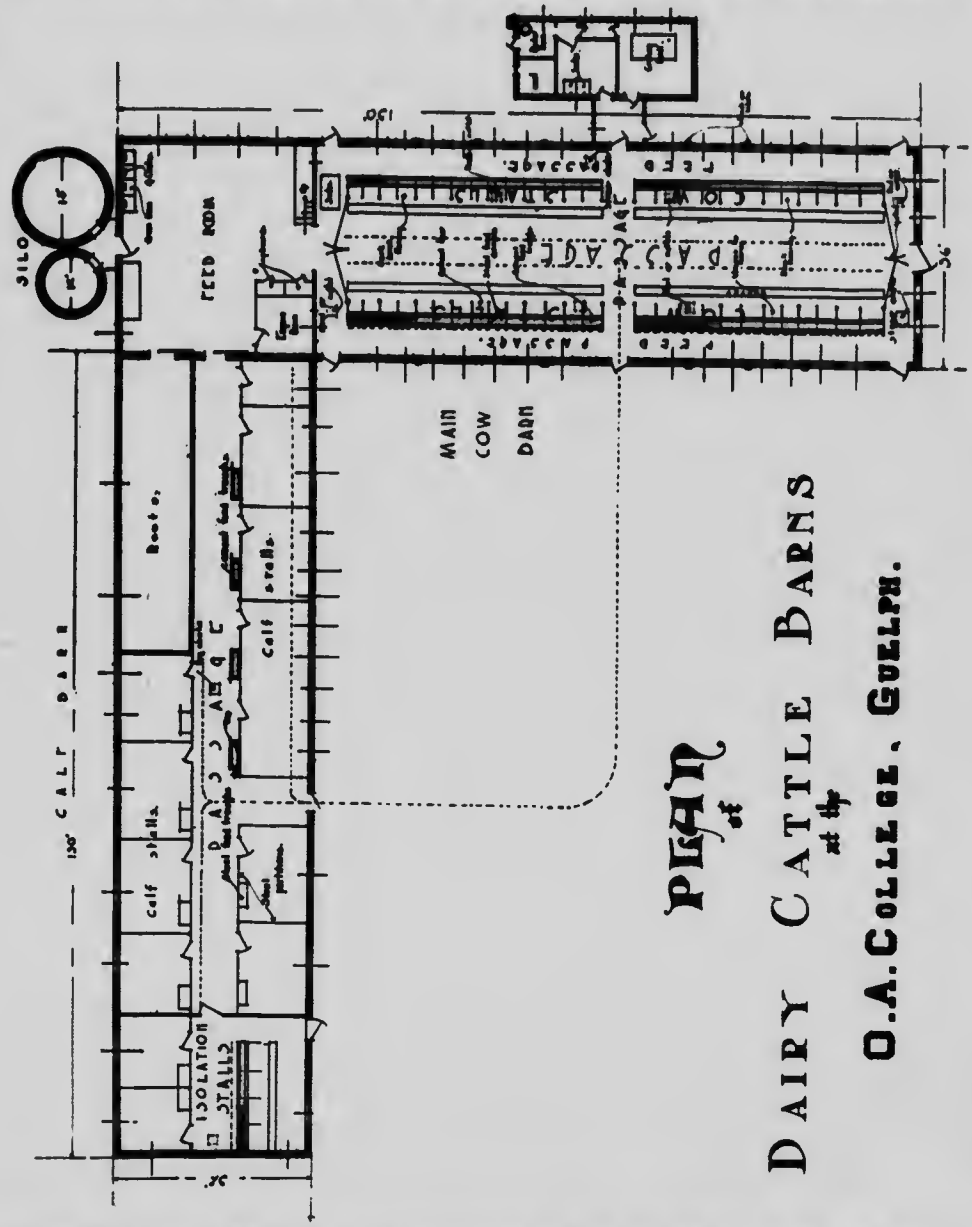
1. Capital invested in keeping with value of farm.
2. Location of building.
3. Floor space needed for animals.
4. Storage room for feed.
5. Shape of building.
6. Best materials to build with.
7. Convenience of lay-out.
8. Ventilation.
9. Light.

Capital Invested.—It is perfectly true that a farmer rarely gets much for his buildings if he sells his farm, but buildings are a necessity on all farms, and, though the capital invested therein does not yield any direct return, properly planned buildings may be the means of adding to profits by saving labor on live stock and storing crops, and by increasing the health and efficiency of the live stock. From a business standpoint, buildings should supply the necessary permanence, space, convenience, and ventilation, with the least possible investment of money in architectural effect, or fancy equipment that adds nothing to the utility or life of the building.

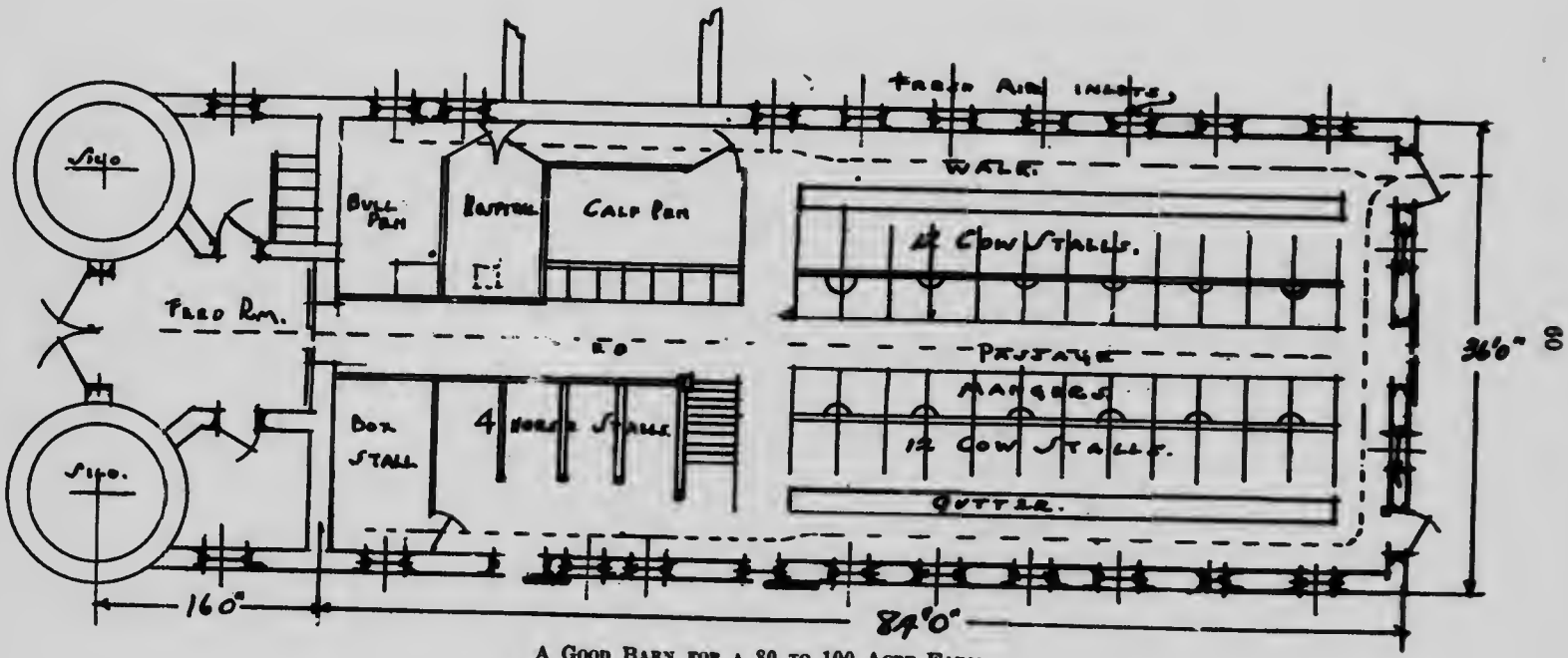
Location.—The first requisite in the proper location in a barn is natural drainage. No system of artificial under-ground drainage will keep dry a building erected in a low place, or remove excess surface water from such a barn yard where men, cattle, and horses are daily trampling. A side hill sloping to the south or west is the ideal place. The location should also be studied out in relation to other buildings already built, or likely to be built in the future. The dairy barn should be just a reasonable distance from the house, but ought to be as near as possible to piggery, straw sheds, and other buildings, with which the daily work of the farm necessitates constant communication. Should it be possible to build in the lee of a wind break, the location would be much improved.

Space Necessary For Animals.—In estimating the dimensions of a stable, fifty feet of floor space per animal stabled will be found about the amount necessary. This figure will provide all the necessary space for all passages, alley ways, and box stalls, in addition to the space actually occupied by the cattle. A slightly

smaller amount may be found convenient if a large proportion of young stock is being raised. It would not be wise to build on a much larger plan. This would provide a lot of waste room and would be too cold in most parts of the Province. To provide the necessary balance between heat and ventilation, an allowance of



from four hundred and fifty to five hundred and fifty cubic feet of air space should be allowed to each animal stabled. With the amount of floor space per animal above mentioned, this cubic requirement would necessitate a ceiling from eight and one half to nine feet high. This height makes possible the best distribution of light in the stable.



A Good Barn for a 80 to 100 Acre Farm.

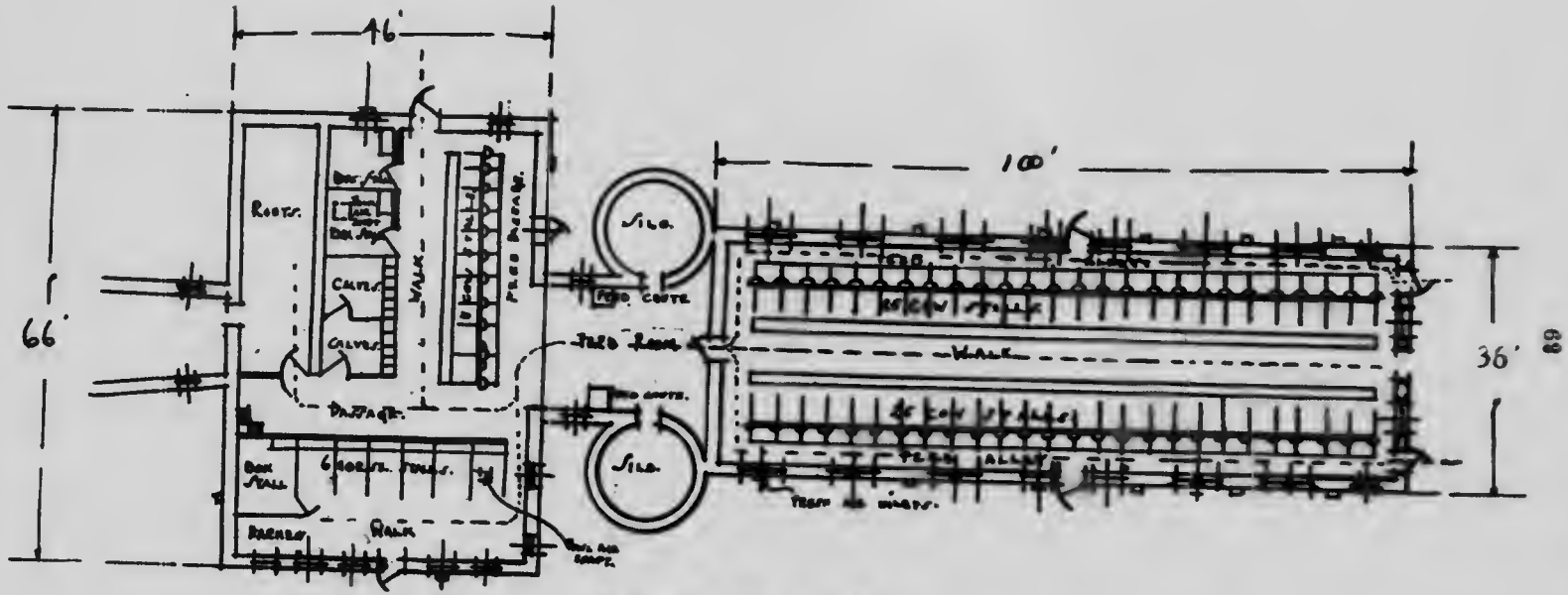
STORAGE FOR FEED.—To store the necessary hay and grain for a herd of cattle, it is well to estimate on at least 800 to 900 cubic feet of space for each animal. This will also provide for one barn floor and practically all the straw that would be used for bedding. If grain is to be stored and threshed in the same barn, somewhat more space will be necessary. For silage space, provision for 150 to 175 cubic feet per animal will be found sufficient.

SHAPE OF BUILDING.—When the size of the barn has been decided on, the next consideration is the shape of the building. It is now well established that the best arrangement to economize on cost of building, space, and labor of feeding, is cattle below and feed above. Though the separate one-story barn for cattle is often advised, a little thought will show that this arrangement involves too much labor carrying feed, and too great expense in building, to be economical under our Ontario conditions, even though there be some advantages in regard to ventilation and sanitation. In remodelling old buildings, however, where a large barn is already built that will provide storage space in plenty, it may often pay to build a one-story addition to house part of the stock. The best arrangement, all things considered—convenience, light and ventilation, is to have two rows of cattle running the length of the building. For such, a total width of about 36 feet is sufficient to provide plenty of room. Narrower barns are more expensive to build, considering capacity, while wider barns provide more stable space than can be economically used by two rows.

Where the horses, cattle, and calves are to be housed in one compact building, an "L" shaped or "T" shaped barn often lends itself to convenience of layout, with the minimum expense, particularly if there is an already erected barn that can be worked into the barn. Where it is necessary to have a threshing floor the "T" shaped barn would be preferable, with the barn floor across the middle of the top of the "T," under which wing would be housed the horses, calves, feed-room, etc. The cow stable could then be built in the upright part of the "T", over which would be stored the most of the hay. The silo could be placed in one of the angles of the two wings, convenient to feed-room. The "L" shaped barn also lends itself to some such arrangement, if the wings are so placed that the barn floor has connection with both of them.

In cases where it is considered advisable to have a great amount of storage room, it might be wise not to make the building too long and high. In this instance, if the barn were built 42 feet wide or over, the stable arrangement could provide for two rows of cattle, and a row of box stalls and calf pens, the latter being along one side. With such an arrangement, the ceiling would need to be high, with high windows to give plenty of light to the middle of the stable. In an extra wide stable, the rows of stalls can be placed crosswise. This is not usually an arrangement that economizes space, as, in addition to the feed passages and cattle walks, there must also be a long passage the length of the stable to make connection with all parts of the stable. This is pretty near all waste room. It would, of course, be impossible in a work of this kind to enumerate all the different styles of buildings that could be satisfactorily adopted. Some of the general ideas have been outlined, and there will be found in the adjoining pages some plans of buildings that may suggest to those interested some ideas that can be incorporated in their building plans.

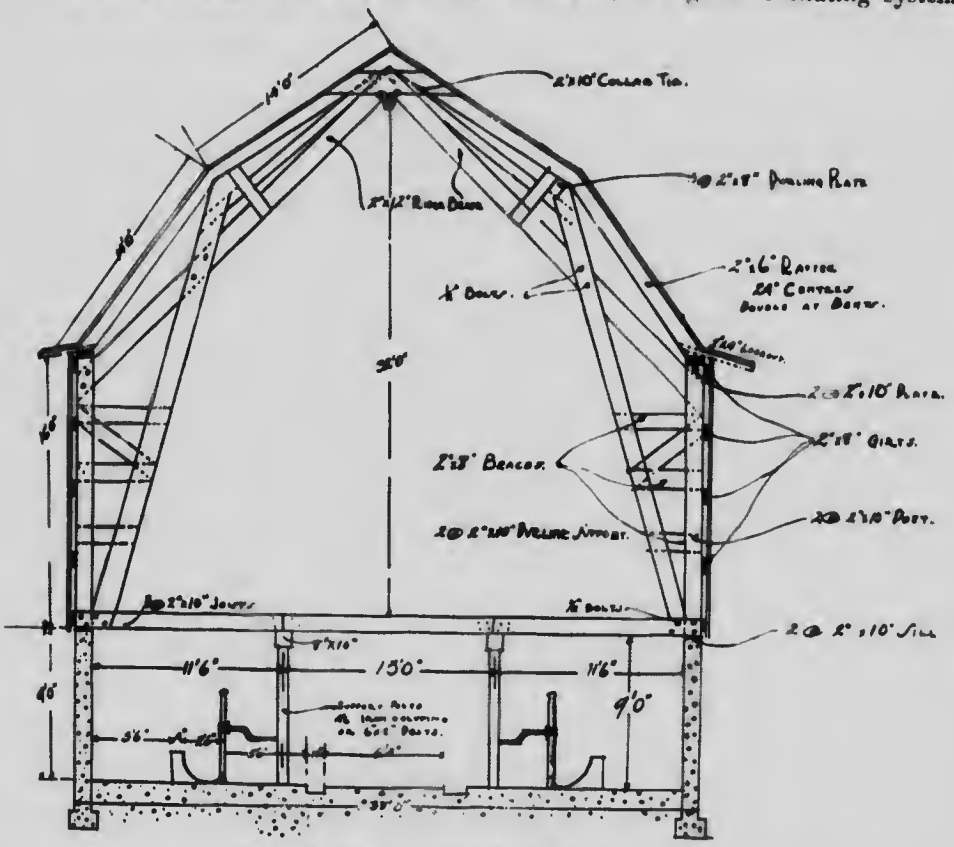
BUILDING MATERIALS.—For foundations, stable floors, and, in most cases, for stable walls, nothing has yet been invented that is as satisfactory as cement. All stable floors should be of concrete, if the materials necessary—gravel, sand, and crushed stone, can be at all obtained. Cement floors are permanent, non-absorbent,



Barn for Large Dairy Farm.

and waterproof, therefore clean and sanitary. When covered with plank where the cattle stand, they are warm, dry, and cause no ill health. They require little or no repairing, and will last as long as the superstructure of the barn, and, moreover, at present prices for lumber, they are nearly as cheap at first cost as good wooden floors.

For stable walls, cement is also satisfactory, being strong, permanent, windproof, and water-proof. Solid walls are rather good conductors of heat, and, therefore, a trifle inclined to be damp in cold weather. For this reason the hollow concrete block, the hollow cement wall, or the brick-lined wall are to be preferred if the extra expense can be easily borne. However, if a good ventilating system

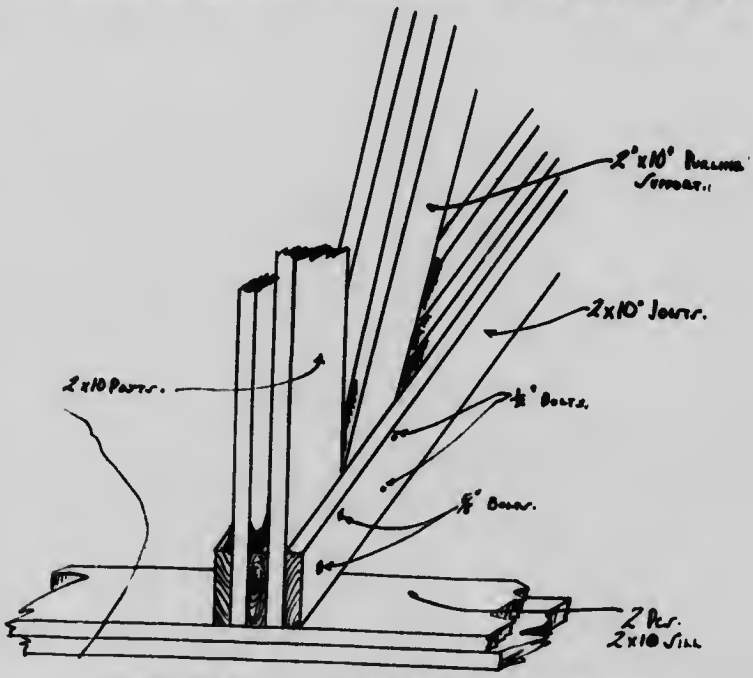


CROSS SECTION OF GOOD PLANK FRAME BARN.
Bents are 12 to 14 feet apart. End bents have no ridge brace, but have 2 in. x 8 in. girts spiked crossways every 4 feet

is installed the solid concrete wall, if well built and smooth, will give good satisfaction. Where wood building material is available, or can be bought cheaply, this kind of wall is also satisfactory, if the points are tight and windproof, and the frame of the barn is sufficiently strong to carry the maximum weight of barn and contents in all kinds of wind storms without twisting. Wooden walls are usually dry, particularly if there is an air space in the wall and plenty building paper is used. If the animals are pretty well crowded in a stable, ordinary walls, double-boarded, only on the outside of the studding, will keep in plenty of warmth except in our severest localities. The use of galvanized iron and steel for stable and barn walls is getting some attention now. For stable walls, steel or iron outer walls,

with an inside lining of wood, would no doubt be satisfactory, if cost was reasonable. For walls of mows and lofts, steel alone would be satisfactory. Steel shingles, on account of their long life, and fire-resisting powers, are being much used. Galvanized iron or steel roofs are not satisfactory for one-story stables, or where the stable air can escape into the upper barn, on account of the congealing of moisture in cold weather and dripping down when milder weather comes. All-steel barns are now being put on the market, and when prices of this material become normal these barns will find many users, as the prices of wooden building material keep advancing. The square timber frame of barns is giving place rapidly to plank frame construction, some details of which will be found on adjoining pages. Brick and stone are now out of the question, in economical barn construction, on account of the high cost of material and labor of erecting.

LAYOUT OF STABLES.—Where two rows of cows are to be placed the length of the stable, it becomes necessary to decide whether the cows shall face the windows

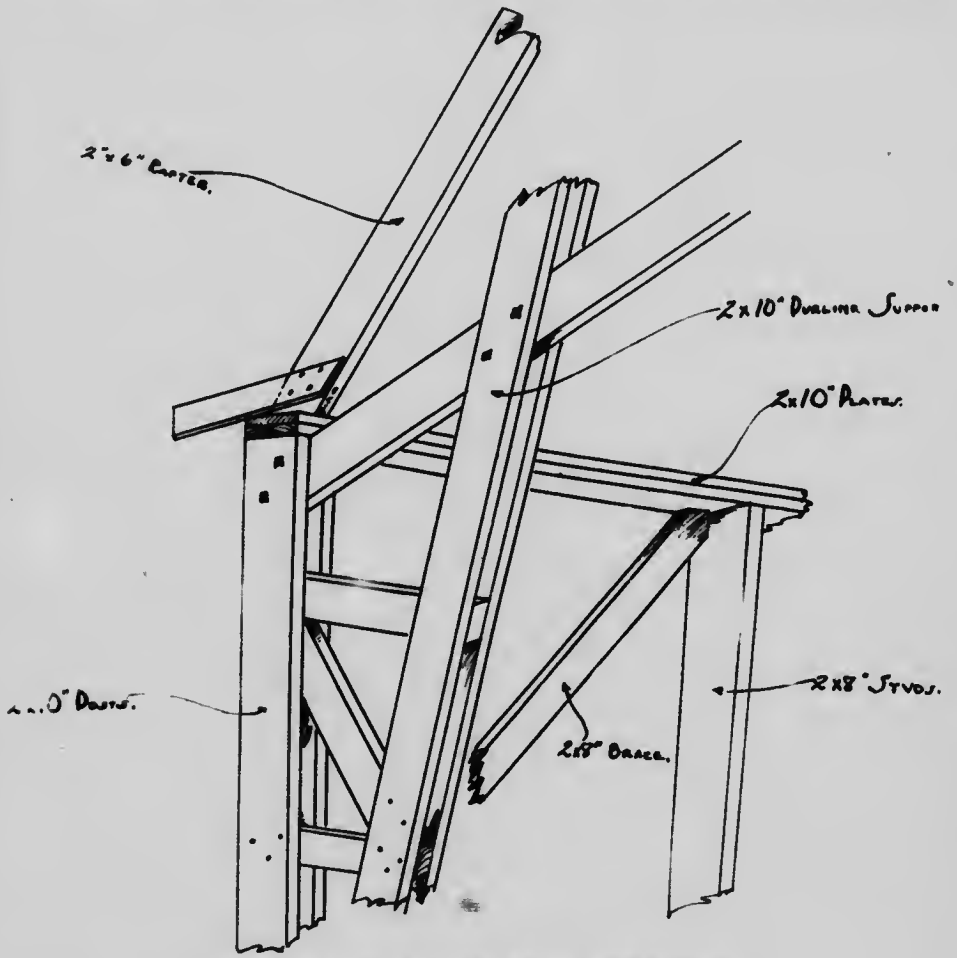


DETAIL OF SILL IN PLANK FRAME CONSTRUCTION.

or face the middle of the stable. Each method has advantages that the other does not possess, but experience and observation lead to the belief that the first method is to be preferred. True, having all cows face a common feeding passage permits of greater ease in feeding, but when we consider that the actual work of feeding in a herd does not occupy nearly as much time as the milking, cleaning stables and cows, bedding, and turning cows in and out, all of which are obviously much easier done from a common passage behind the cows, we are forced to admit that the balance of convenience is on the side of facing cattle outward. Moreover, where cows face inward, it becomes impossible to keep the walls from being splashed with manure as the cows pass along the walk, while trouble in tying up cows is often caused by cows getting in the wrong passage. The hay chutes from above are better placed along the wall than in the middle, where they would be in the way

of the horse-fork above. It is often possible to arrange a stable with the manure passage in the middle, so that a sleigh or wagon can be driven right through, taking up the manure from both gutters. This will be found an excellent arrangement to save handling of manure, as it may be drawn direct to the field.

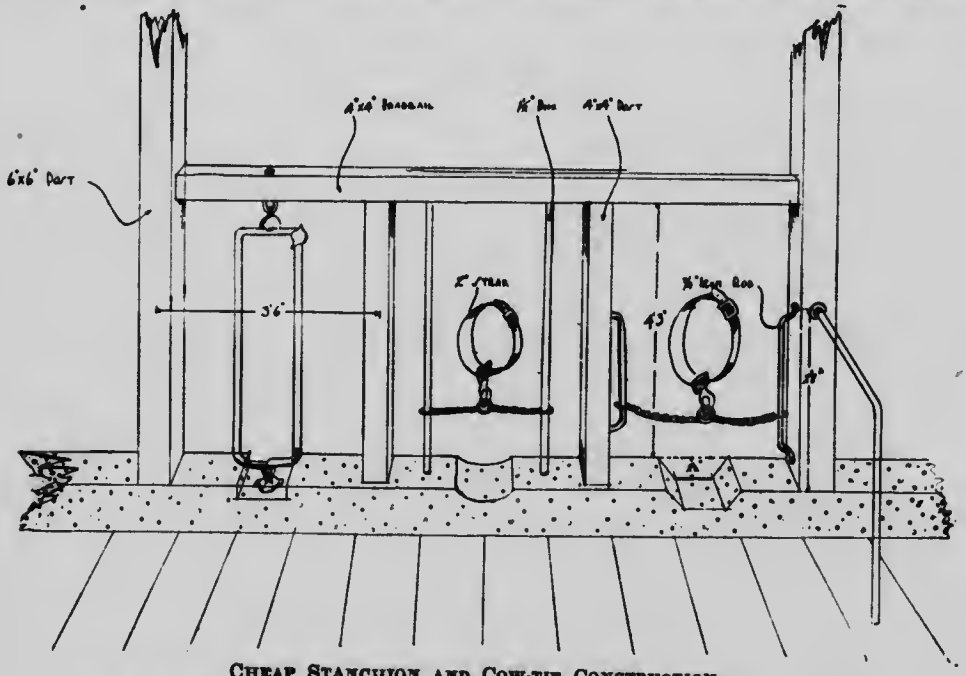
Where there is just one oblong barn, the silos should be placed at one end, preferably the north, so that they will not shut off any light from the side. The feed-room can then be placed at that end. If the barn floor is above the feed-room,



DETAIL AT PLATE IN PLANK FRAME CONSTRUCTION.

the driveway can be made into a good roothouse, and the grain, feed and chop will be in a handy place for handing down into the feed-room, through a chute from the granary above. Where the barn is "L" shaped, the feed-room and silo could occupy the same place, and the wing of the barn would run off from that end, making a good connection with the feed-room, silos and root-house. The feed-room need not be large, space to hold feed carts or barrows, a root pulper, a large meal bin, and a cupboard for tools and medicine, and, if necessary, a pile of mixed feed, such as silage and straw.

The equipment for tying, watering, and feeding cattle, should be the simplest possible, consistent with strength and safety. The swinging stanchion is, for all practical purposes, the handiest, cleanest, cheapest, and safest tie, giving also all the freedom necessary. The framework for holding the stanchion may be of wood or iron construction, either one being good, but the wood being much cheaper, 4 x 4 or 4 x 5 timber being strong enough for head rail and short posts between stanchions. With the swinging stanchion, stall partitions between cows are not necessary. In fact it is doubtful if the short partition usually extending two-thirds of the way to the gutter is of much actual use to the cow, either standing up or lying down, unless the tying is done with chains, in which case a stall partition is necessary as the cows have considerable freedom with their heads. However, if a partition is desired, a piece of inch and a half pipe, bent in a curved right angle, with



CHEAP STANCHION AND COW-TIE CONSTRUCTION.

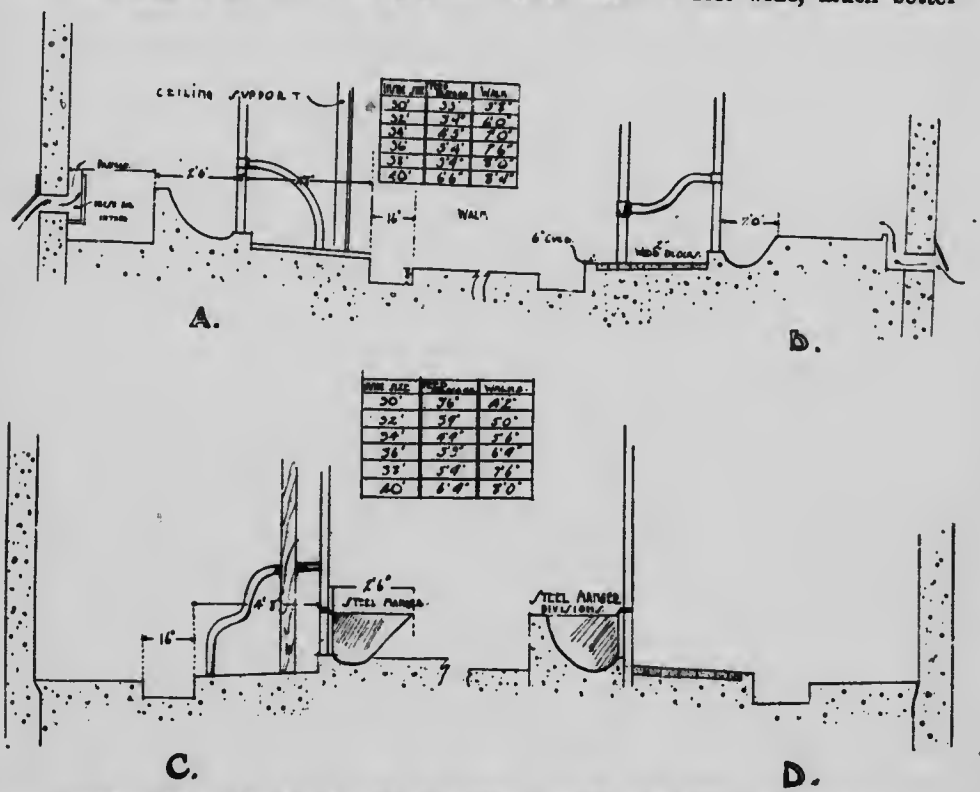
(a) With stanchion no stall partitions are necessary.
(b) With chain-tie partitions at least between each two cows are needed.

the lower end in the cement floor about sixteen inches ahead of the gutter, and the upper end attached to the posts between the stanchions three feet above the floor, is all that is necessary. Posts that support the barn above, should be placed in the stable in the line of the cattle stands, as they are a nuisance if they come in manure gutters or passage ways. The length of the cattle stand from manger to gutter will vary according to the size of the cattle. Five feet six inches will be long enough for the largest cow, while four feet six inches would be the minimum for small cows, like Jerseys, for instance. It may be found advisable to make this stand the maximum length at one end of the stable, and narrow it down to the minimum at the other end. This permits of grading the animals according to size, from one end to the other. Yearling heifers may be stood on a stand but a little over four feet long. Three feet and a half is about the correct width of stall to allow for each cow,

unless the animals are extra large. For the sake of adding apparent size to the cattle, the stand should be three or four inches higher than the walk behind. The stand should have a slope of one inch from manger to gutter.

The gutter may be of varying sizes and shapes, but a square-cornered gutter, about seven inches deep next to the cattle stand, and three or four inches deep next to the passage, and sixteen inches wide, will be found large enough and will cause no trouble to the cow in stepping over. The bottom should be flat, as an inclined bottom may cause a bad slip and damage to a valuable cow. On the adjoining page will be found different types of mangers and gutters.

The passage behind the cows should be at least 5½ feet wide, much better



GOOD TYPES OF STABLE FLOORS, MANGERS, GUTTERS AND FRESH AIR INLETS.

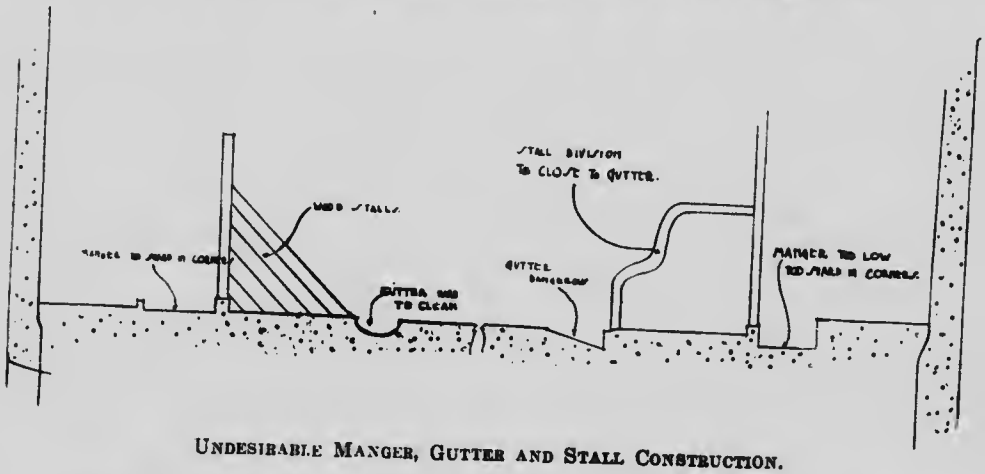
A. Measurements in centre are based on 4 ft. 8 in. length of cattle stands. Where necessary to build longer stands the extra length can be taken off width of walk and feed passages, preferably the latter.
B. For barns 32 ft. in width or less, manger and feed passage B is best, as there are no higher mangers to waste space.
C. Steel manger in C has no bottom.
D. A and D are the best styles of mangers to be used without divisions.

six to seven feet between gutters. If cows face inward, the walk should be at least four feet from wall to gutter. This passage may be only slightly crowned to drain off any water to gutters. It should never be finished with a smooth surface, as it is too slippery. While new, a sprinkling of sand should be kept on it when cows are being turned in or out.

Cement mangers are of so many different styles that a description of each kind is impossible, here. In general, they need to be at least two feet wide at the

top, and to have a sloping side next the feed passage, and the bottom corners rounded to facilitate easy cleaning. A good manger can be made by raising the feed passage a foot higher than the bottom of the manger, sloping off the passage two feet from the stanchion line. Manger partitions between cows are not an absolute necessity in ordinary herds. They are needed in stables where official testing is done, to keep cows from stealing the rations of their neighbours that are being better fed. Where partitions are considered necessary in mangers, the kinds of steel partitions that can be raised out of the way are to be preferred, thus providing a continuous manger that can be easily cleaned and used as a watering trough. The use of wood for mangers can hardly be advised now. The manger bottom may be a couple of inches higher than the cattle stand.

The curb between the cattle stand and the manger should also be of cement. Six inches above the manger bottom is a sufficient height, and four to five inches thick will give sufficient strength. The middle ten inches of curb in each stall must be dropped three inches, so that the bottom end of the stanchion will let the cow's neck down low enough to be comfortable when she is lying down.

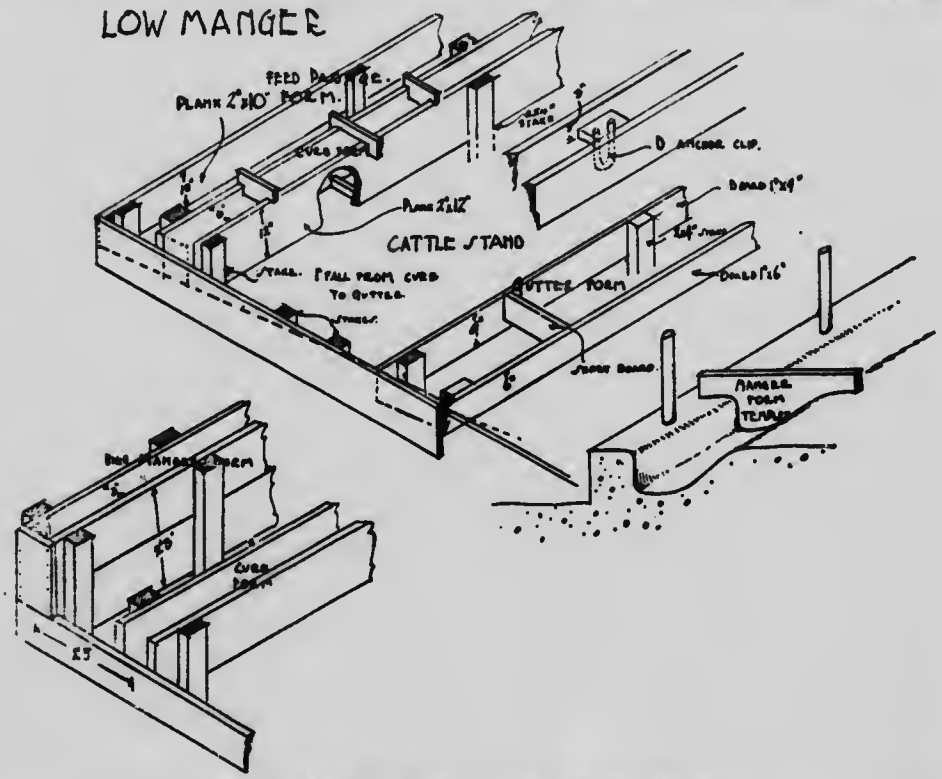


UNDESIRABLE MANGER, GUTTER AND STALL CONSTRUCTION.

The feed passages may be of varying widths, but from three to five feet will be found to work out alright. As the best method of carrying silage, roots, and meal is in barrows or carts, passages should be smooth and have no abrupt steps. Where it is necessary to raise or lower the levels, this should be done by gradual slopes in the floors.

Calf pens and box stalls should be placed in a building or wing separate from the cows, if possible. Where this is not practicable, they are better placed at one end of the rows of cows. They may be of varying sizes. A couple of box stalls should be at least 9 ft. x 9 ft., to use as calving pens, or for sick cows. A couple of small ones, say 6 ft. x 6 ft., or 6 ft. x 5 ft., can often be worked in to advantage, and do very well for very small calves. If the posts in the calf barn are wood, good cheap partitions can be made with strong hog fence, No. 9 wire, stretched tightly, with a wooden rail on top. If the front of the pen is made with wooden or steel calf-stanchions, with a cement manger outside in the passage, the best arrangement for feeding and economizing room is obtained. An extra large pen can occasionally be divided off with hurdles or movable partitions to make two or three smaller ones.

VENTILATION.—The question of ventilation is the one usually least considered when building and remodelling stables. This should not be so, when it is considered that the maintenance of good health in the herd depends more on ventilation than on any other single factor. There can be no doubt that the great prevalence of tuberculosis in Ontario cattle is due to housing animals in the close damp air of low, unventilated stables. Moreover, a good ventilation system costs little to install when buildings are being erected or remodelled. The chief requisite of a system of ventilation is a uniform supply of fresh air without draughts, and the steady drawing off of foul damp air, without lowering the heat of the stable too rapidly. Various systems have been invented and put into use in Ontario stables. Of these, that known as the Rutherford system, is possibly the only one that gives

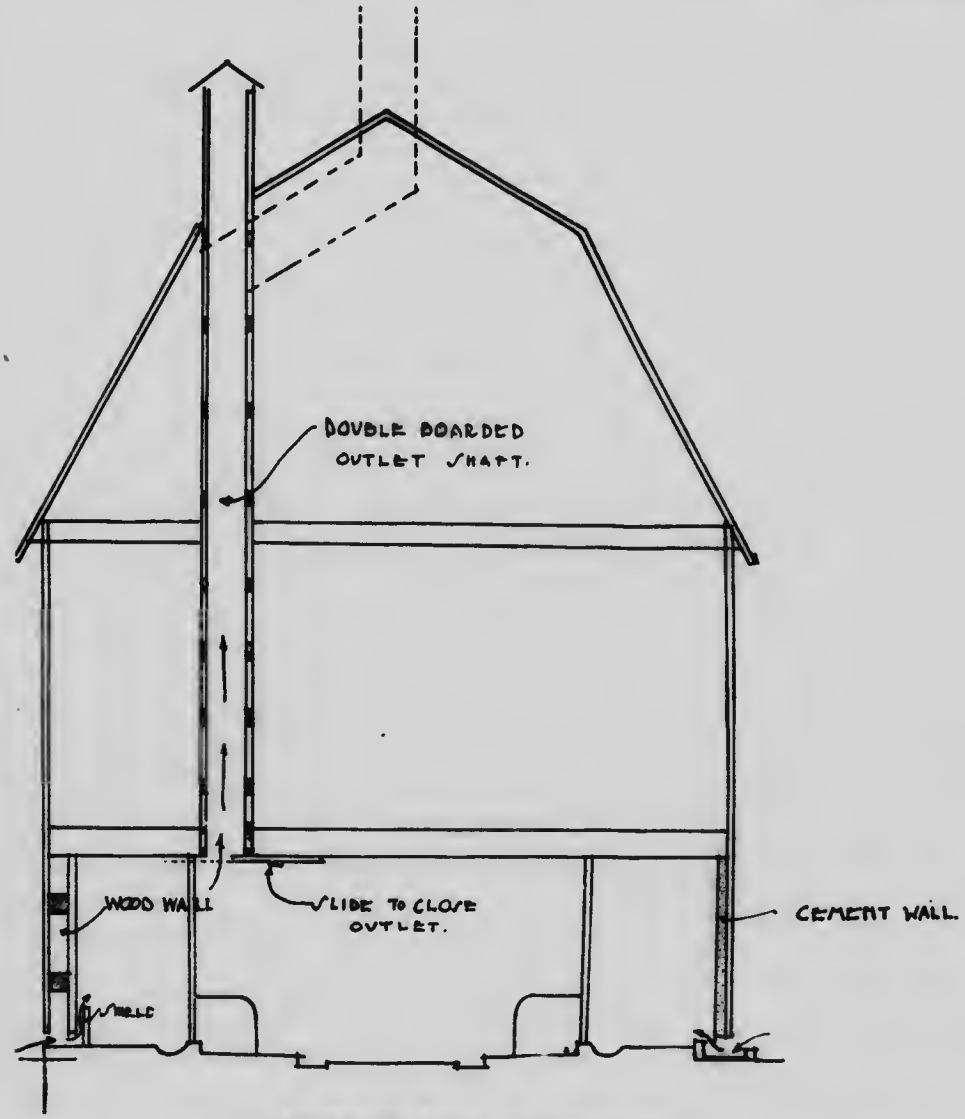


FORM CONSTRUCTION FOR LAYING CONCRETE FLOORS.

general satisfaction in our climate. This system operates on the same principle as a stove. Fresh air being admitted at the floor, heated and fouled by the animal, and raised to the ceiling where it passes out as foul air by ventilating shafts through the roof, carrying with it the moisture that accumulates on the ceilings, in our cold climate.

An accurate estimate has been made of the necessary size of inlets and outlets in this system. The minimum requirements are eight square inches of inlet space, and fifteen square inches of outlet space, for each animal in the stable. However, as no system of ventilation will work automatically in all sorts of weather, without causing draughts or undue lowering of stable temperature, it is advisable to provide about 25 per cent. to 30 per cent. more inlet and outlet space than the

above-mentioned requirements. This, of course, necessitates the use of dampers in the system, particularly the outlet system, to control the flow of air. In mild weather the system can be thrown wide open giving more than actual requirements



RUTHERFORD SYSTEM OF VENTILATION.

Inlets 7 in. x 12 in., outlets 15 in. x 15 in. With square pitch roofs outlet may follow inside of roof to ridge of barn (see dotted line).
Where there is no horse fork in barn, outlet may run up middle of barn through the ridge.

of flow of air, and in severe weather the outlets can be closed down below the minimum size if it is found necessary to conserve heat and avoid freezing in the stable.

The inlets should each be not less than 12 inches by 6 inches, in size of opening. For twenty head, therefore, there should be 20 x 10—200 square inches of

inlet, which would necessitate three inlets of the above size. These inlets should be placed about six inches above the floor line, being holes right through the wall with a wooden or tin shield on the inside to deflect the incoming fresh air upward, so it would not blow directly on the cows. Or, the inlets may come in through the foundation just below the wall, and open directly upward in the passage, covered by a grate or surrounded by a 4 inch curb to keep out dirt. The outside opening should also be protected by a sloping cover, to keep out rain and snow.

The outlets for foul air should each be at least 15 in. x 15 in. Smaller outlets cause too much friction to provide a smooth flow of air. For twenty head of cattle, as above, the best outlet space would be 20 x 20—400 square inches.

This would require two outlets, 15 inches square, or two circular ones each 16 inches in diameter. These flues should be smooth inside and tightly built for proper circulation, and should extend out through the highest part of the roof and be topped by a cupola to keep out rain and snow. If it is desired to bring them out part way down the side of the roof, the top of the cupola must extend higher than the ridge of the barn, in order that eddies of wind, formed by the roof, shall not interfere with the draft in the outlets. At the bottom of the ontlet shaft there should be a damper or trap-door that can be operated by a rope, or else a sliding trap-door that can partly or entirely close up the outlet if necessary in severe weather. The outlets should leave the stable above the backs of the cows, as near the heads as possible. The space necessary above for horse-fork room, in most barns, prevent the outlets being built in the middle of the barn.

This Rutherford system has the great advantage of being cheap of construction. More expensive systems have been advocated, such as the King system, which has proven a failure in this cold climate, principally because it draws ont the foul air from near the floor and makes no provision for drawing off at ceiling the moist air that causes dampness in our cold weather. In this connection it is well to mention that even the Rntherford system will not entirely carry off the excess moisture from ceilings that are not ceiled below the joists. The joists canse pockets that interfere with the free circulation of air. It is well to remember that no system of ventilation will work automatically. They all need control, and success will depend on the attention they get, particularly in cold weather.

LIGHT.—Light is one of the best disinfectants and germicides known to science, and, as it is absolutely free, stables should have as mnch as possible. Windows should be large, high, and as frequent in the walls as strength of building will allow. Six square feet of glass for each animal stabled is not too much, and if the stable is low, seven feet wonld give better results. The best construction of window is one that swings open from the top. This deflects the wind npward toward the ceiling, preventing serious draught on the cows. In districts where cold is very severe, double windows will be found very useful in keeping the stable warm, and preventing the heavy accumulation of frost on the inner windows. This accumulation shuts off light and makes interior of the window frames very sloppy at thawing time.

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