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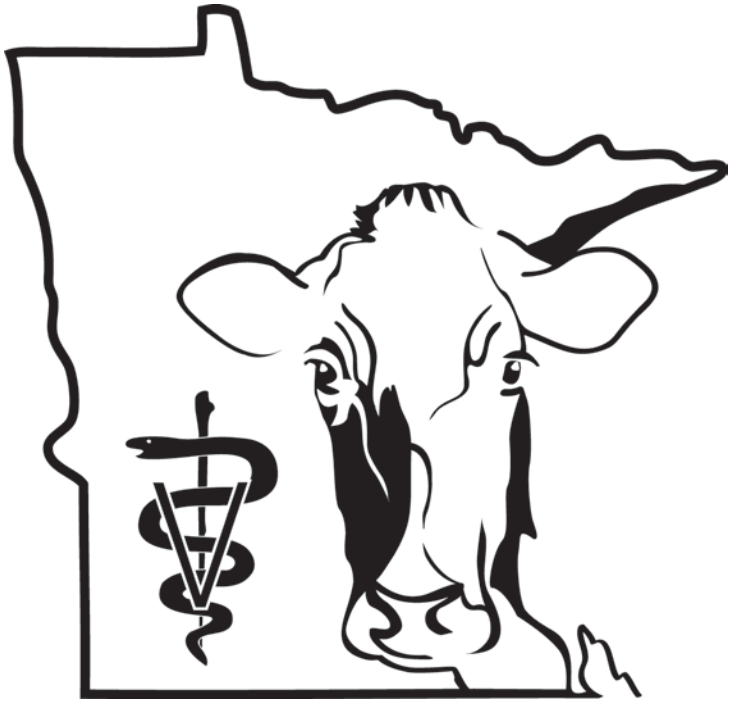

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MANAGEMENT OF THE HIGH YIELDING DAIRY COW

Jack L. Albright
Department of Animal Sciences
Purdue University
West Lafayette, Indiana

INTRODUCTION

Scientific animal management is founded on two principles (35):

1) The strongest impulse in nature is *survival*
2) The second strongest is *reproduction*

When things go wrong, one or both of the above fail. Management has been further defined as:

1) Doing many things well, and
2) Leaving the job better than you found it

FEEDING MANAGEMENT

For some dairy farmers, practitioners, consultants, and students, interested in high yielding cows, this is all very nice so the following may suit them better: "Management is down the throat." It has been said that we are what we eat and the same is true with the cow. Therefore, this paper will deal first with feeding management. For further information on this subject the reader is referred to a previous scientific paper on Feeding Behavior of Dairy Cattle (7).

The primary concern of all animals is the gathering of food (1). All animals evolve as products of their dietary needs: the cow's stomach and the suckling instinct in young mammals are all diet-oriented. An animal is not only what it eats, but it also is designed so that it can eat (14). Dairy cattle responses to various types of feeds and feeding arrangements differ. Dairy farmers can use knowledge of animal behavior to improve cow well-being and yield (6). For instance, feeding and watering systems must be placed where young or inexperienced animals can find them. Feed accessibility may be more important than the actual amount of nutrients provided. Efforts must be made to reduce the competition for feed, water, minerals and shelter. Also, cow space, cow density, and distribution of feed are closely related factors. Feed intake and consequent milk yield are improved by provision of feed when cows need and want to eat (29). When one cow eats, another might be stimulated to do likewise whether she is hungry or not. This behavior is an example of social facilitation (16). When cows eat in groups, they eat more than when they are fed separately. Furthermore, cows kept in groups "are likely to be less fearful, and hence, more contented, healthier, and more productive. The common practice of feeding and milking cows in groups thus has a sound psychological basis" (30).

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1 Presented at the Minnesota Dairy Health Conference, Earle Brown Center, University of Minnesota, St. Paul Campus, May 23, 1996.

Dairy cattle are social animals that operate within a herd structure and follow a leader (leadership-followership) to and from pasture, the feedbunk and milking parlor. Such behavior can be beneficial (e.g., following a leader onto a scale) or detrimental (e.g., a stampede) (11). Behavior becomes a balance of interacting driving forces: for newly mixed cows, aggression is dominant, but it soon diminishes as the social order becomes established and the feeding drive becomes dominant (17). Cows exhibit wide differences in temperament, and their behavior is determined by inheritance, prior experience and training (15). Cows normally are quiet and thrive on consistency and gentle treatment by handlers (15). If you hear or see a cow bellering, what is she telling you? Handling procedures are more stressful for isolated cows; therefore, attempts should be made to have several cows together during medical treatment, during artificial insemination, or during movement from one group to another (9, 34).

Competition for feed, water and space can be reduced by fence line feeding of TMR, which allows all cows to eat at once. Holstein cows that were fence line fed a TMR or corn silage and concentrates ate 26% longer following feeding than the same size group eating from bunks around which they traveled (2). Many dairies practice fence line feeding during which cows' heads are in the natural grazing position. Cows eating with their heads in the downward position produce 17% more saliva, which directly affects rumen function, than cows eating with heads held horizontally (23, 24). When fed in shallow elevated bunks, 10% of cows exhibited year-round rooting, sorting, feed tossing behavior, and feed wastage (0 to 5%). Groups fed at ground level or in headlocks showed little or no feed tossing behavior. This apparent livestock engineering problem is remedied easily by feeding cows in the natural head down position (4). Concrete mangers renovated with epoxy-type finishes, wood or tile aid feed consumption (5). Palatability has a major influence on feed intake in ruminants, and the sense of taste is highly developed in cattle (8). Detailed observations, using intact and ruminally cannulated cows, suggest a behavioral need for the cow to rest and to ruminate on her left side (7).

COMPETITIVE EATING SITUATION

Competition for feed may develop when cows are kept in groups and when manger space is insufficient to allow all cows to feed at once. The critical length of manger space below which competition occurs depends on the time that feed is in the manger. Also, the presence of manger divisions may affect eating behavior of submissive cows, enabling them to eat longer (13). Friend et al. (18) examined the time that cows spent at the manger and their voluntary intakes when each cow was allowed .5, .4, .3, .2, or .1m (20, 16, 12, 8 or 4 in) of manger space; a TMR including 25% ground hay was available for 21 h/d. Only when the length of manger was below .2m (8 in) were eating time and intake reduced. In another trial comparing mangers of .5 and .25m (20 and 10 in) per cow, time spent by the cows in using the mangers and feed intakes were similar (19).

Collis (1978, personal communication) conducted a similar study for 60 British Friesian cows comparing 1.1, .5, .3, .25, .2, .18, or .15m (43, 20, 12, 10, 8 or 6 in) of manger space. At the end of each week, before the reduction in manger space, this group of cows was observed continuously for 24 h. Reduction in manger space had no effect on the mean number of visits. The average total feeding times decreased during the 6 week trial, but not significantly. No

significant differences occurred between the treatment and control groups for percentages of cows observed standing, lying, or feeding. The average milk yields of both groups decreased, but differences between them were not significant. How this short-term experiment with smaller numbers fits actual current herd conditions is not known. A gradual reduction in manger space for an established group of cows may be accepted more than adaptation of a new group to limited manger space.

In a Michigan herd of approximately 600 cows over 200 d, milk yield, conception, animal health, behavior and labor input at 61 versus 46 cm (24 vs. 18 in) of bunk space were checked, and there were no differences (5, 32). High building investments suggest that the most efficient use should be made of dairy facilities. Therefore, 46 cm (18 in) of bunk should be provided instead of 61 cm (24 in) of space per cow for heavy corn silage diets or complete feeds. With cows averaging 36 kg (80 lb) /d, no difference in milk yield was found, but Bill Bickert, an agricultural livestock engineer, asks the question: "What is the effect if cows are averaging 45 or 57 kg (100 or 125 lb) /d of milk or more per day?" (12).

A field study was initiated to look at feeding behavior and bunk use patterns in two high producing herds in New York (25). One group from each herd was selected with the highest milk production per cow and the highest DMI. One would expect this group to exert the most pressure on the feed bunk.

TABLE 1. Characteristics of study herds.

	Herd 1	Herd 2
Total Cows	270	370
RHA (Rolling Herd Average)	23,349	23,400
Milking Frequency	3X	3X
Type of Housing	6 row drive-thru	6 row drive-thru
Feeding Program	TMR	TMR
Feeding Frequency	2X	3X
Cows in Study Group	90	88
Stalls in Study Group	96	75
Linear cm Bunk Space/Cow	37 (1.22 ft)	40 (1.33 ft)
Average Production/Cow	41.4 kg (91 lb)	40 kg (88 lb)
Average Daily DMI	23.6 kg (52 lb)	24.5 kg (54 lb)

A video camera was mounted above and slightly behind the feeding area to give the best view of activity at the feed bunk. Each herd was videotaped for a 24 h period during August 1993. Temperatures were normal for August with highs of around 27° C and lows near 16° C.

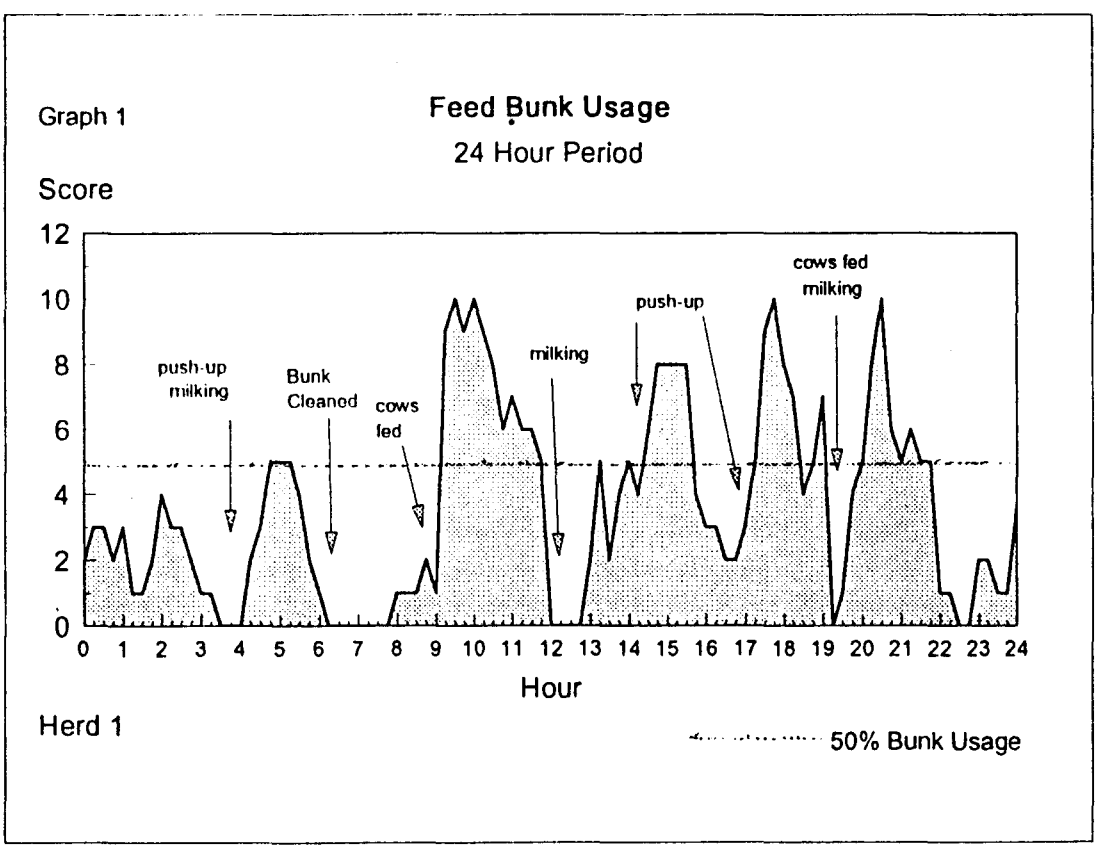
The video was reviewed, and stopped at 15 minute intervals, based on the on-screen video clock. The density of animals at the feed bunk was judged, and a score recorded for each 15 minute period. This provided 96 data points of feed bunk activity for one hour period. The scoring was based on a 0-10 system. Zero would indicate that no animals were at the feed bunk whereas a 10 score would indicate that the bunk space was completely occupied with no room for additional

animals to eat. These scores were then plotted against time to develop graphs of feed bunk usage (See Graphs 1 and 2).

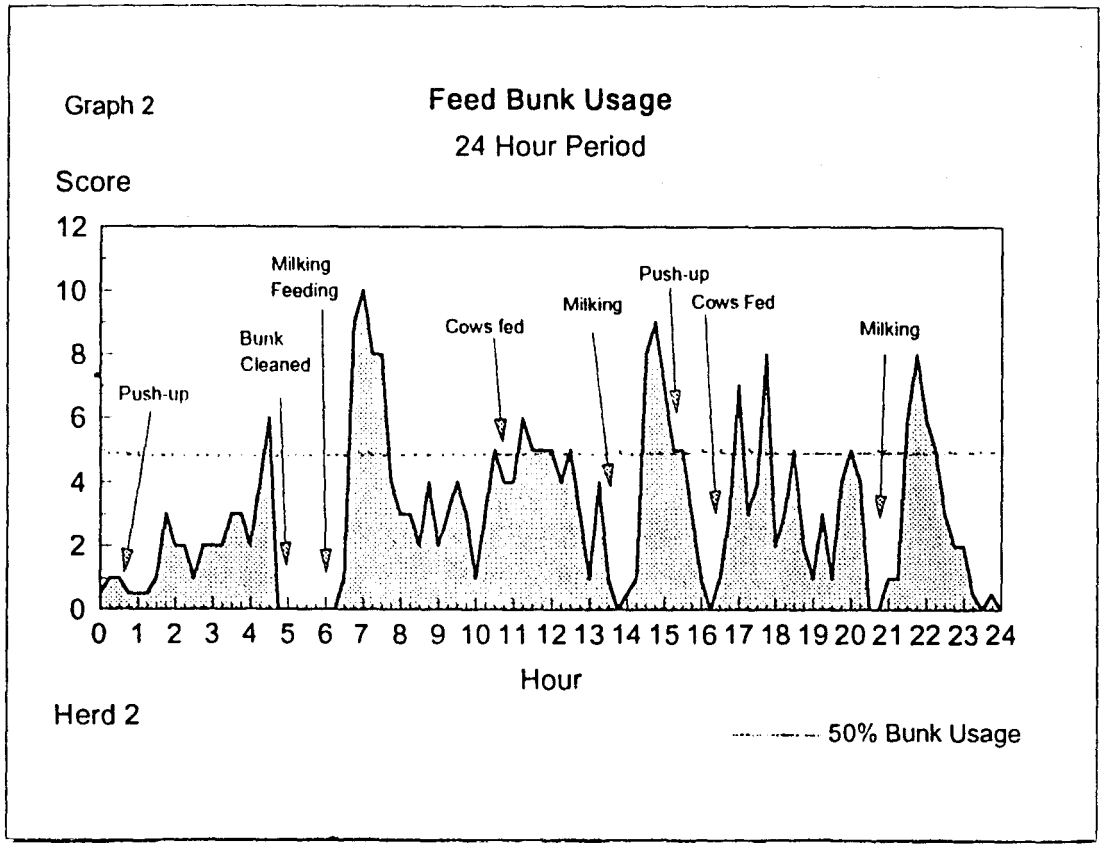
Observations of other barn activities were also noted. These activities included milking, feeding, feed push-up, bunk cleaning, etc. The time, and type of activity was then superimposed on the graph of feed bunk activity.

Several questions were of major concern in doing this study. Did feed bunk space affect feed bunk pressure? How often was feed bunk space not available for additional cows to eat? How did cows utilize feed space throughout a 24 hour period? How did other practices and activities effect feed bunk usage?

Although there are a number of differences between the graphs of Herd 1 and Herd 2, it appears that feed bunk space is limiting for only brief periods throughout the day. Herd 1 (Graph 1) shows four periods when the bunk was fully occupied. These periods were brief, lasting 15 minutes, plus or minus.



Herd 2 (Graph 2) shows only one brief point of restricted bunk space and two other points of nearly full utilization. It does not appear that the bunk space of 37 and 40 cm per cow in herds 1 and 2 respectively, causes a restriction in possible feed intake. In both herds, peak feed bunk usage is followed, in most cases, by a rapid decline in feed bunk usage which would indicate the absence of slug feeding behavior, particularly in Herd 2.



Additional video studies of high producing herds are needed to further define the effect of feeding management, bunk space and barn design on animal behavior (25).

STRESS

Stress has been defined in a variety of ways. Hans Selye, Nobel Prize winner from Canada for his classical work on stress, calls it the non-specific response of the body to any demand made upon it (31). Stress = Situations that Release Emergency Signals for Survival. Stressors are events outside the animal which stress it and the final effect on the animal is distress. Distress is a term used to describe the damaging or unpleasant aspects of stress, some of the latter being needed each day to keep animals alert, alive and attuned to their environment and its dangers.

There are many ways proposed to measure stress in high yielding animals such as thyroid hormones, corticoids, cathecholamine levels, blood glucose, immune function, acute phase

proteins, changes in heart or respiration rate and somatic cells in milk (22). Behavioral signs of stress include "displacement activities" where for example animals in the middle of a fight may stop to graze (21, 24) or stereotypic responses such as the pacing or circular walking of confined zoo animals round their cage (27).

Farm animals can usually tolerate the effect of a single stressor over a short period without undue effect on production. If the animal has to cope with a number of stressors at the same time, health and performance are affected and sickness leading to death may result. Trouble often arises as some of the disease stressors may be sub-clinical and not seen (e.g. mastitis or internal parasites) (22).

DESIGN OF FACILITIES

The design of handling facilities is vital to successful animal handling where the work must be done with minimal stress or injury to both humans and animals. Facilities are often inadequate because they have been designed from a human point of view and the animal's viewpoint has been ignored. For example, cows prefer to be able to see while drinking water to avoid being butted, and more can drink at once from long, narrow troughs than from round troughs. Round troughs are more efficient when placed against fences rather than in the center of pastures (paddocks) but still provide water for several cows when split by the fence between two fields. Under dry conditions several small troughs in the same field would provide better watering for large herds at little extra cost. On pasture it is important to have adequate water (space and flow) to allow the herd to drink as a group activity after they finish grazing as a group especially in drought periods, otherwise production can be affected (22). Similar comments can be made for shade as in the hot summer months with elevated temperature and humidity, cows become "solar collectors." Shade and cow coolers with fans (misters) to enhance evaporative cooling are being used in Arizona where year-round production with over 2,300 cows in the top herd is at 28,000 pounds of milk per cow as well as in Saudi Arabia where milk production is now in the 24 to 25,000 pound range (8, 10).

Farmers or consultants need to check on animal handling and facilities by noting on a balance sheet both positive and negative factors at work. A milking parlor is a good example where such items as sharp turns, slick floors, doors (instead of a common holding pen-parlor), stray voltage, electrified crowding gates, electric prods, fluctuating vacuum, worn out teat cup liners and the number of stocks to beat the cows with, etc., can be noted. Beating animals may be good therapy for an angry farmer, but it does little to accomplish what is required of the animals (22). Most tests of will between the animal and the farmer are won by the animal.

During her world milk yield record, U.S. Holstein, Beecher Arlinda Ellen, ate hay at floor level (3). Evidence exists (23, 24) that cows eating with their heads in the downward position produce considerably more saliva than cows eating with their heads held horizontally, which directly influence the efficiency of ruminal functions. A 24-h behavioral watch (3) has been summarized in Table 2.

TABLE 2. Behavioral profile (24-h) of cow yielding world milk record.

Eating time1	6 h 15 min
Resting (lying)2	13 h 55 min
Other3	3 h 50 min
Chew per min. no.	60
Chews between swallows, no	82

1 In a 24-h period in late lactation, Beecher Arlinda Ellen consumed different feeds: hay, 13 times; grain, 12 times; straw, 2 times; water, 7 times, and mineralized salt, 5 times.

2 Eyes closed for 30 min, broken into about four periods of 5 to 10 min. each. Cow spent 7 h 30 min ruminating (5 h 5 min on her left side and 1 h 50 min on her right side). Of the 14 h lying, 8 h were spent lying on her right side and 6 h on her left side.

3 Ruminating while standing, 30 min; defecating 12 times and urinating 7 times; milked twice daily in a milking parlor; grooming; interaction with other cows, calves, cats, humans; and idling.

The world record milk producing cow for 17 years, Beecher Arlinda Ellen, has died and had her record broken five times since 1992. Currently, there are two Colorado cows in high producing herds with over 60,000 pounds of milk in a one year lactation period.

The environment of dairy cattle should be clean, dry and comfortable (20). Ellen and these other great cows were given the very best of care, feeding and management. Great effort was made to provide maximum comfort. Some recent research work indicates blood flow to the udder increases substantially (28 percent increase) when a cow is lying down compared to standing. Changes in blood flow with posture may be indicative of a repartitioning of flow within the body and to the mammary gland and thus yield, since blood flow is related to the level of milk production (20, 26).

Many believe that milk is being made only when the cows are eating. The above fact of more blood flow to the udder when the cow is lying down should give them some pause to reflect. Since cows are crepuscular meaning they are more active near sunrise and sunset, so that is when the major feeding or grazing cycles take place. (Cattle have a distinct diurnal grazing pattern, which includes a major meal beginning approximately at sunrise. By mid-morning they are full and seeking the shade and down time for ruminating.) Providing they are comfortable, there is plenty of time during the day and night for cows to rest, check their cuds and ruminate (7).

Also, sand or cow mattresses (with rubber pellets) are now recommended (33). At Purdue University last June there were 30 or 40 cows in a tie stall barn with hock lesions. Following installation of rubber-filled mattresses last summer, the number of hock problems had fallen to 7 abnormal hocks by December 1st. Another management rule has fallen by the wayside, namely having 100 cows in a group (3). In the South West, group size has risen to 260 cows in a group within large herds. With good and timely management, well-designed milking parlors, corral space of 500+ square feet per cow, fence line feeding with adequate manger space and headlocks for each cow, there does not appear to be any problem with 260 cows in a group (8). Currently, in several Western states and Saudi Arabia, plans are being made to have 400 cows in a group (8, 10). Is that too many? I don't know, but future research should be done to find out.

GRAZING-BACK TO THE FUTURE?

When I was in New Zealand studying large dairy herd management and animal behavior some 25 years ago, with rotational grazing I observed 300 Jersey cows per acre. Is that too many? I'm not sure, but it was being done with lush pastures (New Zealand clover and grass), temperate climate (no shade) and volcanic ash soil (no need to take cows off pasture during heavy rains). Like most people returning from New Zealand I wondered when the "GP's" (Grazing Pioneers, Grazing Practitioners) would make grazing work in the Lake Central States. These states have variable soil types (clay to sandy loam), hot weather (need for shade) and drought conditions to mention a few differences. It is exciting to see dairy farmers making rotational grazing and seasonal dairying work. There are now grazing herds averaging 20,000 lb. milk per cow. What is the world record for a cow on pasture? Proponents of grazing claim feed costs, cow health problems, labor needs and even producer stress all drop when dairy cows start harvesting some of their own forages. Milk production may drop too (for a while) but for these dairy producers the trade-off is worth making, economically as well as emotionally. For most people, the sight of a dairy herd contentedly grazing evokes an image of a gentler past. A small but growing number of U.S. dairy producers see something else in the form of grazing/seasonal dairying for a better future for themselves and their animals (36).

EPILOGUE

Earlier, two papers were prepared by Mr. Harold L. Beecher, Twelve Mile, Indiana, owner and developer of Beecher Arlinda Ellen, who held the world's record milk production record for 17 years. She produced 55,661 pounds of milk on 2x milking in a 365 day lactation. Ellen's record has been broken five times since 1992.

Harold Beecher wrote two articles for the International Stockman's School, San Antonio, TX, January 10-13, 1977. They were published in the Dairy Science Handbook Vol. 10:203-205. 1977 as Man's Rapport With the Dairy Cow and The Relationship Between the Cattleman and His Veterinarian Vol. 10: 239-241. 1977.

I was asked to speak at the same School in 1981 and a paper featuring Ellen and the Beecher Family was published as Behavior and Management of High Yielding Dairy Cows in the Dairy Science Handbook Vol. 14:343-350. 1981.

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THE RELATIONSHIP BETWEEN THE CATTLEMAN AND HIS VETERINARIAN

By
Harold L.Beecher
Beecher Holsteins
Rochester, Indiana

In writing this paper, I do not profess to being an expert, but only a dairyman who has experienced different degrees of success in my relationship with the veterinarian profession.

The title of this writing refers to an important segment of dairying. It is so important, in fact, that the profit or loss we show can be closely correlated to this relationship. I will attempt to show that many situations can be taken care of by the dairyman if the communication lines between the veterinarian and dairyman are open. Here, however, I also stress that I am not a dairyman who believes only in"do it yourself medicine".

In my twenty-five years of experience with dairy cattle, I have worked basically with three veterinarians or groups of veterinarians. I will give a brief account of each one of these experiences. These accounts will be slanted toward the way I saw them at the time and then will be analyzed further individually.

We will start with Dr. C. When I started dairying, Dr.C. happened to be one of three veterinarians in our area. The farm I rented had been using Dr. C. so there was no reason to change. I recall having heard that he was a good "hog vet". His first visits to my herd are distinctly remembered. I was quite inexperienced and he was not the talkative type. Therefore, results from these visits were variable. I was afraid to ask questions; he offered no explanations, and no "do it yourself" information was ever given or drugs left to administer. After several years, Dr.C. took a job as a federal meat inspector, and R. M. became my veterinarian. This man was a complete contrast to Dr. C., He believed in being on time, so much so that it was an obsession with him. His impatience led him to have a tendency to be rough with animals. However, he did explain his diagnosis and results here were somewhat improved. I received my first experience with two veterinarians in practice together, as Dr. M. took in practice with him a young veterinarian just out of school. Inexperienced and needing to learn from the senior veterinarian, this young man had a rough time due to Dr. M's disposition. Results from this young man were poor.

In 1972, I had an opportunity to use the services of a Veterinarian Clinic that specializes in dairy cattle practice. This group of three veterinarians maintains a 24-hour per day clinic with services available seven days a week. The senior veterinarian I will call Dr. S, and most of my remarks here will be concerning him. Dr.S. is an extremely knowledgeable and informative doctor who constantly explains his actions and diagnoses, being very thorough. Through him we have entered into a completely new veterinarian-dairyman relationship. His skill at educating me in many phases has been instrumental in improvement in our milk production. He has worked closely with my son on sterilty problems and has aided this segment of herd health. We are communicating, and we are getting results.

As stated in the beginning, my record of these experiences is slanted. You can no doubt tell which veterinarian we have been happiest with. Let us further analyze. Going back to Dr. C., we find that he had vast knowledge of animal medicine. He was not a specialist in any one field, was overworked, and did not communicate well with his clients. On the other hand, I was inexperienced and afraid to ask questions. This relationship only improved and endured because I began to ask questions and he started answering them. With this communication, both the results and our personal relationship improved. I also referred to the fact that Dr. C., did not ask me to do even the simplest of treatments mainly because he did not think I was qualified to handle them. This changed as the relationship improved. In summary, then, neither person involved was fully to blame for the problems and it took both of us working together to solve them.

The situation with Dr., M. was different. He was a man always in a hurry. His obsession with being on time was a bad fault, or so it seemed to me. He always expected me to be ready when he arrived and at times,

worked too fast. He was abrupt in his explanations. Yet, Dr. M. saved cows and calves for me by being on time. When I was waiting on him emergencywise, his punctuality was certainly no fault. So here again, as I began to understand this man and his method of practice, our relationship improved. I did not then and do not now approve of his impatience with the animals. As brought out previously, the young doctor whom he took into his practice had a rough time due to his abrupt explanations concerning problems encountered on the farm. His chances for learning were somewhat thwarted. Dr. M. and he, too, needed better communication.

In summing up this relationship, I think that as I gained experience, it was easier for me to work with this doctor. As I pinpointed his faults, I was also able to recognize my own.

My experiences with Dr. S. and his associates have been good ones. This is due to two things. One, my ability to cope with herd health has grown, and secondly, I now have my sons working with me to see that all phases of herd health are taken care of. Both factors are very important to our operation. I have from the start, expected and gotten complete honesty from Dr. S. On the other hand, we have been honest with him. When an animal is to be treated, all pros and cons are discussed. When he comes to our farm we tell him everything we can about the animal he is to treat. We keep health records and there is no guess work. Dr. S. or one of his associates is available 24-hours a day and they expect us to take advantage of this service. They do not want an animal to go without treatment just because it is Sunday or night. In fact, I have been reprimanded for letting a cow go overnight with a 106^{0} temperature. Dr.S. has taught us the proper use of drugs. He emphasizes caution in all treatments. He warns against contamination of milk and meat. He insists upon cleanliness. He takes great care in making proper diagnoses. He is our business partner, but even more importantly, he is our friend.

I have stated that we do a portion of our own veterinary work. My son and I handle a portion of the reproductive work, keeping in constant touch with our veterinarian on problem cows. We treat milk fever cases and on occasion, handle problem calvings. Also, under his supervision, we take care of all calf health problems. We have been extremely fortunate here as a calf born healthy is rarely lost.

But here again, I stress the veterinarian's instructions are followed to the letter and are invaluable. Drugs left with his directions as to use, are labeled and kept in the proper place. Any drugs given are recorded in the animal's permanent record. Animals are watched closely for reactions following administration of drugs. Counteractants are also kept on hand. All of these things minimize our dependence upon the veterinarian's presence. If we are unable to secure immediate assistance from him, we can still treat the animal. Once again, I must stress caution in "do it yourself" diagnosis and treatment. And here again, the communication is so very important.

The veterinarian must realize the need and desirability of the dairyman doing some of the procedures himself. He has to have confidence in the dairyman's ability to do these things. The dairyman, in turn. must have the desire and confidence to do procedures on his own. On the other hand, he needs to go slowly, being sure he understands all treatments and all drugs, and exactly when each should be used. The dairyman must maintain good records of all treatments administered. He will find this makes for good management as well as good financial practice.

It can be assumed that some veterinarians and some dairymen are easier to work with than others. But the common goal surely should be the same. Healthy animals are profitable ones. The dairyman and veterinarian need to work side by side.

This paper would not be complete without some mention of the relationship of the veterinarian and our "Ellen" cow. The "Ellen" cow has not been trouble-free healthwise. She is a tremendously strong cow, but she also has been under more stress than the ordinary dairy animal. This has created problems which she probably would not have had otherwise.

Her first major health problem was a displaced Abomasum in 1974, which occurred three days after calving. She was operated upon by Dr. W., who was a member of our clinic at that time. The Abomasum was successfully replaced. However, during her recovery period she contacted pneumonia and ran temperatures as high as 108^{0}. Part of this problem was caused by a fan directing air into the box stall instead of drawing hot air from the stall. It did not occur to me what was happening and it did not occur to Dr. W., who was making follow-up calls. But Dr. S. walked into the barn and immediately suggested that we

switch the fan around. I mention this because I think that it proves a point. Two or three veterinarians working together complement each other, and quite possibly in this case, saved the life of "Ellen". During the recovery period the care of this cow was complete and communication lines were truly open.

During her world record lactation, she suffered a digestive problem. This was severe enough, so to cause diarrhea and loss of appetite. An Endero serum was administered by Dr. S, who observed her for a period of time for reaction. When none occurred, Dr. S. left the farm. We took Ellen from the box stall to the parlor and prepared her for milking. At this time, a violent reaction occurred. We managed to get her back to her stall with much effort. We then proceeded to give her a counteractant and also called Dr. S. By the time he returned to the farm, Ellen had quieted and the problem was under control.

Once again this proves a point. Because of prior, proper instruction by Dr. S., there was no hesitancy on our part in using counteractant medication. We had discussed reactions and knew what to do. Within twelve hours, Ellen was out of danger. Previous to this, I had never seen a reaction.

"Ellen's" third health problem and her most recent, started while she was dry. Shortly after attaining her world record, she began bloating. The first incidence lasted for three or four days, Dr. S. treated her and the problem cleared up. Then in mid-June, it began again, this time being more acute. Tests were run, blood samples were analyzed, and still there was no solution. The problem continued to magnify. During this period, all of our veterinarians were involved. We talked with them all and they talked with one another. Eventually, Dr. S. suggested we procure the services of our veterinary school at Purdue University.

This was done and in late July, the head veterinarian from Purdue performed a permanent rumen fistula. I think this demonstrated to a high degree the unselfishness and cooperation made possible by a proper relationship of the veterinarians involved.

The last thing I would like to mention about "Ellen" concerns her calving. She freshened on January 21, 1976. Our roads were closed because of snow and it would have been virtually impossible for our veterinarian to have reached us. But due to the fact that he had taken the time to rehearse all possible problems and procedures, we were confident we could handle any problem which might occur. The key here was confidence. We had this because we had communicated.

In summing up this paper, I would have to truthfully say most of my relationships with the veterinary profession have been satisfactory ones. I feel there is a reason for this. First, I think that most veterinarians are highly skilled professionals. I do not think they are all great communicators. I know however, this can be improved by the way in which the dairyman reacts. My own case proves this.

One other thing that improves relations is the asking of questions. We learn by asking. Asking also lets our veterinarian know we are concerned about what he is trying to do. And most of all, we need to remember that veterinarians are human. They make mistakes. They make wrong diagnoses. But we as dairymen need to realize we, too, make mistakes. Both the dairyman and veterinarian are not always cooperative to the fullest and both are guilty of non-communication. As all this becomes clearer and a more serious effort towards correction is made, the relationship between the dairyman and his veterinarian is headed towards improvement which also means money in the bank.

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BEHAVIOR AND MANAGEMENT OF HIGH YIELDING DAIRY COWS

By

Jack L. Albright, Ph.D.
Professor of Animal Sciences
Purdue University
West Lafayette, Indiana

Beecher Arlinda Ellen---World Milk Production Leader

We have come a long way from the early cow domesticated for religious purposes with appropriate crescent horn shape to the dehorned Beecher Arlinda Ellen, who, while working up to her world record milk production was milked by machine twice-daily in a 25-year old side-opening milking parlor. Her lactation curve was normal, but 100 lb/day higher than most high-producing cows. On her best single day of 195.5 pounds of milk, she produced 95.5 lb in the evening and 100 lb in the morning milking. One of the more remarkable facts about Ellen is her fast milking rate. Even on her highest day she milked out in 10 mintues for each of the two milkings.

In 1975 Beecher Arlinda Ellen completed her World Milk Production Record in 365 days on twice-daily milking (Figure 1.). One can only speculate what she would have produced on 3X milking---5, 10, 15% more? On the last day of her record, Ellen officially produced 43 pounds of milk and 1.6 pounds of butterfat on a 3.7% test. Her record was thus officially recorded at 55,661 lb of milk and 1,572 lb of butterfat. (I understand that your tutor for this School, Dr. Ensminger, has mentioned to Mr. Harold L. Beecher, owner of Ellen, that this amazing milk record would last for 20 years.) This is 4,912 lb of milk above the previous production record for 365 days set by Mowry Prince Corinne in 1974 and owned by Mowry Farms, Roaring Spring, Pennsylvania. Ellen and Corinne are the only cows in the world to produce over 50,000 lb of milk in one year. As a 5-year-old cow, Ellen set the World Milk Production Record for 305 days at 50,314 lb of milk. She produced 124.5 lb of milk on her 305th day. This record represents approximately 5 times more milk than the average cow in the U.S.A.

Figure 1. The Harold L. Beecher Family owns a very special cow. Beecher Arlinda Ellen received special attention just like every other animal on the farm. Family members are (left to right) Steve, Harold, Stan, Ellen, Scott (holding Ellen), Patricia (touching Ellen), Norma Jean, Paul, Shirley and kneeling Susan and Sherry. Ellen is listed in the current Guinness Book of World Records as the World Record Milk Producer set in 1975 with 55,661 pounds of milk in 365 days.

The 40,000+ lb Milk Producers

The first eight out of some 20 cows in the United States who have produced over 40,000 lb of milk in one year, are shown in Table 1. In order to make a 40,000 lb record, a cow must average about 110 lb of milk per day for 365 days. No matter how many times per day they are milked or how much special attention they get, they must also stay "on feed" and this is an extraordinary achievement. (Ellen was only "off feed" once during her record). Most of these 40,000 lb milk cows are what almost everyone would call big cows ranging in size from 1,400-1,930 lb averaging over 1,700 lb. Their milk to body weight ratios are high, ranging from 21:1 - 32:1. A good dairy cow should produce 10 times her body weight in milk production. All the eight are classified Good Plus or higher except one who was not classified. All obviously possess amazingly good appetites and several of the early record holding cows were fed a wide variety of feedstuffs. Five

TABLE 1.

SUMMARY OF FIRST 40,000+ LB MILK PRODUCERS - 365 DAY LACTATION BASIS

Name (Registered Holstein)	Year	State	Times Milked	Milk LB	Test %	Butterfat LB	Body Weight	Milk:Body Weight Ratio	Type Classification Score-Points
Carnation Ormsby Madcap Fayne	a) 1942	Washington	4X	41,943	3.3	1392	1800	23:1	Not classified
Green Meadow Lily Pabst	b) 1951	Michigan	3X	42,805	2.9	1246	1400	30:1	Good Plus - 84
Mowry Leader Sis	c) 1967	Pennsylvania	2X	40,174	3.8	1522	1930	21:1	Very Good - 88
Reinharts Arthur-Farms Balled	d) 1970	Maryland	2X	40,981	3.2	1297	----	----	Very Good - 85
Skagvale Graceful Hattie	e) 1971	Washington	2X	44,019	3.4	1505	1700	26:1	Very Good - 87
Breezewood Patsy Bar Pontiac	f) 1974	Ohio	2X	45,280	4.8	2194	1860	24:1	Excellent - 93
Mowry Prince Corinne	g) 1974	Pennsylvania	2X	50,759	3.0	1548	1700	30:1	Excellent - 92
Beecher Arlinda Ellen	h) 1975	Indiana	2X	55,661	2.8	1572	1750	32:1	Excellent - 91
Beecher Arlinda Ellen	i) 1977	Indiana	2X	48,840	3.3	1624	1750	28:1	Excellent - 91

REFERENCE: Cook, T. L. and J. L. Albright. 1976. A study of 40,000 pound milk producers. Holstein-Friesian World 73:1881-1883.

Table 1 Continued...

a) Madcap had the most variable diet of any of the 40,000+ lb. producers. She was fed 18 lb. grain, 35 lb. of the best alfalfa hay available, 20 lb. corn silage, 40 lb. sliced sugar beets and mangles and 10 lb. kale per day. She also drank 15 gallons of water per day.

b) Lily Pabst was also the highest 2X producer at one time with a record at 5 years 0 months in 365 days of 32, 027 lb. milk, 3.1%, 982 lb. fat. During her record breaking performance (above) she was fed 40 lb. of 15% protein grain mix, a small amount of corn silage and beet pulp. She was pastured both day and night in summer and fed alfalfa hay free choice. In the late stages of her lactation she was fed a basket of chopped carrots each day. She stood 52 inches at the withers.

c) Fed 50 lb. of grain ration (1500 lb. shelled corn, 500 lb. of a 32% non-urea protein supplement, 100 lb. of dried beet pulp and vitamins A, D and E added). The roughage portion of her diet consisted of 50 lb. corn silage daily, all the alfalfa mixed hay she could eat, a small amount of dried beet pulp and Sudex pasture in the summer. Sis stood 62 inches at the shoulder.

d) At the time Ballad was the new World's Champion Milk Producer on 2X milking. She had calved at 2YOM, 3YOM, 4YOM, and 5YOM. Her reproduction is an impressive record in itself.

e) Hattie received all the hay (over 60 lb. per day) and pasture she could eat. She also ate 40 lb. of a 12% grain ration per day. Hattie stands 60 inches at the withers.

f) Bar Pontiac was the first U.S. cow to produce over 2,000 lb. butterfat in one year. She was fed 70 lb. grain daily at her peak plus all the good hay she could eat. A large cow, she stands 62 inches at the withers.

g) First cow to exceed 50,000 lb. milk in a single 365 day lactation. Corinne was fed from 50 to 75 lb. alfalfa hay daily and up to 50 lb. of an 18% protein grain mix per day.

h) Set the standard for 2X daily milking for daily (195.5 lb.), 305 days (50,314 lb.) and 365 days (55,661 lb.) milk produced. In peak lactation she ate 65+ lb. of a 16% protein commercial feed and 70+ lb. alfalfa hay per day. She drank 50 to 60 U.S. gallons of water per day. During her record she was tested 19 times with nine surprise tests.

i) Third highest record in history averaging 134 lb. per day. In two consecutive lactations, Ellen produced over 100,000 lb. of milk. Ellen calved at 8 years 5 months for the sixth time (6 bulls) on 10 August, 1977. She produced in 365 days 22,240 lb. milk 4.5% and 1,018 lb. butterfat. As of May, 1978 after her 6th lactation, she has produced 213,021 lb. of milk lifetime. Ellen had surgery on 30 October, 1977 for a displaced abomasum followed by a follow-up procedure in December to resuture the abomasum. In order to obtain female offspring from Ellen, she is being flushed and her eggs are being transferred into host animals.

of the eight cows set their records in this decade where most of their stockmen were willing to feed their unique cows large quantities of high-quality hay (mainly alfalfa) and a compound ration ranging from 12-18% protein based upon the quality of the forage. All of the cows are Registered Holsteins. All are quiet cows, tame, broke to lead and respond to the halter for purposes of handling. They all have endearing names. This is in contrast with the celebrated veterinarian-author James Herriot lamenting the fact that cows no longer have names any more. They all have excellent temperaments and respond well to a close relationship with people.

As production per cow and herd averages increase, one wonders if 40,000+ lb lactations may become common place. Even if they do, these first eight cows and their owners and breeders must be remembered as the high yield pioneers.

The 50,000+ lb Milk Producers

Neither Corinne nor Ellen was fed silage. Mowry Prince Corinne was fed from 50 to 75 lb alfalfa hay daily and up to 50 lb of an 18% crude protein compound mix per day. Being a 1,700 lb body-weight cow, Corinne consumed 5.9-7.4% of her weight in Dry Matter Intake per day. In the case of Ellen, the pertinent data are shown in Table 2. The figures are similar to Corinne's, at 5.1-7.7% of body weight as DMI/day. Ellen's sire, Pawnee Farms Arlinda Chief, had to be removed from feed at seven months of age. He would gorge himself with hay and grain to the extent that he would consistently bloat. Those who have watched Ellen eat hay and grain have noted her aggressive, insatiable, ravenous feeding habits. Economists have been impressed with her income over feed costs of approximately $3,000 per year. Ellen is a cow possessing high dominance and thus she was placed in a box stall within sight of the herd, in order to protect her from injury. Her pen was adjacent to a pen containing cats and weaned calves which she nuzzled and licked as well as being alert to their activity. When she went to her 1/2 acre exercise lot she was never alone as there were sheep and geese nearby. Also, providing and controlling the right amount of feed and stimulation presents a problem for the exceptional high producer in a free stall set-up. There is much truth underlying the rather fanciful notion that to get the most from a top cow, the natural affection which she cannot bestow on her calf must be transferred to her handler---but this affection will not be given where it is not merited.

A Day in the Life of Beecher Arlinda Ellen

The following information was compiled by Scott Beecher in May 1980 with help from members of his family.

General---"Ellen was housed in an old barn (hay loft overhead) in a box stall approximately 10 feet x 12 feet. The pen was bedded with 3-5 inches of dry wood shavings with straw on top. Bedding was changed as needed. She was watered in 3-five gallon plastic buckets. Her grain and beet pulp was fed in a square, galvanized metal tub fixed in one corner of the pen approximately 12 inches off the floor. Hay was fed on the bedding near the tub and always in the same spot.

A salt block was present in her tub at all times. The general rule was: if the cow is out of grain, hay, or water, get her some. Often she would let us know she was hungry or out of feed or water by banging the tub or buckets around."

Following is a rough daily schedule: "Approximately 5:30 a.m.: The first person to the barn takes Ellen approximately 6-8 pounds of grain and rewaters her (the water is warmed slightly if the air temperature is about 32°F or lower. Warming increased her consumption.

7:00 a.m.: Ellen is led into the milking parlor where she is allowed to eat all the feed she can while being milked (usually 10-12 lb.). While she is gone her pen is cleaned and the bedding straightened, her water is changed, approximately 8-10 lb. of wet beet pulp is put into her tub, and approximately 1/2 bale of alfalfa hay is placed in the pen.

About 7:30 a.m.: Ellen is back into the pen.

About 10:30 - 11:00 a.m.: Ellen receives more grain if she has eaten her beet pulp (~6-8 lb.).

About 12:30 p.m. - 1:00 p.m.: Ellen is rewatered and given more hay if she has cleaned up what she was previously given.

About 1:00 p.m. - 5:00 p.m.: If nice, warm weather, Ellen is outside in an exercise lot of approximately 1/2 acre where she could graze (a mixture of blue-grass, orchardgrass, a little timothy, and weeds) or eat apples, either off the ground or off the fairly nonproductive trees that provided them. Water was provided in the lot. If the weather

TABLE 2.

ELLEN'S FEED CONSUMPTION DURING HER WORLD RECORD - 1975

	Assumed DM %	Average for week tested: 26 March	28 April	6 July	25 Aug	22 Sept	Average
Hay consumption lb.	85	70	69	48	40	45	54
Grain consumption lb.	88	65	65	58	49	51	58
Milk, lb. on test day	--	190	175	148	148	125	152
Grain: Milk Ratio	--	1:2.9	1:2.7	1:2.6	1:3.0	1:2.5	1:2.7
Total Feed Intake (Feedstuffs on an as fed basis and her body weight being 1750 lb.)		7.7	7.7	6.1	5.1	5.5	6.4
Calc. DMI (lb.)		117	116	92	77	83	97
Calc. DMI as % BWT		6.7	6.6	5.3	4.4	4.7	5.5
Fecal pH							6.8 - 6.9*
Fecal starch (%)							2.4**

REFERENCE: Data courtesy of Dr. Donald L. Hill, Purdue University, West Lafayette, Indiana and Harold L. Beecher and Family, Route 1, Rochester, Indiana.

*5 samples taken randomly during Ellen's record by Dr. William E. Wheeler, Clay Center, Nebraska. Normal fecal pH is 6.0+ indicating proper rumen buffering.

**Sample taken by Dr. Carl H. Noller, Purdue University. Ellen's extremely low value of 2.4% fecal starch is indicative of her great feed conversion to milk.

was poor, Ellen remained in her boxstall.

About 5:00 p.m.: Ellen is usually back in her box stall. Her water is checked. She is given hay if she needs it.

7:00 p.m.: Ellen is lead into the milking parlor where again she can eat as much feed as she can while being milked (approximately 10-12 lb.). While in the parlor, her pen is cleaned, the bedding straightened, her water changed, approximately 8-10 lb. of wet beet pulp is placed in her tub, and approximately 1/2 bale of alfalfa hay is placed in the pen.

Approximately 7:30 p.m.: Ellen is back into her pen.

Approximately 8:00-8:30 p.m.: Ellen is given more grain (approximately 10-12 lbs.).

Approximately 10:00-10:30 p.m.: Ellen is rewatered and given more hay.

Note: All times (except milking) are approximate and varied according to the daily routine of the farm and the amount of help around. We did try our hardest to keep her on 12 hr-12 hr milking schedule. All percentage figures are average. These of course varied with her production and stage of lactation. Grain was fed on a 3 lbs. milk: 1 lb grain ratio. Ellen was groomed 2x a day every day. In summer, she also had a small box fan over her stall, pulling air off of her."

Profile of a World's Record Milk Producer

A 12 minute edited color video cassette was prepared on Beecher Arlinda Ellen at the Harold L. Beecher and Family Farm near Rochester, Indiana and shown last year at this School. Ellen's publicity and production credits for her best single day, 305 day and 365 day lactation period, her genetic background, preferential treatment, routines and health problems are in it. A 3.5 minute behavioral sequence contains a discussion on Ellen's interaction with the Beecher Family, her herdmates and facilities. (One dairyman-visitor from New Zealand, Merv Hicks, the inventer of the rotary turnstyle is shown offering Ellen some hay on the 365th day of her record. Also Harold Beecher is shown milking Ellen on the last day of her record). This cow was continuously observed over a 48 hour period near the end of her lactation. In a 24 hour period Ellen consumed different feeds for the following number of times: hay (13); grain (12); straw (2); water (7) and mineralized salt (5) (for a total of 6 hr., 15 min.). She spent 13 hr. 55 min. lying down resting with her eyes closed for 30 min. The remaining 3 hr. 50 min were spent ruminating while standing, defecating, milking, grooming, "interaction" with other cattle and idling. She spent 7 hr. 30 minutes ruminating (5 hr. 5 min. on her left side; 1 hr. 50 minutes on her right side and 35 minutes standing.) Her average chews per minute were 60 and her average chews between swallows were 82. Also discussed are Ellen's investigatory behavior, temperament and personablity. Ellen shows an even temperament. Most cows are quick to notice intruders or new objects and will immediately investigate them. Ellen is very relaxed and is not upset by intruders. This is partially due to her receiving attention from many different Beechers as well as visitors and also partially due to her personality.

Bovine Laterality

In her level stall, Ellen rested about 2 hr more on her right side per day than on her left. This agrees with other observations showing that right side laterality increases with age. In Ellen's case with her distended left side and later bloat problems, it seems logical that she would obtain more comfort resting more on her right side. Whether this shifting of body weight led to her displaced abomasum operation in 1977 is open to question.

Bovine laterality can be expressed in cattle in several ways: hooking tendencies in the bull ring; movements to the right or left into a milking parlor, movement onto rotary milking parlors which rotate right or left; and resting behavior---lying on either their left or right side. In our work, with level stall surfaces, cows laid on their left side 53% of the time. With free stall surfaces using clay-fill and sloped 1.5 - 2%, cows laid with their dorsal side (backbone) uphill for an average of 71%. With concrete-filled stalls the figure rises to nearly 90% of the time a cow will rest with her backbone uphill. Casual observation on farms with sloping free stalls oftentimes shows an entire row of cows resting with their backbones uphill.

These findings could have immediate practical implications in the design of free stall barns. A slight slope of uniform direction would encourage cows to lie with their backs in the same direction. Therefore, they would fit the stalls better and the incidence of teat injury caused by a cow stepping on another cow's udder would be reduced. In the long run, encouraging

cows to lie in a particular direction would be helpful following surgical operations. However, cows should be checked to assess the incidence of mastitis and digestive disturbances such as left or right displaced abomasums.

Furthermore, cows sleep very little (30 min. - 1 hr.) and one probable reason is that for the rumen to remain comfortable and functioning normally the cow must remain in a fairly upright position. Hence resting on the left side on a surface slightly uphill is probably the most advantageous position.

The Beecher Family

The story of Ellen is also a story of her family---the Harold L. Beecher family of Route 1, Rochester, Indiana. Harold quit his job as a factory foreman 30 years ago when he and his wife, Norma Jean (alias "Mom" Beecher in the Rochester community), started milking about 18 grade Holsteins for another dairyman, and eventually purchased his own 160 acre farm and the cows. Their first Registered Holstein was Bridgecrest Skylighter Elsie, the dam of Ellen.

Ellen received special treatment from the whole Beecher family, Mr. and Mrs. Beecher and their eight children. With 10 Beechers managing Ellen right from birth (she was the eldest child's 4-H Club project and broke to lead and exhibited in the show ring as a junior calf and yearling), she is used to being handled. The Beechers have been especially careful to prevent teat and udder injuries since she started milking heavily. They have tried to watch her activity, particularly in the exercise lot, to see that she does not romp too much.

The Beechers completed an 80 cow comfort tie-stall barn in August, 1977 to replace their three-stall milking parlor and 65 free stalls. The barn also includes 10 box stalls for Ellen (when in residence) and nine other high yielders, and calf pens. In this barn they have an approximately 1% slope from end to end and the cows can be found lying on one side significantly more than the other side of their body. (This is especially true for cows with previous displaced abomasal operations---some rest 100% of the time on the nonscar side).

No one has satisfactorily explained why Ellen produced such a large amount of milk. No scientist, nutritionist or genetic expert has the complete answer. Therefore, what is left are subjective observations. For instance, Ellen likes her drinking water warmed, and during cold weather she drank up to ten gallons a day more warm water than she previously did when the water was cold. This meant that she consumed between 50-60 gallons of water per day. Ellen also seemed intent on emptying a single water bucket before beginning to drink from another one. A rather unique behavior was noted in regard to this point when she actually tipped a bucket at an angle in order to empty it totally of water when there were two other buckets completely full of water next to the nearly empty one. Try and explain that one! Again, by observation, she preferred to eat her hay directly off the bedding. The most natural position for feeding cattle is at the ground level. In the downward position, the natural eating position, there is a greater flow of saliva, which has a direct influence on the efficiency of rumen function.

The "Ellen" cow has not been trouble-free healthwise. She is a very strong cow, but she also has been under more stress than the ordinary dairy animal. This has clearly created problems which she would not have had otherwise.

Her first major health problem was a displaced abomasum in 1974, which occurred three days after calving and needed surgery. However, during her recovery period, she developed pneumonia and ran temperatures as high as 108°F. Part of this problem was caused by a fan directing cold air into her box stall instead of drawing hot air from the stall. An observant veterinarian solved the problem.

After her world record, another health problem encountered was bloat. The first incidence lasted for three or four days and responded to treatment, but bloat recurred, this time being more acute. Tests were run, blood samples were analyzed, but there was no response and the problem continued to magnify.

Eventually it was decided to have a Purdue veterinarian insert a permanent rumen fistula, about the size of a 50¢ piece, which is still in place. This special fistula was fabricated by Zimmers who specialize in orthopedic limbs. This Warsaw, Indiana firm spent 29 hours and $500 to make this fistula and then donated it to the Beechers.

Beecher Arlina Ellen, now 11+ years old, is a great cow for the Holstein breed. Who can tell that the influence of her unborn offspring and her sons in artificial breeding service will have on the breed?

Since she is so valuable, plans continue to have her superovulated and ova transplanted using nonsurgical techniques. On April 7, 1979 she left the farm and was transported to American Embryos, Inc., in Michigan where she remains at this writing. Her recipient heifer was checked pregnant at 42 days on May 17, 1980. Ellen continues to be flushed for eggs.

Summary

Behavorial characteristics of the high-yielding cow (40,000+ lbs. of milk) include aggressive eating habits consuming large amounts of high quality alfalfa hay; excellent temperaments, personalities and responses to a close relationship with their caretaker(s); they all have names and nicknames; they all are broke to lead and respond to the halter for purposes of handling; and they have strong pedigrees.

The modern, high-yielding dairy cow ("The foster mother of the human race") is a composite of unique behavioral characteristics. She must fit in well with her herdmates as well as her handlers. Proper mental attitude of her caretakers must blend in with skillful management and humane care in today's highly competitive, technological society.