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Cow's Milk

For Infant Food.

By

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of

Mount Vernon, N. Y.



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BY

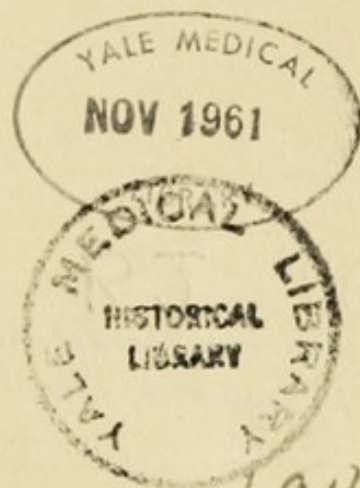
E. F. BRUSH, M.D.

*Read at a Meeting of the American Medical Association at
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COW'S MILK FOR INFANT FOOD.

By E. F. BRUSH, M.D.,

MOUNT VERNON, N. Y.

In India, several years ago, one of the Hindoo Kings, "in order to atone for his cruelties caused a colossal golden cow to be made, through the body of which he passed with profound reverence and made it the era from which all his edicts were dated."* This historical fact is significant. We have practiced all manner of cruelties with the luckless infant deprived of its mother's breast ; we have presented all manner of unfit substances to this small animal whose only language is a cry, whose only desire is food. In fact, whenever a commercial enterprise finds itself burdened with some waste product that cannot be put to other use, it has been deemed a good substitute for mother's milk, and straightway the market is stocked with another "Baby's Food," and physicians ready to recommend it and plenty of babies ready for martyrdom. Now, how can the physicians of the nineteenth century better atone for all their cruelties toward the human young than by causing a better cow to be reared, and from henceforth base all their edicts on the artificial feeding of infants on this better cow with a better milk product? I think that with few exceptions we are all agreed now that nothing excels good pure milk from good healthy cows for the artificial nourishment of infants, and if the great body of physicians put themselves about it

* India and the Hindoos. F. DeW. Ward, 1850, page 34.

with anything like the same energy they have displayed in supporting substitutes they can so reform the breeding of dairy cattle and the handling of their milk that the suffering of the human young will be ameliorated to a far greater degree than was ever hoped for by the astute chemist who started out years ago to make not only a substitute for cow's milk, but also for that of the human mother.* It is this idea of a substitute that has led us away from the more important consideration of improving what nature has already presented to us. Just look at the improvement in the commercial line that the middlemen have made in their milk transactions. These men have reduced the purchasing of milk to a nicety hardly surpassed by the purchasers of gold and diamonds; they have worked down the price of milk from the producer to the lowest possible point; they have dropped fluid measurement and adopted weight as being more accurate; in butter factories they have invented an oil test that will indicate in a very short space of time the exact amount of butter a given quantity of milk will yield, and on this test the price of the milk is regulated; likewise the cheese factories have established a standard of solids in milk which also regulates the price. But all the improvements these men have made do not help us notwithstanding the fact that our chemists, sanitarians, health authorities have followed in the wake of these men and endeavored to make us believe that the healthfulness of milk is dependent upon the total solids, fats, etc., that relate solely to its commercial value. A larger

*"Now, I have come to the most important matter of the lecture, and that is the consideration of the proposition at one time sincerely made of substituting some other food for human milk as being a better food for infants." Abstract of a lecture before the New York Academy of Sciences, by Prof. Albert R. Leeds, Ph.D., of the Stevens Institute of Technology, "Sanitarium," May 24, 1883, page 325.

percentage of fat that is easily removed from milk does not improve it for our purpose ; it matters very little to us whether a given quantity of milk contains 12 or 14 per cent. of solids.

In milk for infant feeding we should consider first the variety of fats, the manner in which they are emulsified and combined ; second, the amount of albumenoids and their condition ; third, the amount and variety of salts ; fourth, the health of the animals from which it is derived, and the food that has been consumed to produce the milk, and fifth, the changes which the milk has gone through before it reaches the infant's stomach. When we come to understand all these conditions we shall readily perceive just what kind of milk we want, and exactly the kind of cow which, with a given variety of food, will produce the very best substitute for the infant in lieu of its own maternal breast.

Let us then first consider the fats. Taking the human milk, which should always be our standard, we find these solids according to the best authoritative analysis occur in proportions of 2.11 to 6.89.* Now this makes an average of 4.131, for human milk. From several hundred analysis of cow's milk in different parts of France, England and America, the average of the chemist is 3.91. Thus you will see the difference, according to the chemist, between the two varieties of milk is very slight. I know, however, from the actual experience of practical dairymen that cow's milk contains more fat than is indicated by the above figures. The lowest amount of butter obtained from mixed milks is one pound of butter from 25 pounds of milk. This would make the fat percentage 4. In drawing this deduction

* Composition and Methods of Analysis of Human Milk by Prof. Albert R. Leeds. Transactions of the College of Physicians of Philadelphia. Third series, Vol. VIII, p. 246.

I am well aware that a pound of butter is not a pound of fat, but a pound of butter obtained from a given quantity of milk represents a pound of fat in that milk, because the quantity of fat in a pound of butter is exactly 84 per cent, and according to the latest experiments at agricultural stations only 84 per cent of the fat can be obtained from the milk by the process of butter making. Now this percentage of 4 is a low practical estimate of the quantity of fat, for among dairymen with special breeding and feeding they get as high as one pound of butter from 14 pounds of milk that is 7.13 per cent. This is a higher percentage than has been found by any chemist in human milk. This is a practical fact, not chemical inference. It is very easy to understand where the fault in chemistry has been. The fat in milk is dependent upon the food the animal receives more than are the albumenoids, and we all know that very many of the varieties of fat contained in cow's feed are volatile, and the chemical methods of using heat dissipate these varieties of fat; hence the low percentage obtained by chemists.

We must all admit that the fats contained in human milk, the product of an omnivorous, largely carnivorous animal, consuming fixed and more stable fats, differ from those contained in the milk of the cow, a herbivorous animal whose food holds more vegetable, volatile and unstable fats. Practically one is a yellow, unctuous, pleasantly odorous fat, as we see in butter, the other is colorless, waxy, decidedly different in odor, and therefore it can be easily understood that the chemist who is obliged to use heat will recover more fat from the human than the cows' milk. Thus we see that the fat is largely dependent on the nature of the food, and from the dairyman we learn that we can regulate the food of the cow so as to materially

affect the proportion of fat secreted. We know very little about the chemistry of fats; as far as I have been able to ascertain there has been but one analysis of cow butter fat made up to the year 1875. Wherever we turn the analysis of Bromeis confronts us, and later English analysts, while finding this analysis all wrong, are unable to give us a correct one. These later analysts,* without ascertaining the proportions, found in butter palmitin, palmitic acid, stearin, stearic acid, olein, oleic acid, butyrin, butyric acid, caproic acid, caprylic acid and capric acid. The fat of human milk has also been analyzed by Robin several years ago and also copiously quoted. I think that it is due to us from the chemists that we have some authoritative analysis of these milk fats, that we may know which if any of the fatty acids are the mischief makers in milk, for I have no doubt that the glycerides and fatty acids from the decomposition of milk have more to do with the development of poisons than the albuminoids have. The present popular method of analyzing milk by heat undoubtedly decomposes the fats, as is evidenced by the skin that forms on the surface of boiling or evaporating milk. This skin is undoubtedly the oxide of lipyl; it was at one time considered that it was coagulated albumen, but it does not form in vacuo, and will continually form on the surface of boiling or evaporating milk as often as you remove it, and resembles very much the skin which forms on old paint pots that have contained vegetable oil. Furthermore the condensation of milk for commercial purposes does not preserve the fats; hence condensed milks are more or less skimmed, the better varieties having only the more volatile fats removed, otherwise they would become rancid. I am coming more and more to consider that the

* Hahner and Angell. *Butter: Its Analysis and Adulterations*. London. 1877.

fats in milk are the bodies most likely to cause the digestive derangements of infancy, and when we know more of the composition and combinations of those bodies occurring in milk, many of the poisons, notably tyrotoxicon, will be less of a mystery than they are now.

Our second consideration will be directed to the albuminoids. Some time ago there arose a mild dispute between two chemists as to the amount of the albuminoids occurring in human milk ; Professor Meiggs asserting that there was only 1 per cent., while Professor Leeds makes the variation of from 0.85 to 4.86, an average of 1.195. Koenig, an earlier analyst, makes the variation from 0.57 to 4.25. Some of these results give as high a percentage of albuminoids in woman's milk as we find in cow's milk, and I have no doubt in my own mind that the time and habit of extracting the milk has a deal to do with the amount of occurring albuminoids. In other words, when milk is extracted every two hours or less, it cannot contain as much of the cell material as milk from the same source extracted at intervals of 12 hours. This latter is riper and it is the nonuniformity of the tissue which causes all the difference in the different occurring albuminoids. We know that during the incubation of eggs casein is developed from egg albumen. This illustrates the ripening of albumen. Furthermore, take an egg just laid by the hen and boil it, and you will find immature albumen in it, that is, after boiling, instead of being thick and firm, like an older egg, much of it is milky. If boiled a few hours later, all the albumen will coagulate perfectly, because it has had time to ripen. There is no doubt that the albuminoids in milk from healthy animals are all cell transformations, not an exudate, as are undoubtedly the fats and salts, because these latter we can influence by the food very plainly, but

in health the albuminoids are constant without regard to the food, while during menstruation, pregnancy and other conditions, notably febrile disturbances, we find the fats and salts not materially affected, but the albumenoids are decreased, increased, or totally changed, as we find in colostrum. The casein, besides being riper in cows' milk, by reason of its stronger growth, is intended by nature to coagulate into a hard mass, because it is the product of a cud-chewer for the nourishment of a cud-chewer, and the reason why it does not always coagulate in the infant's stomach as it does in that of the calf, is, that the latter animal's stomach secretes a principle called chymosin ; this is the principle that curdles cows' milk, and it operates either in an acid or an alkaline medium. Pepsin will not coagulate milk, and hence the hard coagulum of cows' milk that sometimes forms in the infant's stomach is due to acidity of that organ, and this acidity is not always the fault of the stomach, but of the milk itself. The variations in the chemistry of the albuminoids found in cows' milk would not be surprising to any one if he would examine into the condition of some of its mammary sources, for often it will be found on dissecting a cow's udder, which I always do when making an autopsy on a cow, that there are old cicatrices, one or more quarters of the udder intensely inflamed, sometimes a mammiiferous duct clogged with a calculus or a clot of fibrin, and besides these pathological conditions, the mammary gland is subject to benign and malign infiltrations, bacillary tubercular deposits and eruptive diseases of the skin involving the gland and ducts ; therefore, that fibrin, serum, albumen in various forms, are found in the cow's milk is not surprising, and it can safely be assumed that any variation in the albuminoids from the normal casein can be ascribed to sickness on the part of the animal.

We next come to the salts contained in milk, and it is remarkable how few analyses have been made to determine the salts or minerals that are contained in this fluid. Heidlin's analysis, copied everywhere, seems to be the only exhaustive one of the salines in cow's milk made during the present century. It seems to me in this case too that it is time for the chemist to teach us something more. There probably never was a time in our era at least when milk was attracting so much attention as now, and still all our chemists are content with the total solids, fats, albuminoids and sugar—just what the butter and cheese-makers want to know. From this much-quoted analysis of cow's milk salts we learn that milk contains in varying proportions the phosphates of lime, magnesia and iron, the chlorides of potassium, sodium and iron and free soda. Robin gets from human milk, in addition to the foregoing, carbonate of lime and soda, phosphate of soda and the sulphate of soda and potash. We have no means of knowing how constant is the occurrence of any of these salts in milk or under what conditions they are modified; we do know, however, from the experiments of Fehling, that many of the drugs administered to the milking female are excreted in the milk. Therefore we can safely assume that the saline constituents occurring in milk are influenced both by the health and food of the animal. That the phosphates are craved for by the milking cow is evidenced by their habit of chewing old bones and the like, and that there is a lack of this element of food is not to be wondered at when we see herds of milking cows pastured on old worn-out lands; the practical farmer knows that exhausted pasture lands need more than anything else for their rejuvenescence the phosphates, and we know that in our nutrition we need them also. The

land on which a cow is pastured will indicate pretty fairly what we may expect to find in her milk as salts. We have all noticed the excessive growth of sorrel on exhausted land, and can it then be a subject of wonder that some kind of a vegetable acid should be found in the milk of animals that are obliged to include this variety of food in their summer rations and sour ensilage or spoiled brewery grains in their winter feed. Theodore Hänel's discovery of citric acid in cow's milk to the amount of 0.9 and 1.1 grammes per litre is just what might be expected.

Sugar, I think, in milk has always been over-estimated as to its nutritive value, because we know that carnivorous animals do not secrete sugar to any appreciable extent, at least so the chemists tell us, and when we see a small slut nursing seven or eight puppies and keeping them all fat and in a thriving condition, we can easily imagine that sugar is not one of the necessary elements of food ; while on the other hand we know that the gross result of condensed milk feeding where the sugar is in excess is not good. In regard to using the commercial sugar of milk as an addition to cow's milk for infant feeding, I think it is a mistake, as there are undoubtedly all the other crystallizable milk salts with the milk sugar, and consequently we can know very imperfectly what we are feeding an infant with when we are giving milk sugar. If the milk from which the sugar was crystallized contained improper vegetable salts, those would undoubtedly become crystallized with the sugar, and many of the proper salts would have become changed to the lactates. Therefore I think if sugar is to be used at all, although I deem it of doubtful necessity, the pure cane sugar is undoubtedly the best because you know just what it is. When we consider the chemistry of milk as we find it in the books, what does

it all amount to? The chemist has given us to understand that the needs for bodily nourishment are a certain amount of the albumenoids carbohydrates, fats and salts. We can, therefore, from some of the cheap cereals make this ideal food, and for one cent have as much in nutritive value as we get in milk at a cost twenty or thirty times greater. Then, why do we give milk? Because we have tried the chemist's ideal food with the infants at least, and however admirable the theory may be, in practice it is a failure. Nature does not make so close an allowance that there is nothing to spare and no margin. She does not measure food by the rule of three always exactly in the same proportions. Let us examine the work of the chemists themselves, and we find in human milk a standard that we cannot ignore. The albumenoids varying from 0.85 to 4.86. Therefore, let us not deceive ourselves with the popular error of the day, namely; that milk must contain just such a proportion of solids, and solids not fat, and so forth, to a chemical nicety, but let us look into the cow-house and see what goes through the cow to produce the food for infants and what kind of an animal she herself is. Prof. L. B. Arnold, as good an authority as we have in this country on dairy matters, says: "Milk is the scavenger of the cow's body." What would be the sense of taking a sample of water from a sewer and asking a chemist to examine it for sewage, and so when we go into a dairy stable and see dirt and filth, disease and improper food, need we ask the chemist to ascertain the total solids, fats, etc., to find if the milk is fit for infant food? When this fluid will not properly nourish an infant it is not cow's milk, *per se*, that is at fault, but it is either a pathological condition of the cow or improper food or care or the conditions through which the milk has passed on its way from the

cow to the infant. It is safe to say that if we had directed the same attention to the cow, and if the same amount of money that has been spent on the various substitutes had been devoted to the improving of her condition, the infant at least would be better off.

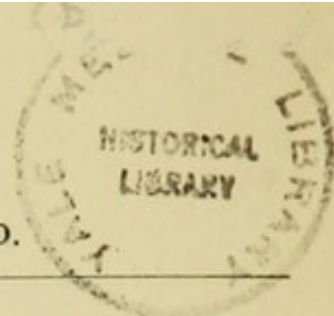
Now we can assert that cow's milk is the best food for the artificial feeding of infants, and when this fails the fault lies in one or other of the following conditions, or several of them combined. First, a faulty condition of the cow herself, and this will be indicated by the condition of the albuminoids ; second, improper food or an improper manner of feeding and caring for the animal, and this will be indicated by the fats and salts ; third, improper handling of the milk after it is taken from the cow, and this will be indicated by the ptomaines, and extractives. A proper understanding of these three sources of danger will make the feeding of infants a simpler matter than that offered by any of the substitutes, and be at the same time a more rational method. We shall consider the conditions of the animal that render her milk unfit for food. The cow is an unique beast, differing in many respects from any of our other domestic animals. One of her peculiarities that has caused a great deal of confusion among veterinary writers, is her normal temperature. Several years ago I searched diligently in books devoted to bovine pathology to find the normal bodily heat of the cow, and the confusion was puzzling. It is variously stated at from 98 to 101 F. I myself made several hundred thermometrical examinations under varying conditions, and found that the temperature is not constant in apparent health, as it is within very narrow limits in the human subject. Of course we cannot tell to a certainty how near to health a dumb creature is. The standard we have to adopt with these animals is that they

are in health when they perform their functions with profit to their owners. Certainly there are many slight ailments that do not carry the animal beyond this limit. Therefore the varying temperature in the cow may be due to slight ailments that do not demand the attention of the veterinarian. The average temperature of the cow in apparent health I have found to be $102\frac{1}{2}$ F, ranging from $101\frac{1}{2}$ to 103. This you will perceive is a peculiarity of the cow, and none of the other large domesticated animals maintain so high a bodily temperature. Another peculiarity of the cow is the constant employment of her generative functions. She is always milking or pregnant, and both the uterus and the mammary glands are employed almost constantly at the same time. Hence her nervous functions are exaggerated. Therefore with an abnormally high temperature, for I have found that bulls and steers have not so high a temperature as the milking cow, and with an unnatural functional activity of the organs of generation, she is used also as a machine to transform food into milk, and it is astonishing to what capacity she has been trained in this direction. With four stomachs, the first alone with a capacity of sixty gallons, she simply eats, and she will eat anything; in health she is always either eating or chewing her cud, and her pedigree sometimes shows the closest consanguinity in her breeding. Now when we consider all these unusual conditions is it at all to be wondered at that the ordinary dairy cow is as a rule an unhealthy animal, more prone to bacillary phthisis and scrofulous affections than other animals? Her nervous system is more subject to severe shocks, and in fact she is a delicate creature, her attendants are not usually either mild or cleanly, nor is her housing always the best.

Our next consideration is the feeding and care of this nervous and delicate animal. The ordinary dairyman

receives for his milk $1\frac{1}{2}$ to $2\frac{1}{2}$ cents per quart. At this low price received by the producer he cannot usually give his cattle the best food. I noticed in a dairy journal this summer, an estimate from the N. Y. Dairy Commissioner. Taking the milk received at the creameries as a basis, the average income from each cow is about \$20.00 a year to the producer. This is almost seven cents a day, from which the dairyman has to buy food and pay for labor. This sum alone would not begin to pay for proper food for the animal, hence the farmer is driven to every known expedient to keep his cows in milk, and the profits being so small, if there is any profit at all, he must utilize every drop of milk, whether the animal giving it be sick or well. In this state of affairs is it not natural that all the cheap foods, such as brewery grains, distillery slops, the refuse from starch factories enter so largely into the food from which our babies' supply of milk is produced. Of course this condition of low price and improper feeding does not apply to every dairy, but after years of experience I have no hesitation in saying that it applies to the great majority of dairy farms, surrounding New York city at least. I have personally inspected small dairies where the sole article of diet was swill gathered in the city. Good food is to the cows of course the prime absolute essential for the production of good milk, and unless the public are willing to pay more for their milk than they do at present a reform in this direction cannot be expected.

The handling of milk after it leaves the cow is the next important consideration. Owing to the cow's natural high temperature, 102 to 103 F., the milk when drawn must cool rapidly, and this first cooling taking place in a cow-house, the milk is of course more or less affected by the conditions generating odors. If these odors are not very bad they



can be removed more or less perfectly from the milk by a process of aeration. This can be accomplished readily by pouring the milk from one vessel to another in a thin stream in the presence of a pure atmosphere, or on a larger scale by pumping pure air into it by a suitable machine. One of the most dangerous methods that I know of for killing the odors that milk absorbs from dirty stables or improper food is that recommended by many practical and otherwise sensible men, namely, the addition of nitrate of potash, that is, common saltpetre. It is very easy from this addition of nitre, combined with the glycerides and sulphates already contained in milk that is decomposing to figure out chemically bodies approximating to nitro-glycerine. It is suggestively strange that the toxic effects of nitro-glycerine are similar to those of tyrotoxin. The often-reported detonation of this latter extractive while undergoing examination in the laboratory is also suggestive of the properties of nitro-glycerine. The addition of chloride of lime which is also recommended for the same purpose, although apparently a less dangerous chemical compound, should nevertheless be prohibited. Soda is also added to milk sometimes to delay the souring process. The prohibition of this chemical may be viewed in the light of a stultification when we consider the large amount of bicarbonate of soda that is used at the present day in one of the popular methods of feeding infants. I think it is no less reprehensible on the part of the physician than it is on the part of the dairyman. No chemical substance whatever should be added to cow's milk by the dairyman. Milk that is procurable too far away to reach the child within a few hours, should not be used for infant feeding. The different degrees of temperature through which it must pass in its transit by country wagon, railroad train, and city express are productive of

changes that cannot but deteriorate the quality of the milk. It is well known that light as well as heat is one of the elements that hasten decomposition in milk, hence the now popular method of serving milk in clear glass bottles is also a popular error. No milk should be served by the milkman for infant feeding after it is twelve hours old, nor should it be served to the infant while it is warm, immediately after leaving the cow, for I have found by actual experiment that cow's milk while still retaining the animal heat if taken into the stomach, would coagulate into a solid mass, but this coagulation was not so hard and rubbery as the curd we see sometimes formed when milk is too old. In regard to sterilized milk, I am of the opinion that it is far better for us to make an effort to improve the quality of milk to such an extent that it will be needless to sterilize it, because of course sterilized milk must take its place with condensed milk and other varieties of preserved food. If we cannot improve our milk then of course sterilization ought always to be practiced, notwithstanding that it is a preserved food like condensed milk it is not necessarily skimmed or sweetened as the latter is.

Having thus outlined the condition of the milk we get and the reasons why it is not always good, let me in the next place suggest remedies for the existing evils. First, in regard to the cow herself. No cow that is bred for a butter-maker should ever be used to furnish milk for infant feeding. The ideal butter-cow is too closely inbred, and consequently too nervous; there is too much free fat in her milk. The ideal cow to furnish milk for our purpose should not be too finely bred and with little if any consanguinity in her breeding. She should not have had her first calf till she was in her third year; her milk should not be used after she is six years old unless she has

been spayed ; she should be of a quiet disposition ; her surroundings clean and quiet ; she should be stall-fed always while giving milk for infants ; her food should be hay without weeds, ground oats, bran, flaxseed meal, roots (beets and carrots), bone-meal and salt, in the winter corn-meal in addition and in summer in lieu of dry hay, green cut clover or grasses free of weeds. She should be curried daily and well bedded, and in the winter the water she drinks should be slightly warmed. The milk should be aerated and cooled as quickly as possible. It should then be put into opaque bottles and securely closed.

Now, why do we not have this kind of cow and obtain this quality of milk from our milk-man ? The very first and prime reason is that milk is sold altogether too cheap. The producer, as I have before mentioned, gets about two cents a quart. The railroad or the carrier gets one cent a quart for all handled, and the distributor gets five cents a quart for peddling to the customers. Therefore, the consumer pays eight cents. This variety of milk does not usually agree with the child, and therefore the consumer is advised to buy some of the Baby Foods as an addition to the milk, and this increases the price of the food to something like fifteen to twenty cents a quart. Now, if the producer got this extra amount of money he could buy better food and better cows, exclude the milk of sick animals, and altogether improve the quality of his produce. But would he do it ? That is the question. Still it would be more humane to make him do it when he is making a living than under circumstances as they exist now. So the question of a purer supply rests very largely with the medical adviser. Instead of recommending commercial Baby Foods in addition to doubtful milk, he should advise the parents to purchase milk at twelve or fifteen cents a quart, and when the infant gets

sick from digestive troubles, then lay the blame where it is justly due, to the milk-man, and he will lose his customer. The supply of baby milk in cities should be kept entirely distinct, and should be procured from those farms that are situated near enough to the customer to get the morning's milk of the day of delivery. The dairies supplying this variety of milk should be under strict sanitary surveillance, for no matter how good a condition a cow may be in if she is in heat, has sustained an injury or is sick in any manner whatever, her milk should not be used for infant feeding until she has completely recovered. The ideal dairy for supplying infant food should be composed entirely of spayed cows, and thus one constant source of nervous functional disturbance would be eliminated. In my own herd I have several spayed cows whose milk I supply for infant feeding. These animals are much more quiet in disposition, they give a more constant and uniform supply of milk, and seem to enjoy a more even degree of health than the cow who is occasionally bulling and becoming pregnant when giving milk.



