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Efficiency in the Dairy Barn

By
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and
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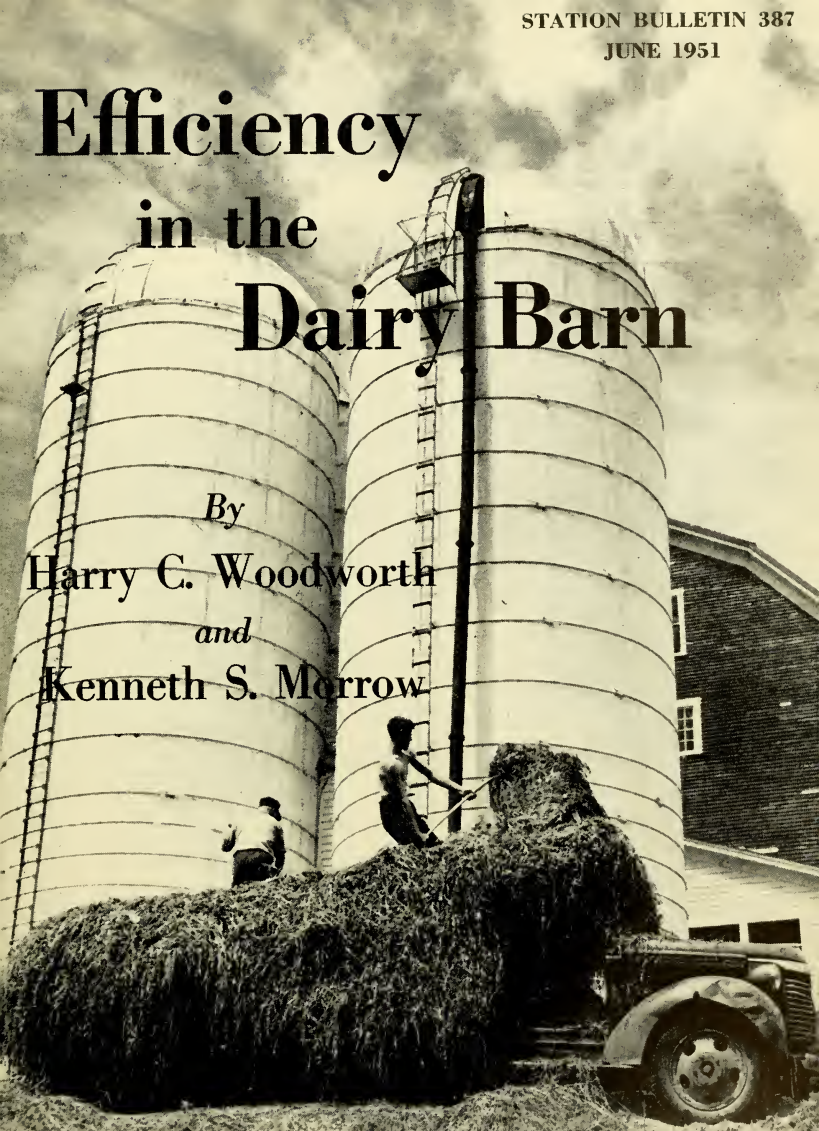

AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF NEW HAMPSHIRE
DURHAM, N. H.

This is the fourth in a series of publications by University of New Hampshire Agricultural Experiment Station researchers on the subject of efficient chore practices in the dairy barn. Others have been:

Part I. *Chore Travel in Dairy Barns* by John C. Holmes. Station Circular 72 (1945).

Part II. *Rapid Milking* by Harry C. Woodworth, Kenneth S. Morrow, and John C. Holmes. Station Circular 76 (1947).

Part III. *The Problem of Slow Milking Cows* by Harry C. Woodworth, Kenneth S. Morrow, and Earl M. Elliott. Station Circular 80 (1949).

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EFFICIENCY IN THE DAIRY BARN

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I Introduction

Objective

This study was initiated to explore the possibilities of increasing the effectiveness of labor in doing chore work in dairy barns. There was evidence from previous studies* that chore work accounted for a large proportion of the total work hours. This large labor requirement tended to be a barrier or bottleneck in limiting total output of the farm. The major objective was to eliminate or lower these barriers to larger production by developing better practices, thus raising the efficiency of the entire dairy farm enterprise. It was expected that greater efficiency in doing certain chores would enable the operator to readjust his farm organization, increase the total output per man, and raise his net income.

Importance of Chore Efficiency

The management of specialized dairy farms has become very complex. Operators faced with high wage rates and a scarcity of available short period labor have been forced to plan their enterprises around their available regular labor. Due to the varying seasonal labor requirements for both crops and dairy barn chores, the effective allocation of the available labor and its efficient use throughout the year is difficult but very important. Efficient chore work is an important segment in the organization of the farm as a whole. Daily chores account for over half the total man days on specialized dairy farms. Where they are done efficiently, there is more time available for field work.

Balance of Operations

On specialized dairy farms in New Hampshire, the field work is concentrated on the production of roughage for the dairy herd. There is a management problem of balancing the size of the herd with the amount of roughage available and also of equalizing the labor load to some extent between the seasons of roughage production and the period of winter chores. The labor that produces the roughage usually must do the work on the livestock that consumes the roughage. Improvements in chore practices have not kept pace with progress in field crop production and this lag tends to further unbalance

* UNH Agricultural Experiment Station Bulletin 275 (1933), *Efficiency Studies in Dairy Farming* by H. C. Woodworth, C. W. Harris, Jr., and Emil Rauchenstein.
UNH Agricultural Experiment Station Bulletin 322 (1940), *Farm Organization and Management in the Colebrook Area,* by H. C. Woodworth and Arna Hangas.
In 1931 and 1932, an average of 132 hours per cow were spent on dairy chores and 25 hours directly on producing the roughage consumed per cow. Approximately 60 per cent of the time actually devoted to operating the farm was spent in doing dairy chores.

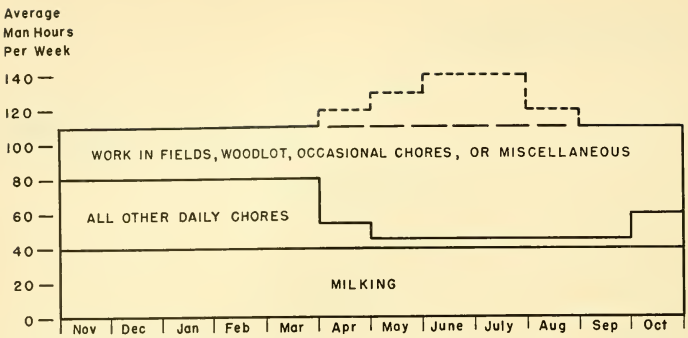

Fig. 1. **On specialized dairy farms, efficient chore work is as important as efficiency of field operations. It enables the operator to enlarge his dairy herd and increase the total output from the farm.**

seasonal labor requirements and to handicap the efficient organization of the dairy enterprise as an economic unit. For instance, the operator who has doubled the output of roughage per man in the last 10 years and yet made no progress on chore work finds it impossible to work out an efficient production unit. Similarly, the lack of progress in chore work holds back the output of the farm. In certain competing areas, the operator has the alternative of allocating a portion of his resources to cash crops and can easily tailor the amount of roughage production to the livestock on his farm. Most New Hampshire dairymen do not have this opportunity for cash crop production and must place greater emphasis on balancing roughage and livestock.

Much of the progress in the efficiency of crop production has come about from the adoption of new machines. The operator tends to purchase progress in increased output per man hour when he buys the machine. He has to make many readjustments, to be sure, but change in procedure is made easy by the novelty of the new machine. In contrast, while progress in chore work involves some mechanization and the use of new gadgets, it is more dependent upon simplification of tasks, reorganization of work procedures, remodeling of barns to reduce travel, the ability of the operator to drop old routines and habits, and the will to concentrate on carrying out new procedures and new timing sequences. These are more difficult to achieve than merely buying a machine. Yet in modern competitive dairying they are essential.

Hours of Labor Per Day

Historically, milk production has been associated with long hours of labor. The very nature of the enterprise has made adjustment to the more reasonable hours of daily labor and for days off for the operator and the hired help difficult to achieve. Labor requirements in dairy chores tend to be confining and inflexible. Certain chore tasks not only need to be done seven days a week, but must be accomplished within rather narrow limits of time. Thus the problem is more complex than the total man hours indicate. There is a need to fit the chore work into a schedule and a time sequence within the limitations of the available labor. If the labor re-

quired for the chore work is budgeted too closely to the available labor, the difficulty of arranging for days off or of handling emergency situations may be intensified.

While this report stresses efficiency of labor and output, it suggests that these chore schedules be fitted into a pattern consistent with the modern concept of reasonable hours of labor and provision for days off occasionally. Labor in industry and the services is mostly on a 40 to 44-hour week. The dairyman, working at home and with some leeway in the middle of the day, might consider a 60-hour week as somewhat in line with other labor groups.

Some part of the benefits accruing from more efficient chore work should be applied to the betterment of working conditions for dairymen and their helpers. This is a difficult problem to work out on the individual farm, but it is thought that a trend by all dairymen in the direction of greater conformity to the work pattern of modern life is essential to the long-run welfare of the dairy industry.

If we assume a program of 60 work hours per week for each worker, the operator of a two-man farm must place his activities most of the year on the basis of this limitation in available labor. It is recognized that emergencies and special seasonal situations will arise in which the workers will need to put in long hours for short periods.

Inflexibility of Certain Tasks

A major characteristic of dairy barn chores is the large proportion of the total tasks and also the total work load that must be performed within definite periods of time. The inflexibility of the routine and rigid sequence of chores results in peaks of labor requirements during each day. On a large dairy, the winter chores may be accomplished with 10 man hours of labor, but since most of the tasks are done at the beginning and end of the day, two men must be available every day at these peak periods. In providing sufficient labor for these peak periods, there occurs on many farms a surplus of labor or under-employed labor at other times, particularly if the farm, as organized, affords no alternative productive employment.

Due to these inflexible labor requirements for specific chores and the resulting peak labor load at the beginning and end of the day, an effective schedule for chore work and the efficient use of labor within the framework of a 60-hour week is very difficult to achieve. Attention has been given throughout this study to the possibility of developing greater flexibility in labor requirements for chores, in order that the operator can use his available labor more advantageously and also more easily arrange for days off. On many farms, greater flexibility in chore labor will also permit the operator to have more leeway in accomplishing other productive work, such as work in the woodlot.

Emphasis on Future Practices

The emphasis in this study has been to project the chore practices into the future rather than merely reporting present practices. It is recognized that few can quickly attain all the efficiencies. Present barn structures cannot be completely ignored although progress toward good practices often depends upon improvements in layout by remodeling at considerable expense. Then, too, most operators cannot make all the adjustments in practices overnight. The individual has to train himself and his helpers to new procedures. Several years may elapse before he can economically cull out slow milkers and substitute easy milkers. He has to

make a few improvements and get oriented before he is able to effectively take additional steps. If the suggestions made in this bulletin seem beyond practical reality to a particular individual, perhaps he can make a few changes now in the direction of greater efficiency and then after a few years he can visualize his future farm organization with a different perspective. Since the purpose of the study was to project, if possible, practices into the future, the discussion necessarily has been beyond immediate reality to many dairymen. It may indicate direction and stimulate observation of present methods and of possibilities of improvement.

In examining each task, or a segment of a task, and in raising questions such as—Is it essential? Can it be eliminated or simplified?—the authors were confronted with complex problems involving dairy technology, sanitation, health of animals, production, and most economic production. In many cases, very little or no data were available upon which to formulate decisions. Practical dairymen have strong opinions about the effect of certain practices and yet occasionally one or more dairymen have changed or eliminated such practices and seem to have maintained production. An attempt has been made to proceed on a forward looking basis, obtaining the advice of dairy technologists, practical dairymen, and others, and avoiding as far as possible the bias due to habit and custom.

Stanchion Type Barns

The study was confined to chore practices in conventional stanchion type barns. In doing so, there was no intent to make comparisons or draw conclusions with respect to pen type and stanchion type barns for New Hampshire. There has been little opportunity in this state to observe chore work in pen type barns operating under normal farm conditions. The problem of a satisfactory and abundant bedding material has restrained farmers from developing the pen type of housing for their cows. A few, however, are housing their older heifers and even a few dry cows loose in pens. This practice seems to work out satisfactorily and is discussed under Young Stock in Chapter XII.

Relation to New Hampshire Farms

The analysis of the problem has been directed quite largely to large dairy enterprises. The basic data were collected from farms with 20 to 55 cows and have been adjusted to a 40-cow basis for comparison. The suggested schedules have been pointed toward a 40-cow farm. The authors of this bulletin recognize that most of the present herds on specialized farms are small.* They are deeply concerned about the prospects and future of the small specialized dairyman who depends on 8 to 10 cows for his living. They are sensitive to the ever-widening gap in efficiency, in output of milk per worker, and in net income between the small operator and the man who has followed a sound program of expansion to use resources to greater advantage.

However, they feel that an expansion to large volume of output and adoption of modern methods is essential to the continuation of the dairy

* UNH Agricultural Experiment Station Bulletin 340 (1942), *Dairy Opportunity Areas in New Hampshire* by Harry C. Woodworth and John C. Holmes. Assuming that the 9115 farms reporting less than six cows in the 1943 tax assessment were noncommercial dairies, the 3818 farms reporting 6 cows or more were distributed as follows.:

Size of herd	*No. of farms*	*Percentage of commercial dairy farms*
6 to 10	1839	48.2
11 to 15	956	25.0
16 to 20	492	12.9
Over 20	531	13.9
	3818	100.0

There has been a definite trend in increase of farms with over 20 cows, but no estimates of the distribution in 1950 are now available.

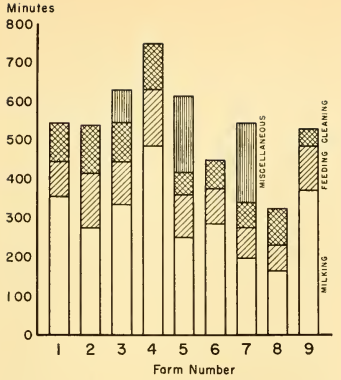

Fig. 2. Man minutes spent on daily cow chores on nine farms in 1942. (Data from each farm are adjusted to a 40-cow basis; 35 cows milking.) Care of milk and milking equipment is not included.

enterprise in this state. It is hoped that the pointing of the analysis toward large dairy enterprises will be helpful to the small operators in adjusting to a larger volume of output. They will probably need a larger herd of cows for even a modest income in the years ahead. After all, the specialized dairyman will have to be efficient in the production of his one specialized product. How the study can be applied to small farms is discussed in Chapter VIII.

How Study Was Carried Out

The first step in this study was the observation of present chore practices on successful, well-managed dairy farms. The farms were selected on the basis of expectation of an opportunity of witnessing efficient chore work. The procedure was not to describe the industry through a random sample, but rather to search for the most efficient practices wherever they could be found. Wherever data are stated regarding present practices, they should be associated with conditions on a few hand-picked farms.

The information collected included stop watch records of each worker's performance for one entire day and descriptions of efficient methods of doing each task. The most efficient practices were noted, and individual dairymen were encouraged to find ways and means of improving even their best practices. The leaders of this project helped devise new methods for doing essential tasks.

Practices and chore schedules were studied. The various tasks were fitted together synthetically, and then checked as far as possible on a limited number of farms. The first year, nine farms were studied in detail. In the following years, all chore activities were observed on five large efficiently-operated farms and one or more chores were studied on a large group. (See Figs. 2 and 3.) For instance, milking was observed on approximately 50 farms and records from an additional 100 farms were made available from the University of New Hampshire Extension Serv-

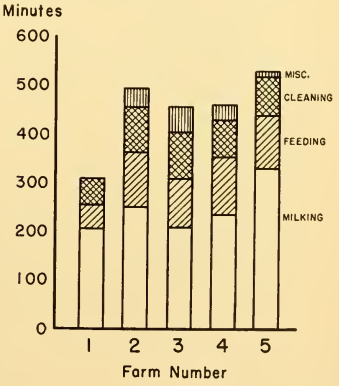

Fig. 3. Man minutes spent on daily cow chores on five farms in 1948, computed on the same basis as in Fig. 2.

ice in Agriculture and Home Economics. At a later period in this study, a brief summary of 38 large dairy farms was made to obtain special data with reference to sequence in doing chores and procedures in washing and caring for equipment. The search for better methods has extended to interviewing a few county agents, grain store men, and machinery dealers for reference to farms where special care in handling grain or doing chores efficiently have been observed. These observations were followed up and in a few cases descriptions of chore procedures were made.

It became apparent in the early stages of the project that greater immediate assistance could be rendered dairy producers by concentrating on milking operations. Farmers were very short of help at that time and the task of milking accounted for about half of the total chore hours. Information was made available to the Extension Service from time to time. Three UNH Agricultural Experiment Station Circulars dealing with these phases of the study have been published under the general heading of *Efficient Dairy Chore Practices.** This bulletin is the last in the series of research publications in the study. It deals mostly with dairy chores other than milking.

* Part I. Station Circular 72 (1945), *Chore Travel in Dairy Barns* by John C. Holmes.

Part II. Station Circular 76 (1947), *Rapid Milking* by Harry C. Woodworth, Kenneth S. Morrow, and John C. Holmes.

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II Chore Tasks

Daily Chores

Twenty-one daily chore tasks were observed. Some of these were performed several times a day on all farms and a few were not done at all by a few operators.

For convenience in the study of chores, the 21 tasks were classified into four groups:

1. Milking
   a. Milking
   b. Care of milk
   c. Equipment
2. Feeding
   a. Hay preparation
   b. Hay feeding
   c. Silage preparation
   d. Silage feeding
   e. Grain preparation
   f. Grain feeding
   g. Miscellaneous material feed preparation
   h. Miscellaneous material feeding
   i. Pushing feed back to mangers
   j. Sweep of clean mangers
3. Cleaning
   a. Manure disposal
   b. Hoe to gutter
   c. Sweep gutter alleyway
   d. Bedding preparation
   e. Bedding distribution
   f. Spreading superphosphate
4. Miscellaneous
   a. Cows "in and out"
   b. Currying

Occasional Chores

In addition to the daily chores listed above, many other tasks are performed occasionally. A partial list of these follows:

1. Supplies
   a. Hauling grain or helping truckers in loading grain
   b. Hauling sawdust and storing for bedding
   c. Counting, wrapping, and shipping empty grain bags
2. Operating barn facilities and equipment
   a. Observing, cleaning, and adjusting water bowls
   b. Adjusting ventilators, windows, etc.
   c. Cleaning vacuum air line
   d. Overhauling milking equipment
   e. Shovelling snow or plowing snow to clear doorways
   f. Cleaning windows and ceilings
   g. Spraying barn
3. Health and sanitation
   a. Giving attention to cows and calves at calving time
   b. Doctoring sick cows
   c. Working on swollen or damaged udders
   d. Spraying cows

4. Herd management
   a. Observing animals
   b. Studying breeding program
   c. Breeding cows or heifers
   d. Figuring rations
   e. Attaching salt blocks to stanchion
   f. Clipping cows
   g. Rearranging cows
   h. Selling and buying cows
   i. Training first calf heifers
   j. Driving cows to and from pasture

Maintenance and Other Tasks

Dairymen do other work in barns in the process of keeping up the equipment and barn facilities. These tasks might be classified as overhead. They may not be directly productive but are essential in the long run.

1. Repair of stanchions, doors and windows
2. Thawing frozen pipes, repairing water pipes

The main attention of this study has been directed toward the daily chores, but because it was realized that occasional chores take a large amount of the farmer's time, estimates were obtained on a few farms. These data are discussed in Chapter VIII.

III Seasonal Differences in Chore Schedules

With the exception of milking, including care of equipment, dairy chores and the hours of labor required vary seasonally. During the winter, when cows are confined in stanchions, an intensive job of caring for the cows, feeding the cows, and cleaning the barn must be done. In the pasture season, the cows are in the barn only a brief time for the morning and night milking and fewer chores need to be performed daily. In New Hampshire there is usually about a month in the fall (October) and a month in the spring (April) when cows are not on pasture, but can be outside part of the time.

For convenience in analysis, three seasonal chore periods were taken as representative of the year:

1. Winter—five months: November, December, January, February, March.
2. Summer—five months: May, June, July, August, September.
3. Fall and spring—two months: October and April.

This grouping of chore periods gives more emphasis to the fall and spring than actually obtains on most New Hampshire dairy farms. However, an analysis of the situation in these short periods seemed important because of the possibilities of considerable saving of time on chores by special adjustments. This would release labor for greater progress in fall and spring field work. (See Figure 1.)

The main emphasis of this study is on chore work in the five winter months, but modifications have been made for the summer pasture season and for the fall and spring periods. These are given special attention in Chapter IX in developing chore schedules for the several seasons.

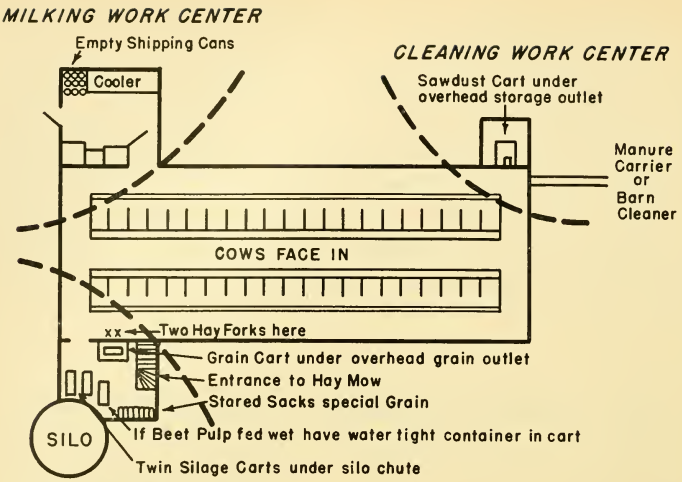


Fig. 4. A plan for three work centers. Each chore begins and ends at a work center.

IV Organization for Chores

Observation of chore work in dairy barns indicates the importance of over-all chore management plans. In some barns there was considerable confusion, workers unnecessarily traveling from one end of the barn to the other. A lack of integration of activities of the different workers resulted in periods of under-employment of one or more individuals. At times, workers under-employed at the moment did tasks that were not essential. As an example, one worker pushed hay to the cows several times in a period of 15 minutes. He did this merely because he had to wait frequently for the other man.

Efficient low labor cost chore work depends on the adequacy and location of facilities, integration and sequence of chore tasks, and general management of workers, as well as simplified work procedure in doing each task. Two important basic chore management principles have been suggested by several research studies.*

1. Plan chore activities around definite work centers.

2. Arrange layout so that chores can be done by circular travel. The conditions under which these principles can be applied may not be easily or economically attained in present dairy barns. But in most instances, if the operator understands the basic philosophy back of these principles, he can improve his present chore situation by partial conformity.

* Vermont Agricultural Experiment Station Bulletin 503 (1943). *Saving Through Farm Job Analysis* by R. M. Carter.

Work Centers

Three work centers are suggested: milking work center, feeding work center, and cleaning work center. (See Fig. 4.)

Milking naturally centers about the milk house, and on most farms all major tasks related to milking, care of milk, cleaning, and maintenance of milking equipment begin and end at the milk house.

The feeding work center can be an area including the silos, the grain room, and the entrance to the hay storage. Silage carts, silage forks, grain carts, grain scoops, and hay forks have a definite and convenient storage place within the area. All major feeding chores begin and end at the feed work center. The equipment or tool used is taken from its definite storage place and returned to that place to complete the task. This eliminates loss of time in looking for tools. If the next task in sequence for the individual worker is associated with that work center, the new task begins without undue travel.

In case all the feed operations cannot be grouped in one area, two feed work centers may need to be used, each one more or less independent as far as facilities, equipment, and tools are concerned.

The cleaning work center is usually the area near the outlet for manure disposal. For instance, the vicinity of the doorway where the manure carrier is pushed out of the barn can be made the cleaning work center. Major tasks involving disposal of manure and cleaning gutter alleyways will begin and end at this center. Equipment and tools used in cleaning would be located there. Since bedding cows usually follows the cleaning operations, the inclusion of storage for bedding and a definite place for the carts and tools used in spreading will be a convenience. On account of sanitation and disease control, the cleaning work center can well be more isolated and the equipment

Fig. 5. A conveniently located milk house, constructed as an addition to the barn.

and tools never used for other purposes. Operators occasionally interrupt whatever task they are doing to hoe the soil back of individual cows into the gutter. This can be held to a minimum, but several hoes can be stored at convenient places for occasional use without undue travel.

Having developed these definite work centers, the sequence of chore tasks and the work schedule of the men can be reorganized so that each man can operate from one center for a considerable time, thus curtailing travel from one work center to another. In a large barn, this may require the assignment of a definite work schedule to each man so that each may confine himself for a longer period to the chores associated with one work center.

Dairy barn chore work is associated with biological processes of the cows, and the nature of the tasks necessarily requires considerable jumping from one task to another and occasionally the interruption of one task to do another. Much time and travel can be avoided if this can be held to a minimum by well-planned work schedules. Definite work schedules for each man provide an opportunity for each man to work productively during the chore period. For instance, in the period after breakfast, one worker might do all the tasks associated with the cleaning work center and the other all the forenoon tasks associated with the feeding center. Workers could exchange schedules by weeks or days if they prefer. But on a given day each has a definite job, and while working in the same barn, they are not in each other's way nor attempting to use the same equipment or tools. Each is doing tasks that one man can do to better advantage than two. There is a better sanitary situation because of fewer trips from the cleaning work center and areas back of the cows to the feeding work center and areas in front of the cows.

A convenient arrangement to reduce travel from one work center to another and to have favorable sanitary conditions is to locate the feeding and milk centers at one end, but at opposite sides of the barn and the cleaning center at the far end of the barn.

Fig. 6. Tools used in the cleaning work centers are in their places. There is no walking from one end of the barn to the other for tools.

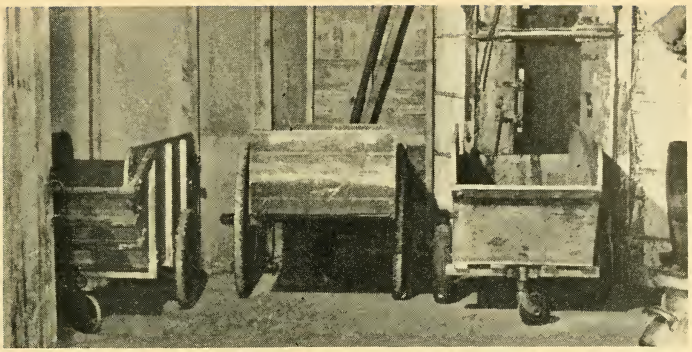


Fig. 7. The operator has provided a definite place in the feeding work center for each cart used in feeding. One cart is never in the way of other activities.

The chore work schedules can then be organized so that all cleaning operations, except the occasional hoeing back of a cow, are done at one period by one man, thus involving only limited travel to and from the cleaning work center. The transfer of a worker's activity from feeding to milking center would involve only travel the width of the barn.

In one barn individual tasks were done efficiently, but the chore records indicated that the man walked 1300 feet daily in traveling from one job to another. With minor changes in chore schedules this could be reduced to 600 feet.

Operators are installing carts for transporting feed and bedding. Observations indicate the importance of special storage space (See Fig. 7) where these can be available (either loaded ready for use or empty) and yet not in the way of other chore work. On one farm, for instance, the operator had to move a grain cart out of the way before he could complete the feeding of silage and later had to move the silage cart in order not to interfere with grain feeding.

The development of a few work centers for doing chores enables the operator to take advantage of improved chore schedules to cut travel, and to simplify placement of tools and equipment.

While these three main work centers are suggested, other satisfactory arrangements are possible. Thus on several farms, the storage place for bedding could not be located at the manure disposal end of the barn because of the difficulty of putting sawdust into it. One operator built his sawdust storage in the feed work center area. This arrangement may not be ideal, but it is workable and practical.

Circular Travel

The arrangement of stalls and alleyways to permit the doing of chores by traveling in a circle as shown in Fig. 8, enables the operator to begin and end most chore tasks at the work center with a minimum of back travel. The tools and equipment needed for a task are back in place and the worker is prepared to start the next job. Grain is fed in one trip around the cows or up and back along the feed alley. Bedding is distributed in one trip around the gutter alleyway. One trip with a

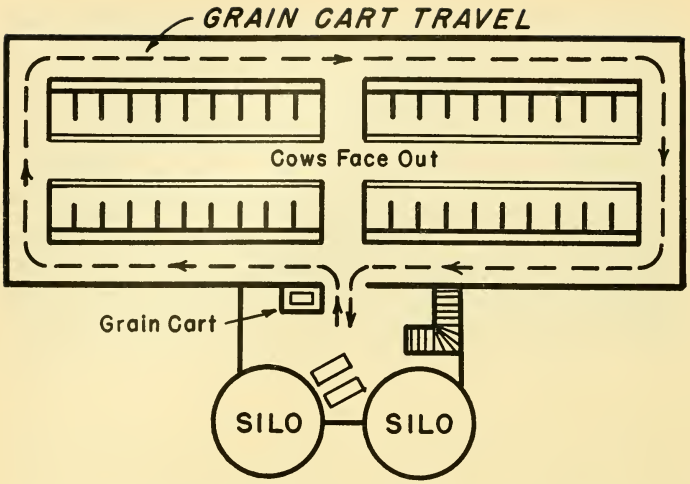


Fig. 8. A diagram of circular travel. Note that the labor on this task begins and ends at the feed work center. The grain cart is in position for the next feeding.

silage cart completes the task except in very large herds where two or more cart loads of silage are needed for one feeding. Even in such cases, the travel of each cart may be in a circle.

Arrangements for circular travel add to and support the effectiveness of good work centers, and well designed and well located work centers enable the operator to take greater advantage of circular travel efficiencies.

V Milking

Milking, washing and care of milking equipment, and the care of the milk house usually require over half the total man hours spent on daily chores on cows during the winter. In the pasture season this accounts for about 80 per cent of the total.

Milking

The milking phase of this study has been reported in Experiment Station Circulars 76 and 80 and so only a few summary comments on efficient milking will be made in this bulletin. Over a period of time, the herd should be selected on the basis of good milking characteristics so that all cows will be milked quickly by machine and without hand stripping. On a few farms studied, from 10 to 20 per cent of the cows were milked by hand. On others, a few cows required over 10 minutes of machine milking. Good milking characteristics should be one of the major qualifications in selecting animals for the herd. If all animals in the herd can be machine milked in 4 minutes or less, the operator can carry on the task of milking efficiently.

The layout and the equipment should favor quick disposal of the milk. The operator needs to get back to the cows as soon as possible. Failure to begin machine stripping within 3 to 3½ minutes after machines are attached was found to be the major barrier to good milking. To avoid delay, the milk receiving equipment should be prepared before milking begins, as in Fig. 9. The 10-gallon milk shipping cans should be in position to receive milk and the covers loosened. Two large strainers should be assembled and in position ready for milk on two of the 10-gallon cans. The operator can carry two pails, holding approximately 13 quarts of milk each, on each trip. He can empty a pail in each of the strainers and return to the stable. Three trips will approximately fill the two cans and on the fourth trip the strainers can be transferred to the next two cans. Under these conditions a trip to the milk house will require from 0.5 to 0.8 minutes.

The operators should train themselves to concentrate during the brief milking period to follow whatever definite pattern is most feasible for their situation. An average man, if trained, can milk normal cows at the rate of 3 man minutes or less per cow per milking. In fact, records as low as 2.1 man minutes per cow per milking were indicated. Efficient rapid milking procedure requires concentration and self discipline in following a definite sequence. If the operator is overtired, is not concentrating, or is disturbed by visitors, he may fail to follow through and become involved in time consuming situations. Observations indicate that most men cannot carry on a conversation and concentrate on milking at the same time. A five-minute rest period just before milking may be a profitable use of time on some farms. The man is then better prepared to concentrate on this definite task of milking. The rest period emphasizes the importance of the task. For detailed information on milking, see Experiment Station Circulars 76 and 80.

Fig. 9. This shows a good arrangement of shipping cans before milking. Note that seven 10-gallon shipping cans have been arranged in a semicircle, the covers loosened and two large strainers substituted for covers on two cans. The mallet for loosening cans is on the milk cooler. The supply of empty cans are tiered up in the corner. The operator ordinarily poured milk from the center of the room, but moved to the wall to show the strainers when the picture was taken.

Care of Milk

The care of the milk on wholesale milk farms consists of making the can covers secure and putting the cans into the cooler tank. In hot weather the operators try to get the cans into coolers as soon as they are full, but usually there is some leeway as to when they are put in. Since the shipping cans are in position near the coolers before the milking begins, the operator can secure the can cover,

lift the cooler box cover, lift the 10-gallon can of milk, and place it in the water. If the recommendations for carrying milk from the stables are followed, two 10-gallon cans will be filled in three trips to the milk house. On the next trip, the strainers would be moved to the next empty cans in line and the covers secured on the filled cans. At this time or on the next trip to the milk house, the two cans can be placed in the cooler in .2 man minutes. The task is easier where the cooler tank is at a lower level and thus the can has to be raised only a few inches from the floor. The displacement of water eases the weight in lowering the can to the bottom. Where the cooler is on the same floor level as the milk house a raised platform with steps is used, but more time and greater physical burden are involved.

None of the operators had mechanical can lifters and most of them were not interested because they thought more time would be needed. A mechanical lifter should no doubt be installed where young boys or older men do this chore. If this task is done during milking by the milker, it is important to do it quickly so that the man is back with the cows as soon as possible.

The truck driver usually takes the cans out of the cooler and this has not been considered as a part of the farmer's chore work. If the cooler

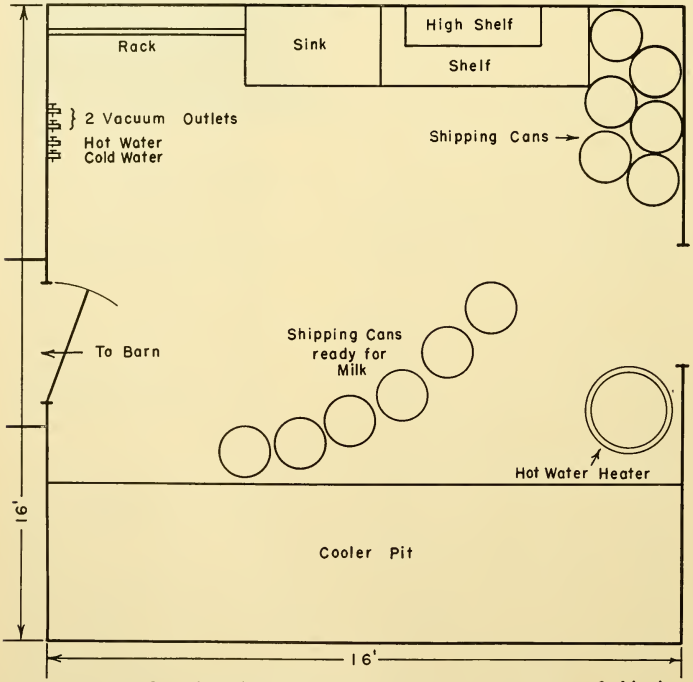


Fig. 10. Floor plan of a milk house, illustrating one arrangement of shipping cans before milking begins.

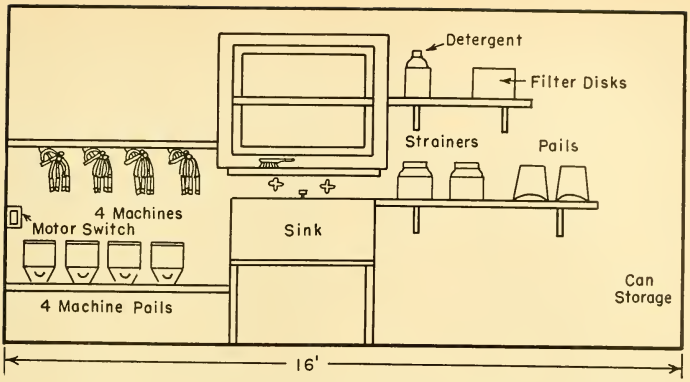


Fig. 11. Side view of milk house interior, illustrating one arrangement of sink, shelves, and milking equipment.

is on a lower level, the lifting is not a great burden for a strong young man. The water supports the cans of milk in the first part of the lift and the man is in a good position to lift when he has the full weight to bear.

Care of Milking Equipment

All farms studied were producing milk for the fluid milk market. The barns and equipment were periodically inspected by agents of distribution companies and health officers. The milk was subject to constant analysis for flavor and bacteria count at the creamery. Each operator was under pressure of possible loss of premiums for low bacteria count and even the eventual loss of his market, if conditions and product were unsatisfactory. Thus the care of milking equipment and sanitation were very important.

Facilities and Practices

Information was obtained on 38 additional large dairy farms as to milk house facilities and practices in care of milking equipment. Twenty-five of these had hot water available in the milk house at all times. Seven of these had installed large electric heaters, and 13 had small electric heaters. Two had hot water piped from the house and three depended on wood or coal heaters. Of the 13 who indicated no continuous hot water available in the milk house, one used no hot water, one brought hot water back from the creamery in the 10-gallon shipping cans, eight carried hot water from the house, and three washed equipment in the house.

Eighteen milk houses were equipped with vacuum pipe extensions, 21 with special racks for teat cups, and 26 with some kind of sink.

There was a wide variation in procedure for taking care of equipment. Eight operators completely dismantled the milking units after each milking. Seven did so once a day, five twice weekly, 13 once a week, and five occasionally. Seventeen washed equipment twice daily and 21 followed the practice of washing equipment after the morning milking and rinsing after the evening milking. No two operators were doing identical jobs and the estimates of time taken daily in care of equipment varied from 15 to 120 minutes. The sample was small and not completely random, but

it gives an indication that facilities vary and that practices are not identical.

What Are Essential Practices?

It seemed desirable to determine the essential practices in taking care of equipment and to formulate at least one schedule that would simplify these practices. This was done with the aid of a dairy bacteriologist in the Dairy Department.

Recent improvements in construction of teat cups and the development of special detergents have aided in simplifying the essential practices. The schedules formulated were based on the use of modern equipment and detergents.

Included under equipment were the assembling of equipment before each milking and carrying to the area in the barn where milking is to begin, as well as the transporting of equipment back to the milk house after milking and rinsing with cold water.

Milking equipment can be cleaned and maintained with less effort if the milk house is well designed and facilities conveniently located. One satisfactory arrangement follows. A sink and equipment shelves are located on one side: the sink in the middle, the shelf for milking machines on the left, and the shelf for milk pails and strainers on the right. Special hooks for hanging up fully assembled milker heads are spaced above the milking machine equipment shelf so that milking machine parts are grouped in one area. Two air vacuum outlets are available on the adjoining end wall about three feet from the milker equipment shelves. A switch for the milking machine motor is located near the vacuum outlets.

On the other side are located the milk cooler tanks and in one corner are stored the supply of empty 10-gallon shipping cans. This leaves the center of the milk room available for activities such as preparation and arrangement of shipping cans previous to milking, transferring milk cans from cooler to truck, and rinsing equipment.

A good flow of hot and cold water is important in reducing the amount of time needed. The pipes and valves should not be less than ¾ inch. Special arrangements should be made to step up the flow wherever the operator has to wait for rinsing water. In addition, hot and cold water outlets with short hose attached should be located near the vacuum outlet. These will permit the operator to fill pails while doing other activities in the milk house.

Inventory of Equipment

Where one man is operating two single units, the following equipment must be cared for. If two men are operating two single units each, the number of utensils would be doubled except that the two strainers are usually adequate, if they are extra size. Some operators use an extra milker pail to advantage. In this case, however, the extra milker pail would be substituted for one of the ordinary milk pails. This is the equipment needed for one man operating two single units:

2 single milking machine units
2 large strainers
3 milk pails
1 pail for hot water solution
1 strip cup
2 large cloths

In addition, the sink, equipment shelves, and milk house floor must be kept clean.

Suggested Procedure

The procedures followed in the suggested schedule in preparation of equipment before milking and in rinsing in clear water immediately after milking are identical for the morning

and evening milking and one description will suffice.

Following the rinsing in clear water after milking, the equipment is washed in a detergent in the morning and merely rinsed in the detergent solution at night. The milker head and teat cups are partially dismantled for washing in the morning.

In considering the tasks involved in preparing equipment before milking begins, it is assumed that following the previous milking, the milking equipment has been cleaned and put in special place as follows:

1. The milker pails upside down on equipment shelf. The milker heads fully assembled hanging on hooks above the milker pails.
2. The milk pails and strainers (unassembled) on the other equipment shelf.
3. The hot water solution pails and strip cups on a small shelf below the milker equipment shelf and the cloths on a rod near by.
4. The 10-gallon shipping cans with covers on tight stacked in the corner, a mallet in a special place near by for loosening the covers.

Preparation for Milking

The following is a summary of the preparation which must be made for milking. Details are omitted.

1. Assemble milking machines on floor near vacuum outlets and rinse by drawing clear water through teat cups and tubes. Rinse milk pails. Rinse strainers and milk pails with water from milker pails. Assemble machines ready for transportation. Assemble strainers.
2. Arrange 10-gallon shipping cans in line or semicircle, loosen covers and put strainers on cans at far end.
3. Carry assembled units and milk pails to the area in barn where milking is to begin.
4. Prepare pails of hot water, attach strip cup and throw in cloths and carry to area where milking is to begin. The last two steps can be combined where special milking equipment cart is used during milking.

Care After Milking

At the end of each milking, all equipment must be carried to the milk room and all parts in contact with milk must be rinsed in cold water immediately. These two tasks can be done quickly if each utensil is carried to the milk house at the first convenient trip after use. Thus the pail of solution, strip cup and cloths, and milk pails can be carried to the milk house and each deposited in the proper place for rinsing before milking is complete. Each milking machine can be carried to the milk house, emptied, and made ready for rinsing.

The milking machine is rinsed by drawing clear water through it by vacuum and then shaking. The rinse water in the milker pail can then be used to rinse the other equipment. This can be done quickly if milk pails are filled with rinse water in advance of need.

Following the rinsing in clear water in the morning, the milking machines are partially dismantled. The long air hoses and pulsators are removed and placed in their proper storage places. The teat cups, milk tubes, and head parts are put in detergent solution in the sink. In order to protect the air openings in the teat cups from the solution, the air hose is removed from half the teat cups and the free end of an attached air hose substituted. Thus a pair of teat cups are temporarily joined by one air hose. The equipment can remain in the detergent solution until the usual washing period. Each part is washed in the detergent solution with special brushes. Then the strainers, pails, milker pails, solution pails,

cloths, and strip cups are washed. Each milker head is fully assembled and put in place on hooks. Other equipment is put in place without rinsing.

Following rinsing with clear water at night, the process of rinsing is repeated using the detergent solution instead of water the second time. The milker heads are not dismantled. The utensils are put in place.

Man Minutes Required

These steps were worked out in detail (not shown here) and checked in a milk room. The following time schedule is approximate:

	2 machines	*4 machines*
Morning		
Preparation of equipment for milking	4 min.	7 min.
Rinsing after milking	3	5
Washing	5	8
Morning Total	12	20
Evening		
Preparation	4	7
Rinsing after milking	3	5
Rinsing in solution	3	5
Evening Total	10	17
Total for day	22	37

To do these tasks in the time allotted above, the operator would anticipate the need for water and solution and would draw supplies of water and make solutions between other activities. He would use two hands to advantage. He would attach two air hoses to the vacuum at one time and rinse two milkers at once. He would experiment in finding the best and quickest routine for doing each task and a sequence that would fit all the tasks together.

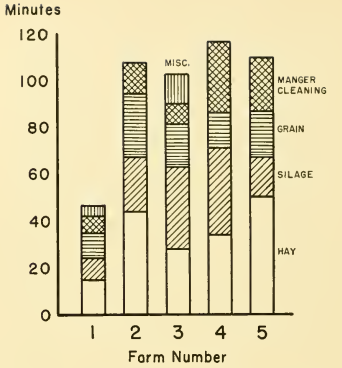


Fig. 12. Man minutes spent on daily feeding chores on five farms in 1948, adjusted to a 40-cow barn. The data for each farm indicate the proportionate time spent on feeding hay, silage and grain, in cleaning mangers, and miscellaneous work associated with feeding.

VI Feeding

The physical task of feeding cows is not identical for all farms due to the differences in combination of types of feed as well as the location of storage of the grain and roughage. While the detailed procedure adopted must be adjusted to the situation on each individual farm, the general program of simplifying the feeding operations is applicable to most farms. Adaptations can be made by each operator.

Approximately two pounds of digestible protein and 15 pounds of total digestible units are needed daily per cow. These nutrients are usually supplied by some combination of hay, silage, and grain. The combination will vary from farm to farm due to availability of different types of roughage and changes in price relationships of grain and roughage to milk. Hay and silage can be substituted one for the other on the basis of one pound of hay to three of silage. Grain can also be varied within limitations depending on the quality of the roughage, price relationships, and capacity of the cows.

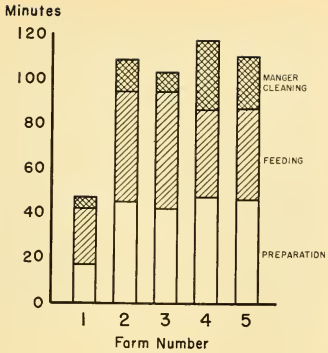


Fig. 13. Man minutes spent on daily feeding chores on five farms in 1948, adjusted to 40 cows. The data indicate the proportionate time spent on preparation of feeds, actually distributing feeds, cleaning mangers, and miscellaneous work. Note particularly the large amount of time used in preparation.

Feed Combinations Vary

The wide differences in feed combinations are illustrated in the following rations:

1. High hay ration, 20# hay, 15# silage, and 10# grain
2. Medium hay ration, 15# hay, 30# silage, and 10# grain
3. Low hay ration, 10# hay, 45# silage, and 10# grain
4. No silage ration, 25# hay, 0# silage, and 10# grain

On the basis of a 40-cow herd, each of these rations means a different weighing of several essential tasks in carrying out feeding operations. As indicated in the following estimates, Ration 3 involves handling half as much hay but three times as much silage as Ration 1.

	Total feed
1. High hay ration 800# hay, 600# silage, 400# grain	1800#
2. Medium hay ration 600# hay, 1200# silage, 400# grain	2200#
3. Low hay ration 400# hay, 1800# silage, 400# grain	2600#
4. No silage ration 1000# hay, 0# silage, 400# grain	1400#

The procedure in feeding a particular combination of feeds can usually be converted into a simple schedule. Thus if several types of grain seem essential for best results in a herd, the process of distributing the several kinds can be simplified and done in one operation.

Experience and tests have indicated that the cow need not be fed several times a day. She has an ample paunch, is endowed with a large digestive system, and has the capacity to function well on two feedings a day. Consequently, the first step in efficient feeding can be the simplification of feeding schedules so that cows are fed only twice daily—in the morning and late afternoon.

The feeding of grain twice a day seems to be good practice, and requires very little additional time. The schedule of feeding roughage can be varied depending on the proportion of hay and silage. A cart load of 600 pounds of silage is about the upper limit of convenient handling. This amount would supply 40 cows with an average of 15 pounds. Thus if the feed of silage is light, one trip around the barn would complete the feeding of silage for the day. Likewise, 1200 pounds of silage would mean two large cartloads and could be handled in two feedings of 600 pounds each. The 1800 pounds of silage could be handled by the use of two cartloads (1200 pounds) at the morning feeding and one cartload (600 pounds) at the evening feed. In the latter case, one feeding of 400 pounds of hay daily could

accompany the lighter feed of silage in the late afternoon.

Thus the feeding of 800 pounds of hay, 600 pounds of silage, and 400 pounds of grain could be accomplished by the following schedule:

Morning
200# grain before milking
400# hay after milking
600# silage after breakfast
Night
200# grain before night milking
400# hay after night milking

On the other hand, the feeding of 400 pounds of hay, 1800 pounds of silage, and 400 pounds of grain might involve the following schedule:

Morning
200# grain before milking
1200# silage, two 600# cartloads, after milking
Night
400# hay before milking
200# grain before milking
600# silage after milking

Thus the operation of feeding in the case above breaks down to the procedures involved in: (1) moving 200 pounds of grain from storage and distribution to cows; (2) transferring 400 pounds of hay from the mow storage and distribution to the cows; and (3) the moving of 600 pounds of silage from the silo to the barn floor and its distribution. These can now be considered one at a time.

Grain Feeding

The feeding of grain consists of two major tasks: (1) preparation, which involves the work in the grain storage, such as the opening of sacks, filling the grain cart, and sweeping the storage, and (2) the actual distribution of the grain to the cows.

A variety of situations exist in present preparation practices:

(1) Grain was stored in 100-pound sacks on the floor above the cows. The operator traveled up the stairs, carried 100-pound sacks to the trap door over the feed floor and dropped them through the opening to the feed alley below. He then traveled down the stairs to the feed floor, opened the sacks and emptied grain into the grain cart. Approximately 100 feet of travel horizontally and a trip up and down one flight of stairs were involved in every feeding.

(2) Grain was stored in a grain room on the same floor as the cows and near the feed alley. The operator opened sacks, lifted them waist high and emptied them into the cart. About 25 feet of travel was involved in going to and from the storage.

(3) A few operators have made special provisions to store grain in bulk on the floor above the cows. At feeding time they draw it directly into the cart by gravity. This arrangement requires very little travel and the work of preparation was done either occasionally or done at the time of delivery of grain. The task

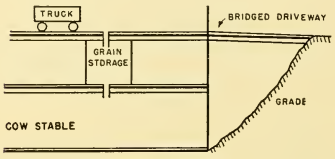


Fig. 14. One method of storing grain on the floor above the cows. Note that when and if grain in bulk becomes available, arrangements could be made to fill the feed bin directly from a dump truck.

of opening and emptying sacks can be done quicker and easier when many sacks are handled at one period. This is because the detailed procedure can be followed and the tools are at hand. In one case the feed company did most of the work of opening and emptying sacks at time of delivery and took the sacks back to the store. The farmer had developed special facilities so that the delivery truckmen could empty the bags of grain directly into the bulk grain storage with less effort than is required on most other farms. The operator had grain available at his control in the feed alley.

Fig. 15A. This grain room is above the feed floor. Grain is stored in sacks on one side of the room. The small bins, with chutes to the floor below, are filled once a week.

The storage of grain in bulk on the floor above the cows and the grain easily accessible near the feed alley seem to minimize the labor required, and should be considered in new or remodeling construction. In some barns it is difficult to arrange storage location so that it is easily accessible for delivery of grain from trucks and also conveniently located for the feeding operation in the floor below. In these cases, a location favoring easy accessibility of grain at the work center on the stable level should be given priority. Having the grain handy on the feeding floor cuts down on the time of operations that must be done at busy periods of the day. It makes the labor more flexible.

The task of getting grain from the grain dealer's truck to farm storage is not within the scope of this study, but it is an important part of grain handling. Usually the grain dealer will deliver sacks of grain to conveniently located storage rooms. On many New Hampshire farms, the delivery truck can be driven onto a driveway floor above the cows, and the bags of grain unloaded into a convenient storage room. Two operators had built one or more bulk storage bins in this room. Chutes extended from these to the feeding floor below. These operators opened and emptied bags of grain into the bulk bins once a week. They could do this at a slack period.

In one case observed, the truck was driven onto a driveway eight feet above the mow floor. A bulk storage bin had been constructed in the space above the cows and immediately below this driveway. The operator hauled his own grain and at the time of delivery opened and emptied the bags directly from the truck to the bulk storage bin. This type of barn is not uncommon in northern New Hampshire and many other operators could take advantage of this plan. When and if grain can be purchased in bulk, provision could be made to dump it directly into the bin.

In order to have grain in bulk above the cows in most modern barns in this state, the grain will have to be elevated 10 or more feet above the floor of the truck. Farmers can locate the bulk bins in the most convenient place for feeding and use special equipment for elevating it. (See Fig. 16.) Such equipment is not expensive and is now available. It is possible that alert grain dealers will become equipped to place the grain

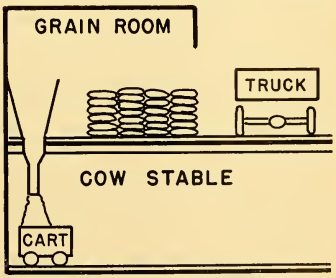


Fig. 15B. This diagram illustrates the handling of grain in Fig. 15A.

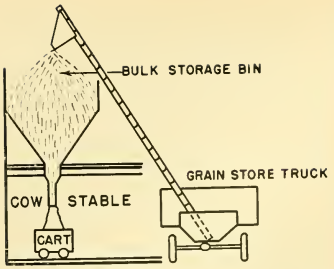


Fig. 16. Illustrating the use of special equipment to fill grain bins. Grain could be hauled to farms in sacks and elevated by machinery. Eventually grain stores may deliver grain in bulk.

mechanically where the farmer wants it.

For the present, the grain dealer could carry portable equipment which can be attached to the rear of the truck when at the farm. He could haul grain in bags to the farm and empty into the hopper of the elevating equipment. In time, if sufficient number of farmers have made the proper arrangements for bulk storage, the grain company might install special facilities for handling in bulk. The farmer, of course, can install his own equipment. The grain could be delivered to the farm in bags and opened and emptied into the elevating hopper. Another plan would be to elevate the sacks to a temporary grain room on the floor above the cows and the operator can open and empty the bags once a week. Incidentally, one poultry operator elevates 10 bags of grain at a time to the top of an old barn with ordinary hay barn equipment. He empties the bags into bulk bins once a week and can draw grain from chutes on three floors below the bins.

This storage bin can be divided to accommodate more than one kind of grain, or with two bins available, loads of the same kind of grain can be alternated to insure using up all old grain before new deliveries are fed. The grain storage capacity need not be large on New England dairy farms since the operator can depend on purchasing mixed feed as needed. Six to eight tons capacity will permit taking advantage of large truck load deliveries and allow for sufficient carry-over in case of delayed supplies. Two bins, each 4 by 6 feet and 10 feet high, will hold about 8 tons of feed which will be sufficient for a 40-cow herd. The bins should be not over 6 feet wide to avoid bridging over. There is no economy in large capacity to take advantage of expected price changes. The individual who wishes to speculate can more conveniently hedge on the grain market.

The arrangement of storage and chutes so that the operator can draw supplies by gravity to fill the grain cart eliminates most of the daily chores involved in preparation.

Fig. 17. The operator is pulling the rope that will fill the grain cart in half a minute or less. This is the same farm as diagrammed in Fig. 14.

Grain Carts

Most operators on farms studied used some type of cart in feeding grain. The range in man minutes per day, adjusted to a 40-cow basis, was from a low of 5.6 to a high of 17.3.

Some of the operators feed several kinds of grain—sometimes they feed special mixtures of grain to some of the cows, sometimes they feed two or more kinds to all the cows. In one case the operator made a round with one kind of grain and then another round with a second type. He took 17.3 man minutes daily.

Most of the operators who used two kinds of grain had a division in the cart and made one round. Some operators fed only one kind of grain which simplified the process.

All the operators were careful feeders and varied the amount to each individual cow. Three methods were employed in distributing the right amount: (1) estimating volume in hand scoop; (2) by weight as registered on scale on special hand scoop; and (3) by actual weight as read on suspended spring scale. The first two methods were quicker than the third.

Some of the grain carts were unnecessarily heavy and awkward. A light, easily maneuvered cart holding only a little more grain than needed for one feeding will be most satisfactory. The operator can estimate the maximum grain he will need at one feeding and build the capacity of the cart accordingly. On a 40-cow farm a cart holding 250 pounds of grain will be large enough. Attention should be given to having the floor of the cart at a level which will enable the operator to move along without undue stooping.

Most dairymen know their cows and can make a circle traveling along one manger and back along the other, feeding 40 cows one feed in a short

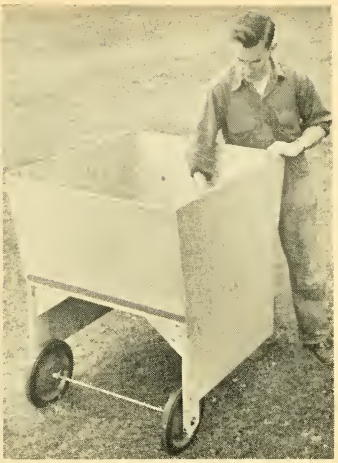


Fig. 18. One design for a grain cart. Note that the grain is at a convenient height for the operator. It is light and handles easily. It was built under the supervision of Paul A. Gilman, UNH Assistant Professor of Agricultural Engineering.

period of 4 minutes or less. If the grain cart storage place is located conveniently, less than 175 feet of travel is involved at each feeding.

The distribution of grain to cows can be mechanized and made more or less automatic, but hand feeding takes so little time that the development of such equipment is not pressing. Feeding grain by hand to each individual cow, even if done quickly, affords an opportunity for special observation of each animal—an important item in the art of successful dairying.

Feeding Hay

The feeding of hay involves two operations: (1) moving it from the place of storage to the feeding floor and (2) its distribution to the cows.

The physical task of transfer from

Fig. 19. One short trip up and back in the feed alley completes the grain feeding task. Note the hay forks in place.

storage to feed alley depends on the form of the hay and the location and type of storage facilities. A number of farmers are operating balers and hay choppers in harvesting hay. Others are exploring their use. While these men may be giving consideration to the harvesting phases of the problem, the handling of the various forms of hay in and out of storage under the various storage situations is very important and needs attention.

Form of Hay

Hay stored as loose long hay tends to bind and is taken from the mow in individual forkfuls. Once on a smooth floor 60 pounds or more can be pushed along rather easily because it holds together as a bunch. Baled hay is thrown from the mow a bale at a time. It handles easily and conveniently. Chopped hay can be raked down hill from the top of the mow. It can be made to "flow" but does not handle efficiently with the ordinary fork. It packs and bridges over. Also it tends to fall apart when forked and without special tools it does not push along a smooth floor very satisfactorily. Thus each form handles differently and each presents a special problem.

Mow-feed Alley Pattern

The many variations in location and type of storage facilities present a variety of problems in getting hay to the feed floor. The amount of physical work and the time required are much greater where hay has to be transported long distances. In most of the old original barns a driveway extended through the full length from end to end, eight feet or more above the ground level. The hay was stored in bents on one side along the driveway. Cows were stanchioned in one line on the opposite side with hay stored overhead. In remodelling these old barns, the cattle have usually been moved to stanchions on the ground level, leaving the upper part of the barn available for hay storage.

These remodelling jobs, together with some new construction, have resulted in about four patterns of rela-

tionship of hay storage to feed alleys.

1. In the first pattern (Fig. 20) the central driveway through the floor of the mow has been retained. This leaves floor space available in the middle of the barn. Hay is thrown from the top of the bents to the mow floor and then is pushed along the mow floor to one or more trap doors. If the cattle face in in the stable below, and if several hay chutes or doors are available, the movement of hay is fairly direct and convenient. There is a waste of storage space.

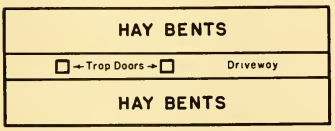


Fig. 20. This mow floor plan illustrates one type of hay storage location. The hay is thrown to the driveway floor and then through trap doors to the feeding floor below. It is fairly convenient but wasteful of space.

2. In the second pattern (Fig. 21) all or most of the driveway has been discarded and the entire floor is available for hay storage. Most of the new barns are of this type; the cows on ground level and the hay stored the full width of the barn overhead. Most of the barns are equipped with hay chutes which extend to the top of the hay. But in some barns a few feet of the original driveway has been retained and hay is thrown from the top of the adjacent mows to the driveway floor and then through the trap door to the feed alley below. As the barn feeding season advances and additional bents are fed out, more and more mow floor space and additional trap doors are available. When hay chutes have been installed the hay is fed out from the top of the mow by throwing forkfuls through the chute to the feed alley below. In this case, if several chutes are available, hay is not moved very far horizontally at any time.

3. In the third case (Fig. 23) the cow stable is to one side and not under the hay storage. Usually a one-story building 34 feet wide extends out at right angles to the axis of the old barn. Hay stored at one end of the mow must be moved the full length and half the width of the barn to transfer it to one end of the feeding floor. Hay must be moved a considerable distance both in the mow and in the feed alley. The cow stable may be on a lower level than the mow floor or it may be on the same level.

4. The fourth pattern (Fig. 22) is similar to the third except that about half of the cow stable and half of the cows are under the mow and the distance that hay must be moved would be only about half as far.

Hay is moved horizontally only small distances in the first two situations described. The hay is immediately over the cows and can be transferred to the stable floor below either directly through long hay chutes or by first pitching to the mow floor and then through trap doors. However, many of the hay chutes

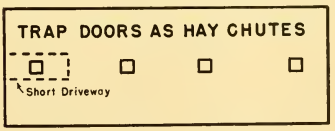


Fig. 21. This was originally the same type as in Fig. 20. Only one end of the driveway has been retained.

were too small in barns of the Fig. 21 type and the driveway in the Fig. 20 type was sometimes clogged with stored supplies and machinery, making it difficult to transfer hay. In one case, because of the blocked driveway the operator pitched hay from bent one to bent two, from bent two to the driveway and carried the hay

in forkfuls to the center of the barn. He spent 18 man minutes of strenuous effort in getting the day's supply of hay to the feed alley. The storage location was convenient but the passageway was blocked.

The average weight movement of hay horizontally in the Fig. 23 type in a 40-cow barn would be about 40 feet in the mow and a similar distance in the feed alley. Some of the hay would move only a short distance, but on the other hand hay in the last bent at the far end of the barn is approximately 160 feet from the far end of the stable. In the Fig. 22 barn, the average movement of hay horizontally is about 25 feet and approximately the same in the stable below. The hay in the farthest bent is about 120 feet from the last cow. Where the cow stable extends out from the middle of the old barn, these distances in the mow would be less.

The physical task in transferring hay from storage to feed alley in these four arrangements are not identical and each operator has to study his situation and adopt a procedure that will be efficient and practical. He will need to reconsider his procedure if he shifts from one form of hay to another.

Hay is usually moved out of the

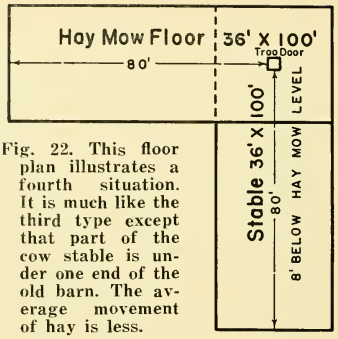


Fig. 22. This floor plan illustrates a fourth situation. It is much like the third type except that part of the cow stable is under one end of the old barn. The average movement of hay is less.

mow immediately before feeding, and the amount handled is limited to the one feeding. Thus about the same amount of travel to and from the mow, usually up and down stairs or ladders, is required without regard to the amount of hay needed for one feeding. To get 800 pounds of hay from storage to feed alley in one barn, the operator traveled approximately 1000 feet per day. This included average travel of 372 feet horizontally and 35 feet vertically, and in addition, moving the hay an average of 40 feet in the mow.

One operator had built several over-sized hay chutes, which would hold sufficient hay for two feedings. Each hay chute had double doors which could be opened and closed from below. The operator would fill these chutes at some convenient time during the day and at the proper time for feeding would draw down the hay from the chute by merely pressing on the door latch with his hay fork. He did not have to leave the stable floor at a time when other chores were pressing.

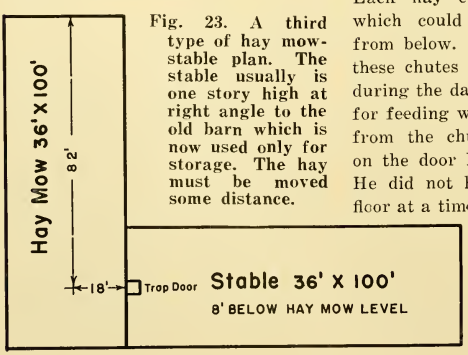


Fig. 23. A third type of hay mow-stable plan. The stable usually is one story high at right angle to the old barn which is now used only for storage. The hay must be moved some distance.

Records taken on individual farms in this study represent the activities on that particular day, and, in the

case of hay preparation, may not be typical for other periods in the barn feeding season. The physical task of moving hay out of storage changes as the season advances. The hay may come from a more difficult location and more hay may be fed when silage supply is low. The man minutes spent daily on hay preparation varied from 3.7 to 18 (adjusted to a 40-cow basis).

Attention has been called in previous pages of the importance of making chore tasks more flexible as to time of day of performance. Preparation of hay is a task that can be reorganized and done occasionally rather than just before each feeding. This type of arrangement may or may not reduce total man minutes expended, but more important, it can afford more flexibility in the use of available labor. In the following discussion on handling the three forms of hay the possibility of arrangements to do this chore only once or twice a week and at some convenient slack period is stressed particularly. More flexibility in the use of labor as well as greater efficiency can be gained by developing special methods of getting hay to the feed alley. Because of the many combinations of forms of hay and pattern of mow-feed alley arrangements, only general problems will be discussed.*

Baled Hay

Baled hay lends itself most easily to special handling methods. It is a compact package 18 x 12 x 30 inches weighing approximately 60 pounds. One feed of 400 pounds will require about seven bales. In one trip to the mow, provision can be made for sufficient bales for several feeds. One procedure in barns with some free mow floor space is to stack enough bales for one feeding on the edge of the trap door opening. These can be tripped (Fig. 24) to fall to the feed alley when needed. One group of bales on each side of the trap door will supply four feedings. With an additional trap door the supply can be doubled to eight feedings. To do this each group of bales is stacked on a quarter-inch rope, one end of which is fastened near the chute. When the bales are in place the rope is thrown over the bales, the free end in reach of the operator on the feed alley floor. A pull on the rope dumps the bales through the trap door.

Another practical arrangement is to balance the bales near the edge of

* As a result of this study, the Department of Agricultural Engineering of the New Hampshire Experiment Station has initiated a project to develop mechanical means of getting hay out of the mow. The Harvey P. Hood Dairy Foundation granted funds to the Experiment Station for this purpose.

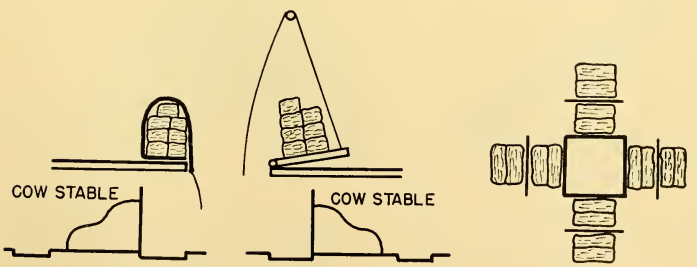


Fig. 24. These sketches indicate inexpensive methods of preparing baled hay in advance so that it is available to the operator from the feeding floor.

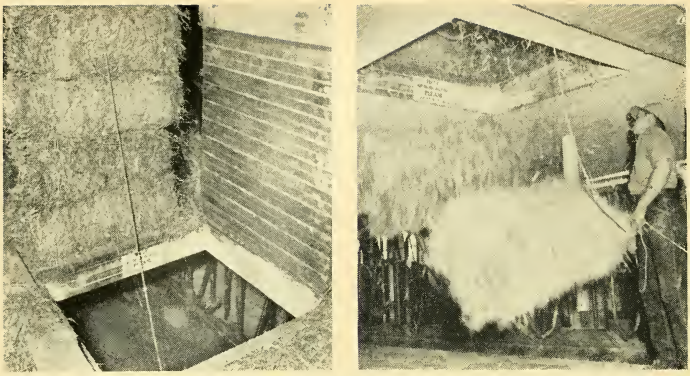


Fig. 25. Actual operation of one method of tripping bales. At left, the bales are in position on the mow floor with the pull rope thrown over them. At right, the operator has pulled the rope and the first two bales are dropping.

the trap door in such a way that a poke with the fork from the feed alley floor will trip the bales.

Another method is a slide extending diagonally from the trap door on the mow floor level to the top of the hay mow. This slide can be loaded occasionally. As the bottom bales are removed, the others will slide down into position to be removed.

Or a moving belt on a light frame operated by an electric motor can be installed. This can be horizontal on the mow floor delivering bales through the trap door or can operate at the top of the mow delivering bales through the chute. The belt could be loaded occasionally and the delivery of bales to the feed alley controlled by push button. One wide belt 30 feet long will hold, stacked two high, about 40 bales or 2400 pounds of hay. This is sufficient for six 400-pound feedings. Stacked four high the belt would hold 4800 pounds and provide eight 400-pound feedings.

Where hay chutes have been installed, the same procedures, with slight modifications, can be worked out using openings to the chute at

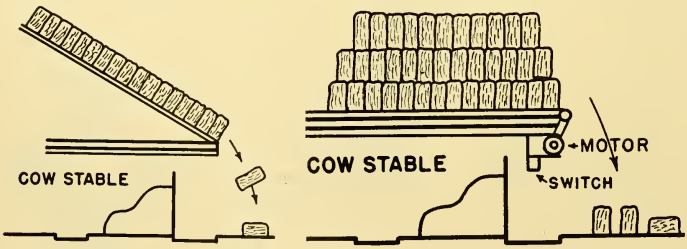


Fig. 26. These sketches indicate more elaborate methods requiring special equipment. The one at the right would require a motor and belt, but in one trip to the mow the operator would load up sufficient number of bales for several feeds.

any level.

In barns where the hay must be moved long distances in the mow such as in Figs. 22 and 23, the electric-powered belt could be used to advantage. In this case a second control switch would be installed at the end of the belt. It could be loaded at the far end as the belt moved toward the trap door or chute. A 40-foot belt conveyer would serve the dual purpose of reducing the hand movement of bales to a nominal amount and of making supplies available on push button control. This conveyor system could be extended above the cows in the one-story stable in barn type 3 (Fig. 23).

Chopped Hay

Chopped hay is usually blown in, filling the entire width of the mow space. Where over-sized hay chutes are installed, these can be filled in advance and the hay drawn down into the stable at feeding time by opening the chute door. Where several chutes are available, sufficient hay for two or more feedings can be prepared in one trip to the mow. At a later season, when the hay must be moved horizontally some distance on the mow floor, a large canvas hammock with ropes attached can be used. This can be filled with hay by so placing it that the hay can be raked down hill. It can then be dragged on the mow floor to the edge of the trap door much the same as long hay is drawn or pushed. At feeding time the chopped hay can be drawn through the trap door by pulling on the rope from the floor below. In this way, by the use of several of these canvas hammocks, hay for several feeds can be prepared in advance.

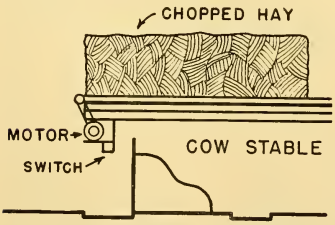


Fig. 28. This sketch illustrates a method of preparing a feeding of chopped hay in advance and making it available from the stable floor.

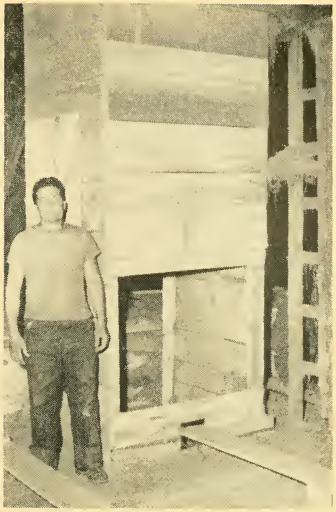


Fig. 27. This over-size hay chute has a trap door at the bottom which can be opened from the stable floor. The operator fills this and three other similar chutes with chopped hay at a convenient time. He can draw down sufficient hay for several feedings without return to the mow.

Another arrangement is a moving belt (See Fig. 28) similar to the equipment in the bottom of a manure spreader.* The belt would move horizontally in a crib on the mow floor. This crib can be filled at a convenient time. Hay is made avail-

* The Agricultural Engineering Department of the New Hampshire Experiment Station is now working on this problem.

able from the stable floor by pressing an electric switch. Since the sides of the crib would be less than 4 feet high it could be filled in the early feeding period by raking the hay downward. At a later period, filling the crib would require more hand work.

Long Hay

In getting long hay out of the mow, the oversized hay chute previously described can be used to advantage in some barns. The crib with a moving wide belt will be effective where free mow floor space is available near the trap door leading to the feed alley. The canvas hammock described under chopped hay can be loaded in advance and then unloaded by pulling the rope from the feed alley floor. Where long hay must be carried long distances in the mow, special arrangements may be made to use the regular hay carrier and track system. Mechanical power (Fig. 29) could be used to raise several hundred pounds of hay any desired height from the mow and carried along the barn and dumped as desired. This procedure can be perfected by engineers.

In barns of the Fig. 23 arrangement, a wooden platform on low wheels could be used near the end of the winter feeding period to transport hay from the far end of the barn. Small quantities of long hay, of course, can be pushed fairly conveniently along a smooth mow floor. In several instances, operators had installed hay mow driers in such a way that the operator had to carry hay rather than push it. More time and greater effort were required.

The task of getting hay out of the mow to the feed alley floor involves more travel and becomes more important as the size of the herd increases and consequently different practices must be considered for a very large herd. For instance, the man with 60 cows, handling half a ton or more of baled hay a day, might use his truck to transport a week's supply of hay from the mow to a more convenient small storage near the feed alley. Under these conditions the hay can be kept in temporary storage some distance from the stable, and supplies trucked in once a week.

In some cases, special arrangements can be made for one or several convenient storage spaces adjacent to the feed alley and so located that they can be filled easily from the mow. For instance, if the cows face in, a room at the end of the barn can sometimes be provided. If the cows face out a room on each side of the barn is convenient. Sufficient supplies of hay for two or three days can be stored in these rooms and pushed out as needed.

Summary

In large dairy barns, the movement of 200,000 or more pounds of hay

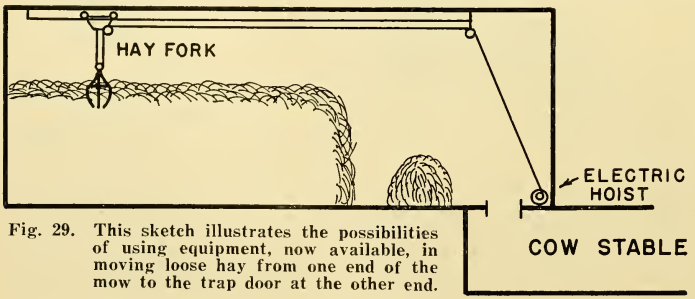


Fig. 29. This sketch illustrates the possibilities of using equipment, now available, in moving loose hay from one end of the mow to the trap door at the other end.

from the mow to the feed floor is a large task even if it is partially obscured by spreading the labor over a long period. In some barns where the hay has to be transported a long distance in the mow, special attention should be given to inexpensive mechanical aids.

More important than the reduction of total physical human effort and man hours is the development of practices that will make this operation more flexible in the demand for labor. If an operator under his conditions finds a way to prepare hay in the mow one day a week so that a week's supply is available to him at his control by push button methods, he has reduced the need of labor at definite peak period times. His available labor can be used to greater advantage.

Distributing Hay

On the farms studied, the range in time spent in distributing hay was 6.4 to 61.2 man minutes daily on a basis of 40 cows. The highest was on a farm where imported Kansas-baled hay was fed, and the lowest was local field baled hay. In the first instance, the operator had difficulty shaking the tightly compressed heavy Kansas bales apart. In the second case, the bales were made by machines that cut the hay in sections during the field baling process. They were light, weighing about 60 pounds each, and fell apart when the binding twine was cut. One operator feeding long hay twice daily spent 19.4 man minutes distributing to the cows (40-cow basis) and one operator distributing chopped hay by cart spent 15.6 man minutes. One year later the time on these farms had been reduced to 12.7 and 9.2 man minutes, respectively.

The distribution of hay to the cows is most convenient when the supply is available at several points in the

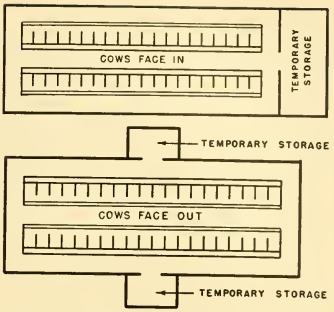


Fig. 30. Small temporary storage space near the feed alley may be useful in feeding hay on some farms.

feed alley and is at the control of the operator from the feed floor. Each form of hay handles differently, but an experienced operator can distribute 400 pounds of hay for one feeding to 40 cows in about three minutes provided the hay is available at several points. If the hay is available only at the end of the barn, the operator will require more movement of hay and will take longer to complete the operation. In the case of chopped hay, the use of a cart is practical if hay has to be moved some distance. The cart can be filled by gravity from storage above. The hay can be forked out or partially rolled out of the cart with a special silage fork. The operator can usually move the cart by pushing it with the fork so that little time is lost. The special silage cart with unloading device can be used to advantage on some farms. The cartload of feed for 20 cows was distributed in 1.5 man minutes.

A load of 250 pounds of chopped hay, which represents one feeding for 20 cows, is about the limit of convenience in handling by cart. In feeding 40 cows, facilities for filling the cart by gravity from above at each end of the barn would be most

satisfactory. The operator would start with a full cart at one end of the barn, feeding 20 cows in one line of stanchions. He would fill the cart at that end and feed the cows in the other line on the return since hay would be taken out of both ends of the barn.

About seven bales will be needed for one feeding of 40 cows. Operators usually carry or lug one bale at a time on the feed alley floor leaving a bale for each group of five or six cows. They then break open the bales and quickly distribute slices of hay to the individual cows. On one farm where the hay was delivered from the mow to one end of the feed alley, the operator carried one bale at a time traveling nearly 500 feet. He now plans to use a low platform hand truck with a capacity for one feeding of hay.

Feeding Silage

On a few of the farms, the operators were handicapped in feeding silage by poor silo location and narrow doors and passage ways. A major and expensive remodelling job would have to be completed before the task of handling silage could be done quickly. In one case, for instance, the bottom of the silo was 10 feet below floor level and the last 40 tons had to be pitched upwards. In another case where conditions were favorable, the operator forked approximately 600 pounds of silage from the silo directly into a large cart and distributed it to 40 cows in 10.8 man minutes. Preparation took 5.6 man minutes and distribution 5.2 man minutes. The same task by another worker in the afternoon of the same day took a total of 15.3 man minutes. A longer period in the silo was partly due to taking silage from the most distant area.

Preparation

Throwing silage directly into the cart was the usual practice. The few exceptions were where the present layout was not favorable for the use of a cart. Most farmers planned to throw out sufficient silage for one feed at some convenient slack period. But sometimes the routine of chores was such, especially if the cart was used for other purposes, that the operator had to fork out silage at a very busy chore period. Since 600 pounds of silage is all that can be conveniently handled on one cartload, the feeding of 1800 pounds of silage daily would involve three trips to the silo.

It is suggested that sufficient cart volume be available for at least one feed. Where 1800 pounds are fed to 40 cows, the procedure might be to feed 1200 pounds in the morning and 600 pounds at night. Twin carts so constructed that both could be placed side by side under the silo chute would enable the operator to obtain the 1200 pounds in one trip to the silo*

Transporting Silage

Carrying silage in baskets is, of course, obsolete. Attention should now be given to the design of carts that can be handled easily and the silage distributed quickly. Where the silage is forked out of the cart, the rear end and sides should be so designed that the operator, as far as possible, moves the silage sidewise and downward and avoids raising each individual forkful a foot or more. Since a large load may weigh over 600 pounds, well designed wheels and bearings will be an advantage. One of the difficulties noted was the extra time and heavy physical work required to turn a large cartload of silage around a 90-degree corner. If the front wheels are placed well back

* Silo unloaders are available on the market but these are somewhat complicated and expensive. None was in use in this state for observation. Also, a special silo has been developed which enables the operator to take silage out from the bottom of the silo mechanically. This is in the experimental stage and expensive.

Fig. 31. Silage is distributed quickly to waiting cows. The cart is still in the experimental stage and is being designed.

and the back wheel is on a swivel, the turning will be easier.

A special cart was made to unload and distribute silage. By means of a revolving belt operated by a hand crank, the silage was moved out of the side of the cart. On several trials sufficient silage for a feed for 20 cows was distributed in an average of 1.1 minutes. Including the travel to and from the silo, 600 pounds of silage can be distributed in 4 man minutes or less.

Miscellaneous Feeds

Several operators added small quantities of special feed to the ration to give variety and to stimulate appetite. The usual practice was to feed these extra items at noon or some special time during the middle of the day. On one farm, low quality hay was fed in the morning. At noon a limited feeding of high quality rowen was fed on the theory that the cows would eat more total roughage. Incidentally, this was one method of using up low quality hay. The operator will soon have a larger proportion of good quality legume hay and there will then be no advantage in feeding several times a day. The need to feed cows more than twice a day is perhaps debatable, but if these special feeds can be mixed with regular feeds or omitted entirely, greater labor efficiency will result.

Where the operator feels that special feeds are essential to economic production on his farm, he should give special attention to the labor efficiency of this extra feeding. If, for instance, an operator is mixing 100 pounds of beet pulp with 300 pounds of water and feeding it to 40 cows

Fig. 32. For a special feed mixture of beet pulp and water, a steel drum or wooden barrel on wheels can be made to distribute the mixture quickly.

Fig. 33. Where the operator swept feed to the cows (above), it took 4.8 man minutes. With a scraper (below), it took him only 0.45 man minutes.

in the middle of the day, he can make use of a steel container or a wooden barrel on wheels. He can prepare the mix in a slack period and at the proper time distribute the feed quickly with this cart and a shovel. To distribute this material by shovel from a stationary position in the stable involved travel, time, and energy.

Pushing Hay to Cows

Cows have the annoying habit of nosing feed out of the manger into the feed alley. Operators push or sweep the feed back into the mangers several times a day. For instance, one operator did this seven times a day. He used a small broom and used 14.1 man minutes daily. The task was done more often than essential and the equipment for doing it was inadequate. One operator used a light wooden pusher for this purpose with good results. On one farm where the cows face out, a special wooden pusher was designed by

the leaders of this project to fit the particular situation. With this pusher, one trip at a normal walking gait around the circle of the feeding alley, traveling a total distance of 210 feet in one minute, served the purpose. How much sweeping is essential may be a personal matter, but twice a day should be sufficient.

The design of the manger has a great deal to do with the habit of cows in nosing feed into the alley. One operator, in remodelling his stable, built a flat bottomed level type manger. The manger extends out from the stanchion on the level for two feet and then rises only three inches to the feed alley (Fig. 34). Cows do not throw the feed around very much. Fewer trips and less time is required to push it back.

Cleaning Manger

Practices in regard to cleaning the mangers varied greatly. One operator swept the manger twice daily with a small broom averaging about 15 man minutes daily on a 40-cow basis. On another farm, the operator cleaned the manger less than once a week. The need for a thorough frequent cleaning apparently depends on the type and quality of the feed.

The operator who cleaned the manger only occasionally seemed to have clean mangers. He was a heavy feeder and yet the cows seemed to clean up the feed in the mangers. The flat-bottomed manger is more easily cleaned than the curved manger. A wooden pusher designed to fit the mangers or a push broom of the right size can be used.

A curved push broom with stiff fibre was made for one operator who had the conventional curved manger. A stock steel broom 34 inches wide was bent to conform to the curve on the manger. One trip around the feeding circle was adequate except when there were large accumulations of uneaten roughage.

Some of the labor directed to cleaning mangers and frequent pushing of feed to the cows results from short periods of under-employment. Where one worker is waiting for another because of faulty timing, he tends to

Fig. 34. Level mangers lessen the scattering of feed by cows.

Fig. 35. This curved manger took 4.5 man minutes to sweep with an ordinary broom (above). With the curved broom (below), the time required was 2.45 man minutes.

keep busy even if the task is not essential at that moment. This habit was probably acquired when operations were small and labor was cheap. But it has been maintained in a period of high wages.

Summary of Feeding

The daily task of feeding cows varied greatly on the farms studied. Adjusted to a 40-cow basis, the highest record in labor used was 145.8 and the lowest was 47.7 man minutes.

The time and ease of feeding can be reduced on most farms by:

1. Organizing a work center for feeding operations—a place where all daily feeding tasks begin and end. This is especially desirable in planning a new barn or in remodelling an old one. The silos, the grain room, and the entrance to the hay storage can be grouped in one general work center area. The silage and grain carts and all the small equipment used in feeding should have special places. The feeding work center should be located not too far from the milk work center. If this is done, a shift from a feeding chore to a milking task or vice-versa will involve as little travel as possible.

2. Organizing the stall arrangement so that each operation can be done in a trip around a circle, thus avoiding back tracking. If cows face out, feeding grain involves one trip around the barn beginning and ending at the work center.

3. Simplifying the feeding operations into the essential things. Eliminate the frills. Have as few kinds of mixture of concentrates as possible. Mix grains instead of feeding several grains separately.

4. Using well-designed carts for grain and silage. Have a special place for each cart so that it does not interfere with other chores.

5. Making special arrangements so that feed preparation can be done in advance, thus making labor requirements more flexible and reducing total time.

The actual distribution of feed, not including preparation, can be accomplished in 5 trips around the feeding alleys at total travel of about 1400 feet in 22 man minutes.

The table below shows the man minutes required under ideal conditions to distribute feed to 40 cows. It does not include preparation.

Thus if the preparation work can all be done in advance, one man can do the feeding at the proper time very quickly. If an operator is spending more than 60 man minutes per day in feeding 40 cows, special attention might well be given to exploring possibilities of readjustments to reduce the time.

Minutes Required to Feed 40 Cows

Feed	Amount total (pounds)	Per trip (pounds)	N. of trips	Travel Per trip (feet)	Total (feet)	Time required per trip	Total (man minutes)
Grain	400	200	2	215	430	3.5	7.0
Hay	800	400	2	340	680	5.0	10.0
Silage	600	600	1	215	215	5.0	5.0
All feeds	1800		5	257	1325		22.0

VII Cleaning and Sanitation

Under cleaning and sanitation are grouped six tasks that are concerned with removing material from the gutters, maintaining clean and dry bedded stalls and clean alleyways. These are:

1. Manure disposal—moving manure out of the stable; 2. Hoe to gutter—scraping manure from stall to gutter; 3. Scraping alleyway—cleaning the alleyway back of cows; 4. Preparing bedding—getting sawdust from storage to stable; 5. Bedding—distributing bedding to stalls; and 6. Superphosphate to gutter—distributing superphosphate into the gutter.

There is some difference of opinion as to how often and how well some of these individual tasks should be done. Most of the farms are subject to rigid inspection by health boards of the markets served. Better dairymen wish to maintain a presentable appearance, have the stable sanitary and free of odors, and the cows comfortable. This induces some of the men to do some phases of the cleaning operation more frequently than is essential for practical wholesale dairy farming.

With wide, deep gutters, the cleaning of gutters and the spreading of sawdust bedding once a day should be adequate and practical. Operators are using more sawdust than formerly. Consequently there is less need for frequent distribution.

Manure Disposal

In the winter stabling season approximately 50 pounds of feces and 20 pounds of urine are discharged daily per cow. About 10 pounds of sawdust per cow applied as bedding is eventually added to this, making a total of about 80 pounds of material which must be removed daily from the conventional stall-type barn. Thus in a 40-cow stable, about one and one-half tons of material must be moved from the gutter to the manure spreader or to the manure pile daily. In the course of the year approximately 300 tons would be moved.

The complete task of manure disposal involves the work of transporting to the fields and distribution to the land. But since this project is limited to barn chores, the work associated with spreading was not included. The work of filling the spreader direct from the carrier or the barn cleaner was included. But not included were the time required to get the tractor started and attached to the spreader and the actual travel to and from the field and spreading.

Most of the dairymen with modern stables were spreading manure each day throughout the barn stabling season. In fact, about one-half of the operators allowed themselves no other alternative. They had no provision to pile the manure. So it had to be carted away from the barn every day. Some of the operators

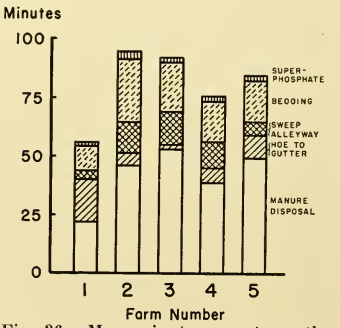


Fig. 36. Man minutes spent on the daily routine of cleaning cow stables on five farms in 1948.

were supplying markets where the inspection provisions compel the operator to remove the manure from the barn vicinity every day. The usual barn cleaner installation provides no alternative.

This is discussed in some detail because, while the practice of hauling and spreading manure each day is good management, the practice with no alternative provision makes the task very inflexible as to labor requirements. The operator has to start his tractor, connect on to the manure spreader and distribute two loads of manure every morning no matter what situation is at hand. If the operator could divert about 10 per cent of the winter's total manure supply to a pile to be hauled out in the spring, he would have a more advantageous control over the daily labor requirements. The greater flexibility afforded by the alternative of dumping on a pile would enable him to plan more easily for days off for labor and avoid complications in the event of emergencies. The spreading of manure throughout the winter enables the operator to begin spring work unhampered and is a good management practice. Provision for diversion of not over 10 per cent of the total might enable him to distribute his available labor to better advantage.*

The removal of a ton or more of manure daily from the dairy stable is a major task. On the farms studied it was transported from the barn by wheelbarrow, by combination truck carrier, and by mechanical barn cleaner. Observations on use of wheelbarrow on large farms indicated both greater time spent and harder work. There were time losses in each trip in getting out of and back into the barn. If a wheelbarrow is used, a special two-wheeled outfit will ake less physical effort but will require better facilities outside the barn.

The combination hand truck and carrier worked very well and provided alternative procedure each day. The operator could unload directly into the spreader or push the carrier to the end of the track and dump on a pile. Considerable physical exertion was needed to push the load to the end of the barn and to elevate the bucket to the carrier. On one farm the operator had installed a motor and special elevating equipment at the end of the barn. By throwing the hoisting chain over a special pulley and pressing the motor switch, the carrier could be elevated from the hand truck to the carrier track. Special equipment for elevating carriers is now available. It can be attached to the carrier, enabling the operator to do that part of the task quickly and easily. On one farm a young man disposed of the manure from 40 cows by truck and carrier in 40 man minutes. On another farm a total of 45.2 man minutes were required to remove manure from 40 cows. In this case five carrier loads were taken in the morning and two loads in the afternoon. It is estimated that the average man, following a normal working speed, should be able to remove the manure from 40 cows in an hour or less daily. However, this represents hard physical and somewhat disagreeable work. Many older operators are not equal to the task.

One operator used 59 man minutes daily in 1949, adjusted to a 40-cow herd basis. In 1950 this had been reduced to 17.5 man minutes by the use of the mechanical cleaner. This included the removal of openings and ramps in preparation, the closing of openings and return of ramps at the end, as well as attention to leveling the load at the spreader.

The use of gutter cleaners is com-

* This problem might well receive the attention of agricultural engineers. A simple solution that will work in sub-zero weather would be a real help to large dairy farmers. (See Appendix 2.)

paratively new and is restricted to a few farms. No attempt is made here to analyze the problem and make recommendations, except to suggest that the decision to buy should be made on the basis of the individual situation. A young man with limited capital may well come to the conclusion that he can allocate his available capital to other more pressing needs to greater advantage.

On the farm mentioned above the gutter cleaner (Fig. 37), costing about $1900 installed, saved approximately 40 man minutes a day or about 133 hours a year. The farm, carrying 50 cows and 25 head of young stock, is operated by an elderly man and his son. The father can no longer do the hard physical work of shovelling manure out of the gutter, but he can handle the spreader and he can press the switch. The availability of the barn cleaner enables him to function as a full time worker. The father and son can, if necessary, do all the chores associated with a herd of 50 cows. In this case, the large investment did not seriously curtail other needs and was a sound and economic decision. It gives more flexibility between father and son in doing the chore work and can be paid for from current income.

On some farms the mechanical cleaner may be practical. On others the operator can well continue with his truck carrier combination. He can motorize the carrier lift mechanism and save some handwork. Nevertheless, the trend, as dairy farms become larger, will probably be toward mechanical barn cleaners, partly because men prefer pressing a button to standing in a gutter shovelling manure. It is easier to get and hold good help. Hired men like to press buttons, too. In case of labor shortage or emer-

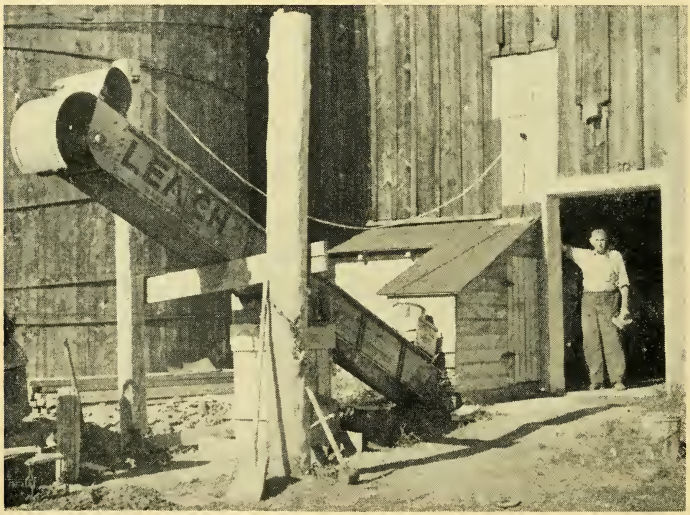


Fig. 37. This older operator has substituted the electric switch for the manure shovel. This enables him to continue as a full time worker. Although he could no longer do the hard physical work usually associated with this task, he can drive the team or tractor and he loves to turn the switch.

Fig. 38. This homemade barn cleaner dumps the manure on a concrete manure pit floor some distance from the barn. Under favorable conditions the operator can clean his stable in 11 minutes. He can load directly into the spreader but prefers to let it pile up and use tractor loader and spreaders in the spring and late fall.

gency, the operator is not completely helpless. But the young man developing a farm cannot have everything at once. He must give careful consideration to other needs before investing in a barn cleaner.

Hoe to Gutter

The soiling of the platform and the need to hoe down to the gutter varies greatly from farm to farm. Arrangement of stanchions and size of stalls are a factor. Cows apparently vary in their habits. Some are very clean. Occasionally a group of cows are very dirty in this respect.

On some farms the operator made the rounds quickly twice a day, and very little attention was given at other times. On other farms the task was done frequently. The total time varied from 1.7 to 18.7 man minutes adjusted to a 40-cow basis. The total time may not be important but often other chores were interrupted.

Deep, wide gutters and proper adjustment of stalls to the size of cows are aids in keeping platforms clean. There is some evidence that cows can be trained to take a position in the stall which results in less soil on the platform. One operator had

Fig. 39. Sweeping the gutter alleyway (above) took 3.1 man minutes, while scraping (below) required 0.48 man minutes.

a group of older cows that were difficult to keep clean. He installed an electric fence wire just above their withers. This induced the cows to back up to the edge of the gutter before eliminating urine or fecal material. It resulted in a cleaner platform and less need for hoeing material to the gutter. The electric current, of course, had to be turned off during milking and while currying. The operator thinks he can train young cows so that they will tend to keep the platforms clean after the electric fence is discontinued.

The labor in hoeing down can be kept at a minimum by a trip around the barn twice daily and occasional attention to an individual cow. Travel and time can be conserved by having one hoe placed at the work center and several other hoes available in

definite places immediately back of the cows. It is also suggested that attention be given to adjustment of stalls and that the electric fence wire be used on individual cows that give trouble.

Scraping Alleyway

Most of the operators kept the gutter alleyways clean by sweeping with a stiff narrow brush. This was done twice or more times a day. This task took from 3.4 up to 27.5 man minutes daily, adjusted to a 40-cow basis. On one farm the operator swept the alleyway clean twice daily, then covered with a light coat of sawdust, using a hand rake to even it up. The stable looked clean and nice. It may not have been more sanitary. On one farm, the operator used a 14-inch steel scraper which he held at an angle and pushed as he walked the full length of the alleyway. About four trips around the barn completed the task. He did this once a day in 3.4 man minutes with satisfactory results.

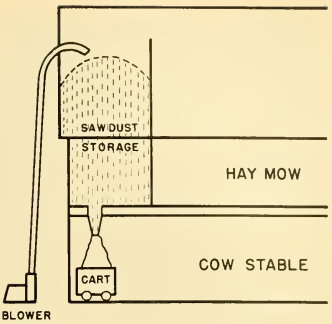


Fig. 40. An illustration of sawdust storage on one farm.

The leaders of this project constructed a four-foot steel scraper which enabled the workers to do this task satisfactorily in one trip around the barn. This required 1.8 man

Fig. 41. This shows the trap doors leading to the sawdust storage. They are filled directly from the truck.

Fig. 42. A view from the stable alleyway looking into one of the sawdust storage bins.

minutes for each trip.

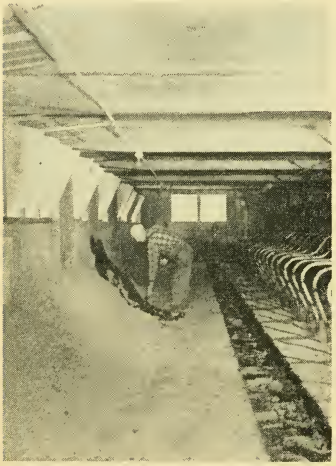
In barns with wide, deep gutters, the alleyways can be kept clean with one scraping daily by using a special four-foot steel scraper. In a 40-cow barn, this will take about two man minutes per day.

Preparing Bedding

In recent years better dairymen have increased greatly the amount of sawdust used for bedding. It is estimated that about one-fourth bushel or approximately 8 pounds daily are used. This is over 10 bushels daily or approximately 2,000 bushels yearly per 40 cows.

Most operators had no very definite plans for storage and small supplies were obtained at frequent intervals. A few men have made provisions for storage by remodelling their barns.

Several operators have provided storage space for sawdust in the hay



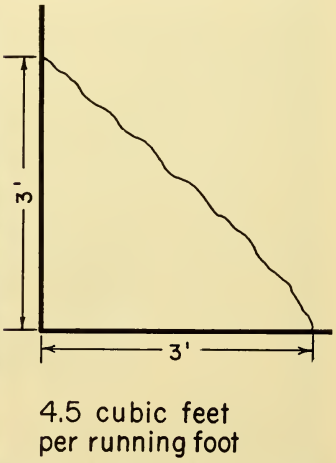


Fig. 43. Sufficient space to store 1000 bushels of sawdust was provided when this barn was remodelled. The sawdust is shoveled directly from the truck through the windows. The operator is taking a shovelful of sawdust and is about to make a half turn and then spread it over the stall platforms. The diagram at right shows a section view of this storage method which will hold 4.5 cubic feet for every running foot along the stable floor. Compare this method with the one shown in Fig. 44.

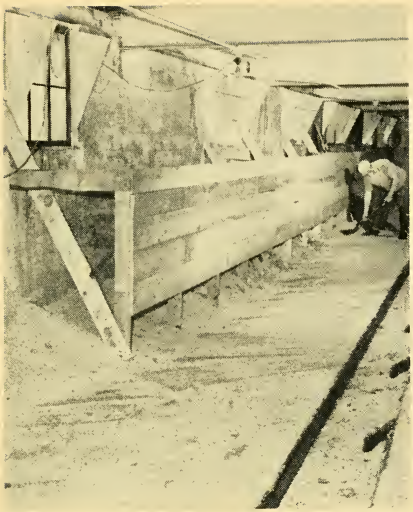


Fig. 44. In this method of stable storage of sawdust, it is possible to store 8 cubic feet of sawdust for every running foot along the floor. In the barn shown at the left, wood supports are used in place of the steel posts pictured in the drawing. The sawdust is shoveled into this storage bin from the window, the same as in Fig. 43.

mow and made provisions for drawing supplies on the stable floor by gravity as needed (Fig. 40). In two instances the sawdust was blown into the storage. In another two instances it was shovelled from the truck which had been driven onto the hay mow floor. The storage bin should be lined with tar paper or other material to prevent rot of barn timbers. One man, in remodelling, provided a concrete ramp (Fig. 41) at the end of the barn. He can unload conveniently and the sawdust is available through large doors from the stable to the concrete storage.

It is important to have large storage supplies conveniently located so that trucks can be unloaded easily and the material made available at a handy place. Sawdust can be loaded on trucks and unloaded by mechanical means. Securing and hauling of sawdust has become a major problem on many large farms. In extreme cases, as much as 14 hours of man labor have been involved in one truck load of sawdust—due to waiting in turn at the sawdust pile, the long haul of 40 or more miles, and the hand shovelling involved in loading and unloading.

The interest of the industry would be advanced by the development of special custom services in which one operator develops special equipment to load mechanically at the sawdust pile and has his truck equipped to deliver mechanically and quickly to any storage bin.

On two farms fairly large supplies of sawdust were stored in the gutter alleyway along the outside walls of the stable. For example, in a newly remodelled barn the old structure was 40 feet wide. The operator built two rows of stanchions with cows facing in. This left a very wide alleyway

back of the cows (Fig. 43). He was able to store 1000 bushels of sawdust without handicap to the other chores. Sawdust was unloaded directly from the truck by shovelling through the windows. A mechanical unloader would save some labor in this operation.

Bedding

On a number of farms, the sawdust was carried from storage in bushel baskets and spread by pushing it out by hand. This method required a large amount of time and travel. For instance, on one farm in bedding 40 cows, 9 trips were made to storage requiring 1170 feet of travel and 13.5 man minutes. On farms where sawdust was stored immediately back of the cows, the sawdust was spread by scoop very efficiently. Due to inconvenient storage location, bedding took about 30 minutes on two farms.

On one farm a special cart, large enough to hold the daily requirement, had been constructed. This was filled by gravity from above. Approximately 3.4 man minutes, adjusted for 40 cows, were required.

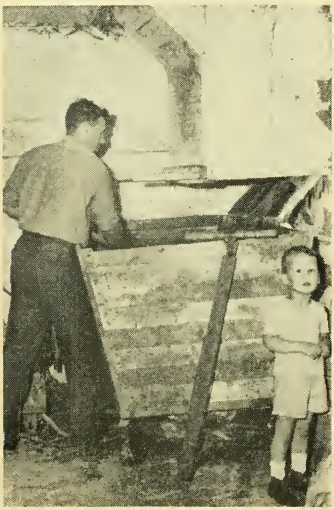


Fig. 45. This sawdust cart is filled quickly by gravity from an overhead bin.

There is no one best way for storing, handling, and spreading bedding. It is suggested that the operator provide convenient storage for at least 25 bushels per cow, which would be about half the annual need, and adopt one of the several good methods for spreading it quickly and easily once a day. Five man minutes daily for 40 cows should be sufficient for this task. All work of preparation can be done at some convenient time.

Superphosphate to Gutter

Most dairymen were spreading about one and one-quarter pounds of superphosphate back of the cows. Those with gutter cleaners discontinued this practice and instead added superphosphate to the spreader load. Most operators used a pail and pushed the material out by hand as they walked along the gutter. In larger barns some of them made two trips because the pail did not hold a sufficient amount for the entire herd. This task took from 1.2 to 6.5 man minutes for 40 cows. The operator with the lowest time had superphosphate stored in one corner of the barn and had sufficient animals to warrant the distribution of a 100-pound bag a day. He tore a small hole in one corner of the bag, picked up the bag, regulated an even flow of material from the hole, and walked quickly around the barn. A special bucket holding 50 pounds, sufficient for 40 cows, can be devised for spreading superphosphate. This has a controlled opening in the bottom which enables the operator to spread the superphosphate as he walks along. This could be mounted on a wheel if the 50 pounds seemed to be a burden.* •

* A special superphosphate gutter spreader is now manufactured and can be purchased.

Fig. 46. This illustrates one way of getting sawdust from storage. The small wheels on the cart are hidden by the doorway.

Miscellaneous Objects

A few operators have a tendency to accumulate items in the alleyways, ends of the barn or window sills. These cause extra work. Many of these items are obsolete and have no association with care of cows. It is suggested that a neat cabinet be built in a convenient place for storage of essential items and that all other things be removed from the barn.

In summary, the stable with 40 cows can be adequately cleaned and cows bedded in about 25 man minutes provided a modern barn cleaner is installed and convenient sawdust storage and handling facilities are available. With the use of the combination truck carrier, approximately 55 man minutes would be needed.

VIII Miscellaneous Chores

Two chore practices, currying and turning cows out, were not performed daily on all farms. About half the operators curried cows daily, usually doing a more thorough job when time permitted. The others curried only occasionally or not at all. Likewise, in turning cows out, practices varied greatly on different farms. A few men never turned cows out during the barn housing period. Quantitative data are not available to indicate the results of either practice, but both were considered as daily chores even though they may not be as essential as the other tasks.

Currying

The animals in barns where daily currying is practiced were cleaner

and looked better. The general appearance of the stable was more favorable.

In fluid milk areas where dairies are inspected by health officials and visited by consumers, clean cows are an important public relations item. Cows that receive this extra attention may give slightly more milk, but the value of the extra milk may not be sufficient to cover the extra labor. The amount of currying will depend on the situation with respect to other income opportunities for the available labor.

Several operators spent approximately one man minute per cow daily in currying. Vigorous hand currying for forty minutes is a fairly strenuous task, and operators were interested in trying out mechanical aids.*

Turning Cows Out

Turning the cows out once a day, except in very severe weather, also has merit. The cows have an opportunity for limited exercise and the operator can better note the cows in heat.

On one farm cows were turned out by one worker at the rate of 5 man minutes for 40 cows. He started at one end of one line of stanchions, walked along the feed alley, and released one cow at a time. He had trained his dog to keep the cows moving along. The first cows were thus prevented from blocking the doorway and dirtying up the alleyway with droppings. On this occasion the operator took odd moments between chores to observe cows. He noted cows in heat. Two men got the cows back in their proper stalls and tied up in 5 minutes or a total of 10 man minutes. Silage had been distributed and the cows were prompt in getting to their stalls, although some attention had to be given to a half dozen cows who entered the wrong stalls. Thus on this farm 15 man minutes were taken for the total operation of cows "out and in."

On another farm the cows faced out and the doorway at the end was eight feet wide. The cows went out and came in without difficulty. The time was approximately the same as in the case of the other farm.

Observations indicate a difference in the way cows go to their proper stall when entering the barn. On a few farms most of the cows went directly to their places. On some farms there was considerable confusion and extra time and patience was required to straighten this out. In several instances there had been no change in location of cows for three or four months and there seemed no particular reason for so many of them going into the wrong stalls. This may be a matter of habit which might be changed over a period of time if the operator made a special effort to keep them moving to their right stalls. Perhaps he could, at first, let only a few in the barn at one time and follow up with an attempt to get them rather quickly into their proper places.

The practice of turning cows out each day affects the time and the order of doing other chores. Bedding can be done to better advantage when the cows are out. The alleyway back of the cows may need extra attention.

On some farms animals on one side have to move across the feed alley. The operator has to give special attention to cleaning this area and even then the sanitary and disease control is not ideal.

Several men who do not turn out their cows indicated they had trouble with cows slipping on concrete stable floors when entering the barn due to

* Several mechanical devices are on the market. One type is a vacuum cleaner and another type uses revolving brushes.

Table 1

Summary Estimates on Man Minutes to do Daily Chore Tasks during Winter Period. Adjusted to a 40-cow Farm (35 cows milking). Estimates do not include occasional chores.

	Man Minutes daily	
Milking		
Milking	175	
Care of milk	5	
Equipment	45	
		225
Feeding		
Hay preparation	10	
Hay feeding	10	
Silage preparation	10	
Silage feeding	5	
Grain preparation	1	
Grain feeding	6	
Push feed to cows	2	
Sweep manger	2	
		46
Cleaning		
Manure disposal	40	
Hoe to gutter	4	
Sweep alleyway	2	
Bedding preparation	2	
Bedding	5	
Superphosphate	1	
		54
Miscellaneous		
Cows in and out	15	
Currying	20	
		35
Total daily chore work on cows		360
Wait periods before milking	20	
Time out for spreading manure	20	
Time on small calves	16	
Young stock	35	
		91
Total daily chores		451

ice on their hoofs after being in the snow for a period.

It is suggested that a total of 15 man minutes will usually be required for cows "out and in." To hustle cows beyond a certain point results in confusion and excites them. Convenient access to and from doorways is important.

Occasional Chores

As indicated previously, the dairy farmer spends a large amount of time and effort on tasks that are done now and then. These tasks are essential but they come as emergencies, as special problems, or as jobs that are done infrequently. Very little information is available as to these occasional chores. Seven dairymen, each with about 40 cows, were interviewed with reference to the time taken to do these tasks. The data are shown in Table 2. At the present time these operations take nearly 700 man hours annually on a 40-cow herd. This is equivalent to 17.5 man hours per cow annually. Operators can profit by giving attention to ways and means of doing these tasks more efficiently.

Table 2

Average man hours spent annually in doing occasional dairy chores on seven large dairy farms. (Four of the farms had approximately 40 cows and three had about 50 cows. The data from the 50-cow farms were adjusted to a 40-cow basis.)

No.	Man Hours	Chore
1	68.0	Attending to cows at calving time.
2	10.4	Working on swollen or damaged udders, etc.
3	13.4	Caring for sick cows.
4	20.8	Breeding.
5	3.9	Training first calf heifers.
6	26.3	Helping to unload grain from truck to storage.
7	126.3	Supplying sawdust for bedding.
8	7.6	Adjusting water bowls.
9	4.6	Rearranging cows in stalls.
10	28.6	Studying production records and breeding program.
11	5.1	Spraying barn.
12	15.1	Spraying cows.
13	24.6	Cleaning windows and ceilings.
14	19.3	Selling or buying cows.
15	4.1	Cleaning vacuum pipe.
16	16.6	Shoveling snow and plowing snow to clear doors and passageways.
17	30.3	Clipping cows.
18	21.1	Overhauling milking equipment.
19	8.6	Adjusting windows or checking ventilations.
20	9.3	Folding, counting, and tying feed bags.
21	157.1	Driving cows to and from pasture.
22	4.0	Attaching salt blocks.
23	4.5	Figuring rations.
24	24.7	Observing animals.
	23.6	Other.
	677.9	Total occasional chores.

IX Chore Schedules

So far each chore task has been discussed as an individual item. Present practices were described, improved methods were suggested, and a definite number of man minutes needed to do each task were stated as guides. The quantitative estimates of labor for each task were based on actual records on good farms, adjusted to a 40-cow herd basis. They indicate the authors' judgment as to the time needed for an average man—one who is interested and trained in good chore procedure—working in a barn where facilities and equipment are adequate. These are summarized in Table 1.

These estimates of labor needed to do the daily chores associated with a herd of 40 cows total 360 man minutes. If a five-minute rest period just prior to milking is practiced, an additional 20 man minutes would be added where two men milk, bringing the total to 380 man minutes. Some allowance should be made for interruptions and emergencies. If the men are doing hard physical work during the day, the chores are likely to be performed at a slower rate.

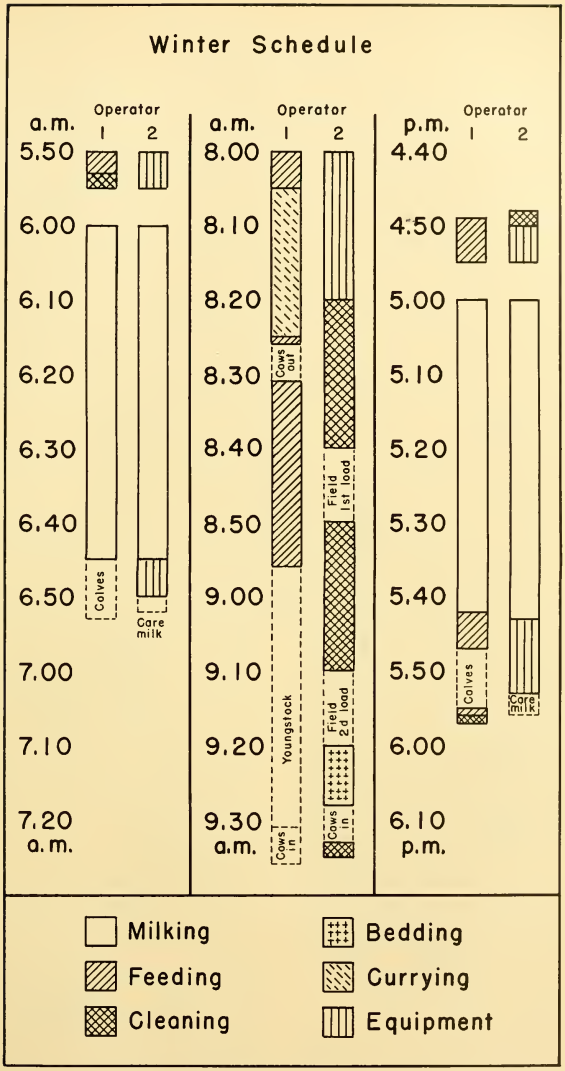


Fig. 47. Efficient individual chores were put together synthetically in this schedule for two men in a 40-cow stable (35 cows milking). Proper layout of equipment was provided.

Sequence of Chore Tasks

Records covering chore activities on 33 farms* indicate no particular pattern of sequence in which chore practices are undertaken. Five operators followed the order of feeding grain, milking, and feeding hay before breakfast and repeated these tasks in the same order before supper. Milking was the first chore in the morning on nine farms. Ten milked after supper. A few fed hay or silage before milking in the morning. One operator curried cows before milking in the morning.

Apparently there is a wide choice of sequence in the order of doing dairy chores and, as far as known, without affecting production. Practically all operators planned to have not less than an 11-hour interval between beginning morning and night milkings. The one exception to this began milking at 6:00 a. m. and at 4:00 p. m.—a ten-hour interval. Over one-half planned to have not over 11½ hours' interval between morning and night milkings. It may be important to have the intervals between milkings not more than 13 hours because the cow tends to reduce milk secretion when the pressure in the udder becomes tense. Consequently there may be some loss in production if the interval between milkings is extended.

For high quality of milk, silage and other feeds with strong odors should be fed after, rather than before, milking. It also may be important not to have frequent major changes in the order of chores, especially in respect to feeding, but otherwise the operator has considerable leeway in the order of doing daily chores.

Schedule of Chore Tasks

One of the purposes of this study is to project the efficiencies of all the individual tasks by reorganization of chore work as a whole. The next step is an attempt to integrate the 22 individual chore practices previously discussed into an efficient total schedule. Fig. 47 represents one schedule for two men on a 40-cow farm. This schedule for the winter months was developed synthetically but each individual practice was based on the detailed studies and projected estimates described previously. The schedule assumes a good layout, two skilled men who have worked out a good barn management program. The data shown in Fig. 47 are intended as descriptions of the possibilities.

The authors of this bulletin have not attempted, and in fact have not had an opportunity, to test out this particular schedule under actual barn conditions. Instead they have had to depend on actual time schedules observed on cooperating farms where most, but not all, chores were done efficiently. In every case there were handicaps due to layout and delays in doing one or more tasks. The results on two farms are indicated in Figs. 48 and 49. In total time*, converted to a 40-cow herd, one farm was 42 man minutes under the synthetic schedule and the other 37 man minutes above the schedule. The records of these actual chore performances on two farms give a favorable indication that the synthetic schedule can be attained and that chores can be done quickly.

Similar records on these two farms were taken in 1942, 1949, and in 1950. The barn facilities and the number of animals were practically the same at each period. There had been a change in workers and in practices. The changes in chore time on these two farms are shown in Fig. 50. Prog-

* These were specialized dairy farms with more than 20 cows. The farms studied in detail were not included.

* Time on equipment was not obtained in full in either case and so the comparison must be made on basis of not including this item. The cases represented by Fig. 48 and 49 took 268 and 347 man minutes (40-cow basis), respectively, as compared to 310 in the synthetic schedule.

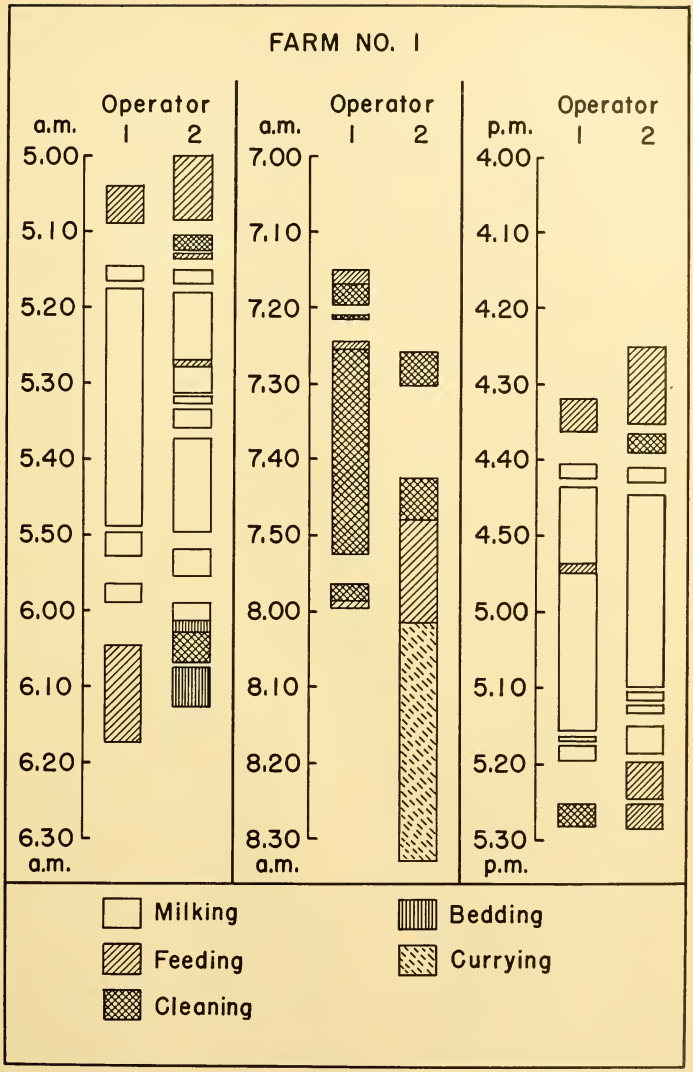


Fig. 48. This is a schedule based on the actual records of two men taking care care of 58 cows and heifers, 36 of them milking.

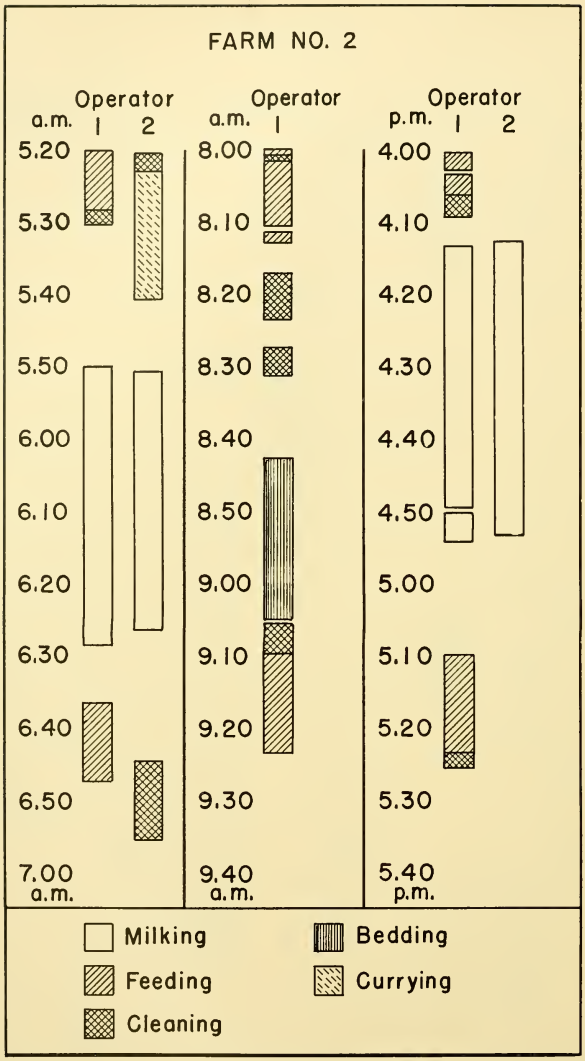


Fig. 49. This is a schedule taken from the actual records of two men taking care of 40 cows, 34 of them milking.

ress had been made over an eight-year period. In one case from 473 to 248 man minutes and in the other case from 541 to 329 man minutes.

Summer Chore Schedules

Chore work so far has been related to the winter barn stabling period. In the pasture season and also for a short period in fall and spring some tasks can be eliminated entirely and others done partially or occasionally. Milking, care of equipment, and feeding grain require about the same effort and time. Occasionally in spring and fall the cows get their udders and teats covered with mud and their preparation for milking requires extra time and upsets the milking schedule. Fencing off certain wet areas or spreading gravel in the yards may reduce this difficulty. Cows are tied up and turned out twice a day. Cleaning the barn and spreading bedding require very little time. Fig. 51 describes one schedule for doing the chores on a 40-cow herd, where two men work together to accomplish both morning and evening chores. Both men would be available for field or other work from 8.:00 a. m. to 4:30 p. m.

Fig. 51 also describes a modification of this schedule: one man doing all the evening chores in order to permit the other man to continue field work. One man starting afternoon chores at 4:00 p. m. would complete the task at about 6:40 p. m.

April and October Schedule

At the present time most farmers house their cows from October 1 through April, a period of seven months. The chores during October and April are usually about the same as in midwinter except that many have their cows outside for several hours on good days. A full chore schedule in the barn in these months tends to delay completion of fall field work and handicaps spring work.

The chore work for these months can be reduced by planning in advance so that roughage can be fed outside with very little labor. Forty cows will consume from 6 to 15 tons of hay per month, depending on the amount of silage fed and the size of the cows. If an operator plans to feed 12 tons of hay in October and 12 tons in April, he can build two inexpensive hay self-feeders (Fig. 52) in separate yards near the barn to hold about 12 tons each. He can fill these with his usual hay harvest methods in haying season. Supplies of hay are available to the cattle by opening the gate. Some dairymen supplement their pastures every year by feeding hay for a limited period every summer. Most dairymen do this in very dry summers. The same procedure of using a self-feeder would be convenient in this summer period. Three 12-ton self-feeders in separate small yards would enable the operator to use one of these for each of the three periods:. spring, summer and fall. These self-feeders need not be expensive.

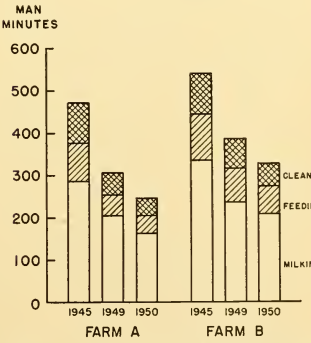
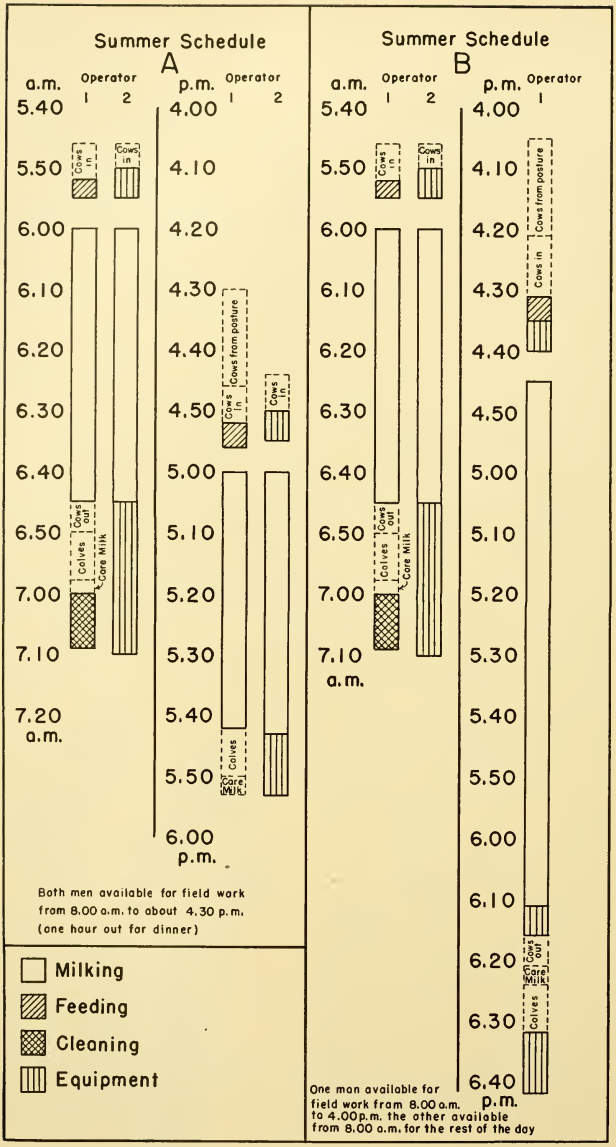


Fig. 50. This indicates the progress in chore work on two farms. Most cooperating farms made progress at the beginning and then leveled off. These two operators persisted. All data are adjusted to a 40-cow herd (35 milking).


Summer Schedule
A
a.m.
Operator
1
2
p.m.
Operator
1
2
5.40
5.50
6.00
6.10
6.20
6.30
6.40
6.50
7.00
7.10
7.20
a.m.
4.00
4.10
4.20
4.30
4.40
4.50
5.00
5.10
5.20
5.30
5.40
5.50
6.00
p.m.
Cows in
Cows out
Calves
Care Milk
Cows from pasture
Both men available for field work from 8.00 a.m. to about 4.30 p.m. (one hour out for dinner)
Summer Schedule
B
a.m.
Operator
1
2
p.m.
Operator
1
5.40
5.50
6.00
6.10
6.20
6.30
6.40
6.50
7.00
7.10
a.m.
4.00
4.10
4.20
4.30
4.40
4.50
5.00
5.10
5.20
5.30
5.40
5.50
6.00
6.10
6.20
6.30
6.40
p.m.
Cows in
Cows out
Calves
Care Milk
Cows from pasture
One man available for field work from 8.00 a.m. to 4.00 p.m. the other available from 8.00 a.m. for the rest of the day
Milking
Feeding
Cleaning
Equipment

Silage also can be fed outside in October and April. In this case the silo room can be remodelled so that a silo cart on wheels or suspended from a carrier track can be filled directly from the silo and pushed through an outside door to feed bunks in the yard (Fig. 53). Or an operator can construct a silo in the open yard and build facilities so that he can push the cart in one direction from the silo to feed the cows and in the other to feed young stock (Fig. 54). The silo cart can operate on flanged wheels using the feed bunk sides as a track. A double trap door arrangement at the bottom of the cart distributes the silage at the control of the operator as he pushes the cart along on top of the feed bunks. This practice has been in use in the cattle feeding areas for many years. Suppose a farmer planned to feed out 40 tons of silage to his cows and young stock during August to supplement pasture, and also to feed out 40 tons in October and 40 tons in April. A small 80-ton silo 14 by 30 feet could be built in the open yard. This could be filled with grass silage in early summer and half of it fed out in August. It could then be refilled with corn silage in early September. Half of it could be fed out in October and the other half in April.

A successful design of silos for self-feeding has been reported by the New Jersey Experiment Station.* This may prove to be a practical way for feeding silage to dairy cows in the spring and fall months. These silos are not completely automatic but only a few minutes would be required occasionally in regulating the feeding rail. These are still in experimental stage.

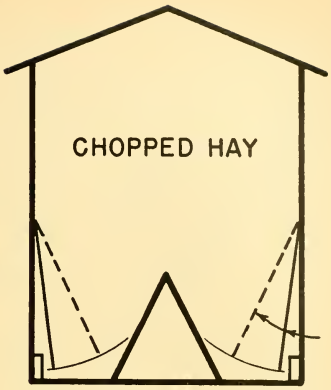


Fig. 52. Sketch of an outdoor hay self-feeder. Three of these 12 ton self-feeders each in a separate small yard would supply the cows with 12 tons in April, 12 tons in the August short pasture season and 12 tons in October. This would involve very little labor in feeding. The arrows at the right show the action of the swinging baffle.

Arrangements made to feed all roughage in self-feeders outside during April and October would reduce the full winter schedule of chore work to five months or 150 days.

Fig. 56 describes one chore schedule for April and October. In this schedule the second man returns to the barn after breakfast, completing the forenoon chores above. The first man is free to start field work immediately after breakfast and can continue until nearly 5:00 p. m. Both men milk morning and afternoon.

These schedules indicate that two men can take care of 40 cows with considerable leeway in the middle of the day. Observations have been

* Mimeograph Report: *Progress Report on the Development of Structures Designed for the Self-feeding of Hay and Ensilage* by C. H. Reed, Department of Agricultural Engineering, College of Agriculture, Rutgers University, The State University of New Jersey.

Fig. 51. Two summer chore schedules (synthetic). In Schedule B one of the workers does all the evening chore work, permitting the other man to work in the field.

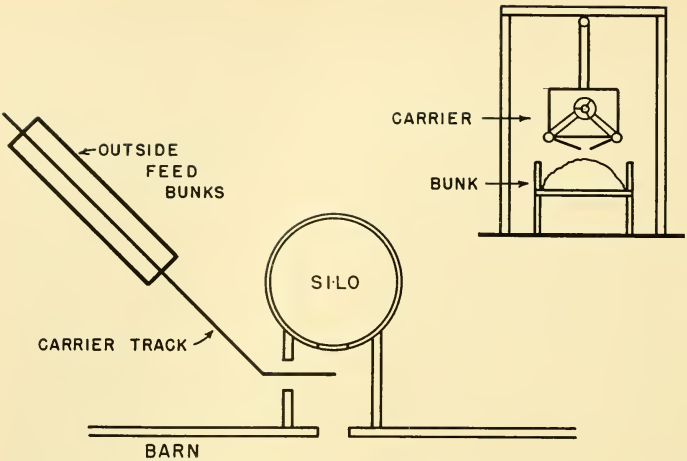


Fig. 53. Arrangements can be made to feed silage outside in October and April. These sketches show how a cart can be filled from the silo and moved to feed bunks outdoors.

made on farms where two men were taking care of 50 cows. No doubt these men could take care of 60 cows. There is no intent to make recommendations as to the number of cows which operators should carry. The authors feel that in many instances a more flexible organization can be had by not budgeting the labor of skilled dairymen too tightly on chore work. It is better instead to use some of the labor between chores on other enterprises. Then in case of emergency there is a better chance to keep the dairy going properly. The number of cows involves management decisions that should be made in the light of the over-all situation on the individual farm.

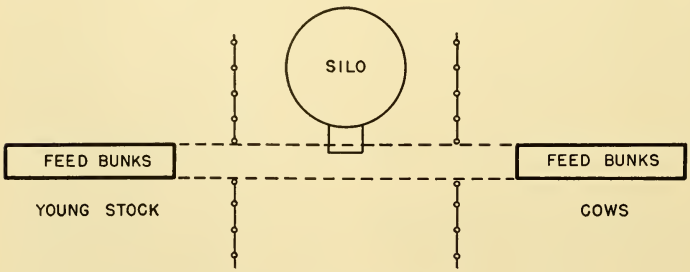


Fig. 54. A small silo in the open yard can be used on large farms to feed cows and young stock in spring and fall.

X Barn Design

Layout and facilities for efficient chore work should be one of the major problems in building a new barn or in remodelling an old one. Barn construction costs are large but so are the labor costs in taking care of milk cows. If we include chore labor, "It is the upkeep that costs." The wrong kind of layout and facilities can easily represent an annual cost of $1,000 or more on a large dairy farm.

The stakes are sufficiently great so that the operator can afford to devote months to his planning of layout and facilities. Most dairymen are in a transition stage and will probably be operating differently and on a larger scale five or ten years from now. Plans for construction should take into account the operator's best judgment of his future as well as his present organization. Thus he may build in such a way as to serve present needs and yet with sufficient flexibility to serve future needs. One end of the barn, preferably the end where the cleaning center is erected, could be constructed in such a way that a one-story addition could be added whenever needed to house additional cows. At this time it is difficult to predict how roughage will be handled on a given farm five years from now. An individual operator, however, may visualize that he will eventually have 100 tons of grass silage, 125 tons of corn silage, and 60 tons of chopped hay. He may well plan his construction accordingly, perhaps outlining a construction program to be developed as needed. If he decides that he can feed hay or silage outdoors to advantage for several months of the year, he can reduce the roughage storage space in the barn.

Special attention should be given to the location of storage facilities so that materials can be gotten in and out easily and yet will conform to the best pattern of chore work. (See Chapter IV on work centers.) The use of mechanical aids, such as carts and conveyors, will no doubt increase in the next ten years. Adequate space in alleyways leading from feed work center to feed alley will be very important. If feed carts are to be used, the travel route should be free of dips. Considerable energy and time is required to turn a large silage cart in an inadequate space or to push it uphill. There should be a handy and adequate space for every cart the operator expects to use. For instance, if a man plans to use a grain cart, a larger mechanical silage cart, and a sawdust cart, special provision should be made in the feed work center so that the grain cart and silage cart are in position to be filled in place and yet are out of the way of other activities. The sawdust cart should be so located that it can also be filled in place and yet not interfere with other chores.

Since the trend is toward some mechanical means of cleaning gutters, the arrangement of the barn layout should be made with this in mind. It is desirable to leave space in the concrete floor for installation of conveyor, etc., to make it easier to in-

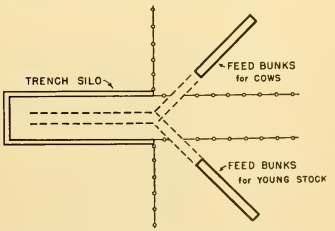


Fig. 55. Silage stored in trench silo also can be fed outside in bunks.

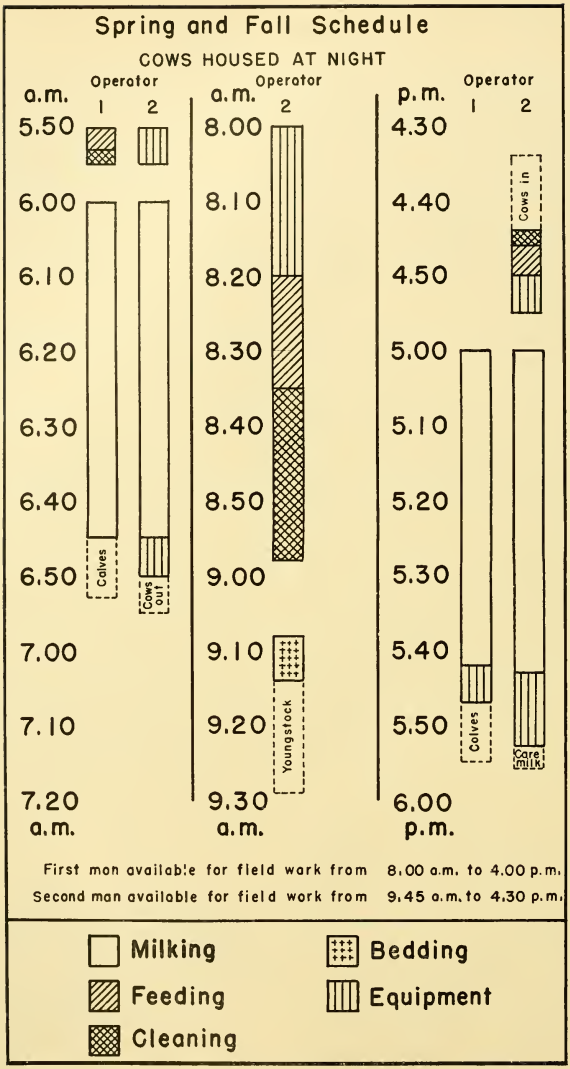


Fig. 56. A spring and fall chore schedule (synthetic). One man completes the after-breakfast morning chores alone, thus permitting the other man to use tractor and equipment.

Fig. 57. In remodelling the barn, the stable was extended well beyond the old barn and adequate space was provided for a feed work center. The old barn has adequate hay capacity for the larger herd.

stall a barn cleaner at a later date.

The intent of this section on barn design is not to discuss or mention all the important labor saving situations in a barn that may be important five years hence, but to emphasize the need for dairy farmers to study their chore problems in some detail before building a barn or remodelling. (See Appendix II.)

XI Calves

The previous sections have been confined to the chores associated directly with care of cows. This section is devoted to the work with calves.

The operator of a 40-cow farm in this state will usually have from two to six cows freshening each month.* He will select from 10 to 13 heifer calves a year to raise as replacements.

* U N H Agricultural Experiment Station Technical Bulletin 86 (1945), *Analysis of Certain Factors Involved in Dairy Herd Management in New Hampshire* by K. S. Morrow, H. A. Keener, and C. N. Hall.

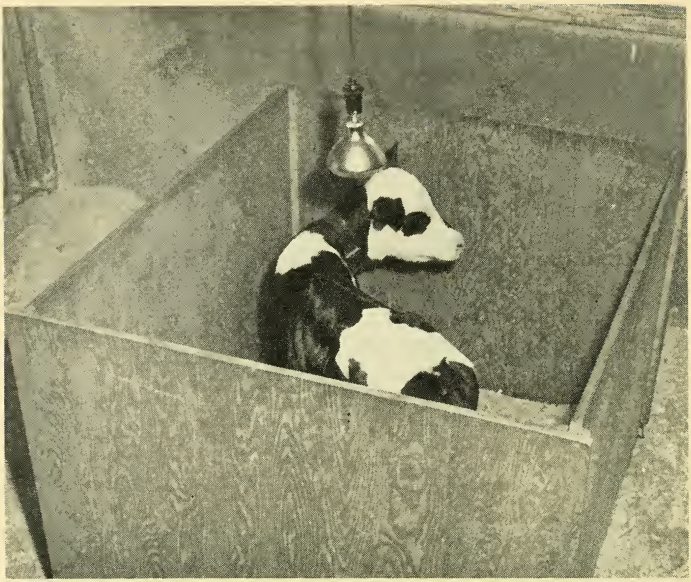


Fig. 58. Small 4 x 4 pens with arrangements to protect the animal from drafts is recommended for the first ten days of the calf's life. Note heat lamp above the calf.

Thus he will usually have a few calves to feed and care for at all periods of the year. During the first months of their existence these calves must have special care. The bull calves and the heifer calves not selected for raising are usually disposed of at an early age.

Present Practices

A few operators had not made special provisions for housing calves. They tied them up with collar and rope in alleyways or most any place where space seemed semi-available. These arrangements required extra time and were a handicap in the performance of other chores.

Usually small pens holding three or four calves were available. Most of these were pens without any special equipment. Whether tied or in pens, with a few exceptions, the operator fed calves one at a time using one hand to hold the pail and the other to wield a switch to fend off the other calves. From one-half to one minute is required for a calf to consume the feeding of milk or mixture. So the feeding of 10 or more calves can take considerable time if the methods are obsolete.

The watering of older calves required a lot of time on some farms. In a few instances the hired man waited for water because of lack of pressure. Watering with one pail when the source of water is not convenient is not efficient. Where hot water was used in preparing a special mix for the calves, there was a tendency to make several trips from the milk house with small containers. On one farm 42.7 man minutes daily

were spent in feeding 12 calves a special mix.

A few operators had developed special facilities for calves and could feed them to better advantage. About four calves were confined in each small pen. Provision was made at the manger end of the pen so that each calf could be tied up in a stanchion and released quickly. A holder in front of each stanchion held the pail in place so that a calf could not overturn it, and yet it could be placed or removed quickly and easily. At feeding time the operator placed the pails in the holders and tied up the calves. He returned later to collect the pails and release the calves.

Each pen was equipped with a self-fed hay rack which was kept filled. Grain was fed either in the manger or in the calf pails.

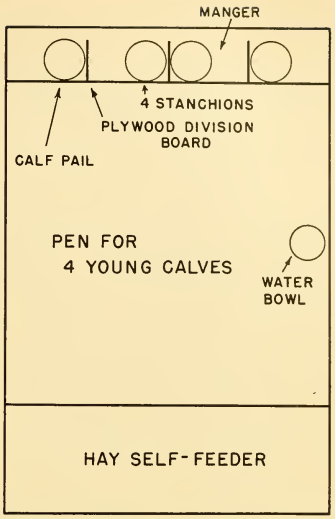


Fig. 59. Floor plan of a calf pen for calves ten days to three months of age.

Efficient Practices

The calf should have special attention during the first week. One procedure is confinement individually in very small pens 4 feet x 4 feet for about 10 days (Fig. 58). Such pens can be lined with plywood or heavy canvas to protect the calf from drafts. In the winter months heat lamps can be used if the temperature in these small calf pens drops below 50 degrees. Three pens of this size will usually suffice for a 40-cow herd. Two calves can occupy a pen if necessary. These very small pens should be cleaned daily.

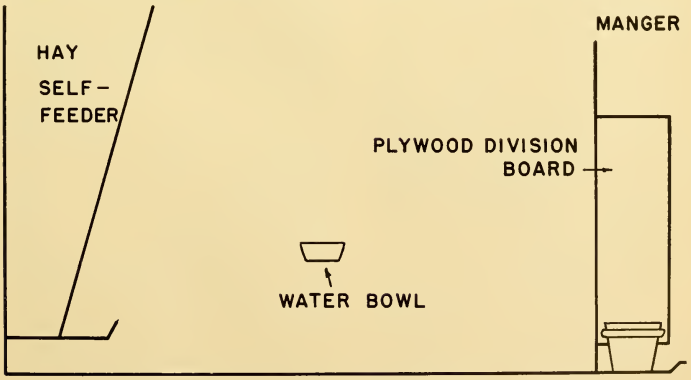


Fig. 60. Side view of the calf pen, shown in Fig. 59.

At the end of ten days the calves can be grouped in larger pens (Fig. 59). A pen about 6 x 8 feet will handle five small calves. These pens should be located in a fairly warm place that is free of drafts. It is suggested that four or five stanchions be installed at one end so that all can be opened or closed quickly. Special holders should be made to keep the calf pails in place at the manger level.

If special calf pails with nipples are used, a holder can be installed which will enable the operator to quickly put the pail in a secure position for the calf. With this arrangement, if there are 10 calves to be fed, the operator can carry the 10 calf pails and 60 pounds of milk in one trip. If pails are filled in the milk house, the ten can be carried by means of a special long rod. If the operator chooses to distribute the milk into individual pails at a point near the calf pens, he can carry the milk in a large can along with the ten empty pails. He can put a pail in each holder for a calf, close to the stanchion. He can return a few minutes later to open the stanchions and collect the pails. A small plywood or metal division between the calves will discourage the sucking of ears, etc., while tied in the stanchion. The task of feeding 10 calves twice a day can be done in about 15 minutes. Pens of calves over six weeks of age can be cleaned two or three times a week in busy periods.

XII Young Stock

Chores in caring for young stock varied greatly on different farms. Where heifers were quartered in stanchions in the same stable with the cows, chore tasks were often merged. Little difference was noted in the methods used or in the time required per head in feeding, in bedding, or in cleaning gutters. The labor requirements tended to be inflexible as to the time of day, due to the close association with chores on cows. In farms producing fluid milk and subject to rigid inspection, good sanitary conditions in the main cow stable, including the part occupied by young stock and bulls, must be maintained at all times.

Present Practices

Where young stock were quartered in a separate barn, there was more flexibility as to when the tasks were done and in the methods used. On one farm 53 head of young stock were tied up in the main barn in stanchions and 138 man minutes were spent daily in caring for them. On one other farm, where 30 head of young stock were tied in stanchions in a separate barn, 88 minutes were spent on the daily chores. The layout and facilities were not too efficient, but the operator did have considerable leeway as to when he worked in the young stock barn. This is the schedule:

	Time spent (minutes)
Feeding hay twice daily (total)	34.6
Turn out and tie up	7.2
Feed grain	5.2
Feed silage	11.5
Sweep manger	1.0
Manure disposal	16.1
Bedding	8.5
Sweep gutter alleyway	3.9
	88.0

A few operators had remodelled old barns especially for young stock and confined six to eight heifers of similar age in each of several pens. In one case 28 heifers were grouped in four pens on the ground floor of an

old barn. Two large hay self-feeders, each servicing two pens, were easily and quickly filled from the floor above. Each pen was equipped with a water bowl. Silage and grain were fed daily in a long manger in each pen. The operator added new bedding each day and cleaned the pens once a week. While considerable sawdust bedding was required, the operator felt he kept the amount to a minimum by weekly cleaning.

All the daily tasks were completed in one trip to the barn and required about 25 man minutes. This was about one man minute daily per heifer. About 180 man minutes were spent once a week in cleaning the pens and preparing for the next week. Because hay and water were always available to the heifers, there was considerable leeway as to when the operator visited this barn and the weekly chore of cleaning could be done within a range of several days. Thus the labor requirements on these heifers were quite flexible.

The heifers under six months of age were usually quartered in the main cow barn and received more frequent attention.

Efficient Practices

One arrangement for housing young stock loose in pens is indicated in Fig. 61. Note that the stock in each pen has access to a small open yard. Due to a wide doorway in front, tractor power can be used in cleaning out manure. The feeding of hay in self-feeders is convenient. Grain and silage can be fed in the manger. Automatic water bowls are installed in a protected area of each pen. In order to prevent freezing, the water pipes can be laid under-

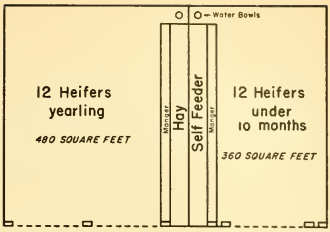


Fig. 61. Floor plan of a pen housing young stock.

ground to a point directly under the bowls and lead heating cable can be used if necessary in the coldest weather.

An operator can usually find a convenient way to feed silage to young stock even if they are quartered in a separate barn. When as many as 30 head of young stock are carried, a small silo can be attached to the barn, and the silage fed either in bunks inside or outside the building, depending on the weather. In case this is not feasible on a particular farm, the operator can remodel his present silo room and install a carrier track so that silage can be taken directly from the silo to the young stock feed bunks. The silage carrier can be equipped with double trap doors which will eliminate hand work in unloading. Grain can be distributed on top of the silage and partially mixed with it so that these concentrates will be more evenly distributed when fed to loose cattle.

It is estimated that 30 young stock can be cared for in 35 man minutes daily, with additional time occasionally in cleaning. The older heifers would be transferred to the main barn two or three weeks before freshening so that they will handle more easily when first milked.

XIII Application of Study to Typical Farms

The data for this study have been obtained mostly on dairy farms with 30 to 60 cows. Much of the analysis has been pointed toward the management of a large herd. How can the results be related realistically and economically to the dairy farms of the state when only 14 per cent of the commercial dairy farms have over 20 cows and only a limited number carry as many as 40 cows? The answer is that this study has been directed as much toward the small operator, who is, or will be, expanding his herd, as toward the operators of large farms. The dairy industry in New Hampshire is going through a transition period in which operations on many small farms must either be expanded or discontinued. Due to rough topography and small irregular fields, modern field equipment cannot be used advantageously on some farms. Operators are so greatly handicapped in production that the financial returns are inadequate. The dairy enterprise will probably be abandoned on such farms in the next 10 years. Expansion to a greater herd size on such farms would require additional labor. This is not practical under the conditions where output per man is, and would continue to be, very small.

Trend Toward Larger Farms

On the other hand, the trend on aggressively operated good farms is toward 30 to 50 cows. Many of the farms now carrying small herds can be reorganized to produce economically sufficient roughage for 30 to 40 cows. This can be accomplished by more intensive land management, by the addition of tillage land by purchase or lease, or by clearing new fields. Thus many operators have or can eventually obtain the potential land resources for the development of a 30- to 40-cow enterprise.

Some of these already have acquired expensive field equipment adequate for the production of roughage for 40 cows. Often this equipment cannot be used economically until roughage production has been increased. These operators have had the personal experience of owning and operating equipment which is sufficiently efficient in output per hour to accomplish all the field work in a few weeks' operation per year. With both machines and manpower underemployed, the operators have a better understanding of their potential opportunities. As a result they are exploring ways and means of expansion. This study is especially directed to these operators who are or will be expanding their herds. The contents of this bulletin may aid them in realizing that one man can care for a large number of cows, if the barn facilities are adequate and if the operator adopts good practices.

The possible application of these data to several farm situations is discussed briefly in the next few paragraphs. Each situation is typical of a group of farms.

The Small Farm

It is recognized that the adoption of better chore practices as suggested in this bulletin will have very little financial benefit to the small farmer who for one reason or another continues to have only a few cows. Efficient chore practices can benefit such a farmer financially only if he is or will be interested in developing a good dairy unit.

The Potentially Good Dairy Farm

This typical farm contains 40 acres of good tillage, 30 acres of pasture,

and 50 acres of woodland. Present roughage production supports 12 cows and 8 young stock. Additional tillage land can be purchased at reasonable agricultural value or leased for a period of years. The buildings are adequate for the present small herd. The 35-year-old operator has ability, but has to finance improvements partially from current income. The adoption of more efficient chore practices would not increase his income immediately. The gross income and cash expenses would be unchanged at first. On the other hand, he is in the midst of potential opportunities. He has the chance of getting control of and developing sufficient land resources for a 40-cow herd.

However, he is now quite busy looking after 12 cows. He needs the personal experience of doing chores quickly and easily before he can fully visualize how he can handle a larger herd. If he adopts efficient chore practices along with improved field practices, he will have a greater appreciation of possibilities and will be more interested in developing them. While he may be very busy with 12 cows at present, the adoption of efficient practicies will give him more time for work on developing his land and barn facilities. Increased financial returns from adoption of efficient practices would begin with the increased output from a larger herd. In this case efficient chore practices are an essential part of "know how" which will be needed by the operator in developing a good dairy unit.

Large and Inefficient Farms

This typical farm now carries over 50 cows. The operator is interested in cows and is a skilled dairyman and obtains good production which is sold on a special market. However, present practices require about five men. Some chore practices are done quite efficiently; others are time consuming. The general work organization is confusing. Men tend to be in each other's way. There is much travel the full length of the barn. Actually there exists under-employment of workers which is not apparent without close observation of what the men are doing and how they are working in relation to each other. The larger the herd and the more numerous the workers, the more essential is good chore management.

Incidentally, the economic position of the 10-cow farmer was questioned in previous pages. Is the position of the large dairyman using the labor of 5 men to care for 50 cows any more secure? He has the same ratio of men to cows and usually of men to total output. A large dairyman may be successful because of a special market and in spite of inefficient chore work. He will benefit immediately by adoption of good chore practices and the reduction of hired labor force.

The Older Operator

This farm could be developed by aggressive management to carry 30 cows, but the 58-year-old operator, because of age and health, has decided to continue with a 20-cow herd.

The adoption of better chore practice can reduce the physical burden of feeding, milking, and cleaning the barn. This should enable him to continue with his present output for several years without hiring additional help. The outlay of capital for improvements can be held at a minimum. Yet the farm will be maintained at a level which would eventually interest a younger, more aggressive operator.

The immediate income would not be increased; the operator, however, would extend his productive earning period. His property would continue to have fair sales value to other oper-

ators when he retires. He has much to gain from adoption of better chore methods.

The Time Saved

In general, large operators have an opportunity of raising their income immediately by adoption of efficient chore practices because they can usually operate with less hired help. The farmer increasing his operations and the size of his herd can benefit from more efficient chores because he can expand without hiring additional labor. The small operator who expects to continue with a small herd will not usually benefit financially, but he might have more leisure.

The labor of the operator and that of the year-round hired men tend to have the characteristics of fixed costs. Their cost continues whether or not their labor is used efficiently. If these fixed costs, which are usually large on a dairy farm, can be spread over a larger herd and consequently greater output, the combination of fixed and variable costs will be less per unit of product. On the other hand, the adoption of more efficient chore practices, without other change such as more cows or fewer men, may reduce the hours of labor on a given farm. But the total cost and total gross sales and income may continue unchanged. The net income can be increased only by lowering the total cost or raising the gross sales.

Thus the adoption of efficient chore practices can increase the operator's money income only if it will reduce the cash expense for labor and other items or increase the output. If the expansion requires considerable outlay of capital for enlarging buildings or purchasing more land, these costs must not be ignored. In some cases they may be sufficiently great to make expansion uneconomic and unprofitable, even if both field work and chore work are done efficiently when measured by output per worker.

Due to the improved practices in both field and barn, the trend is definitely toward larger herds and greater output. Thus the individual dairyman faces a challenge of reorganizing his farm so that he can produce the roughage and handle more cows on an efficient family type basis. Efficiency in chore work is an essential part of the "know how" needed in organizing and carrying on a modern dairy farm.

Appendix I

Most of the chore items are self explanatory and need no description here. However, certain tasks and time required need explanation.

Milking

This includes all time associated with milking, beginning with the preparation of the first cow to the emptying of milk from the last cow. Included are preparation of cows, operating machines, machine stripping, hand stripping, pouring milk from milker pails, hand milking, carrying milk to milk house, pouring into strainer and waiting. If a worker during the milking period did some other chore, his time was charged to that task, but if he waited for the machine, this was considered part of the milking job.

Care of Equipment

This included assembling milking machines and milk pails and carrying them to the area in the barn where milking starts, the preparation of shipping cans for milk, the assembly of strainers and placement on shipping cans, the rinsing of equipment, the dismantling and washing of milking machines, strainers

and other equipment, and flushing of the milk room floor.

Since on several retail farms the equipment was taken care of in association with other tasks by other workers, an accurate description was not available on these farms. In the summary totals this item was left out in comparing farms.

Care of Milk

Data concerning this item were not available on a few farms, especially retail milk farms, and was not included in the summary on most farms. Where data were available, it included the preparation of filled cans and their placement in the milk cooler at the end of milking. Some of this work was accomplished during milking while straining milk. In this case the time was not charged against care of milk.

In all cases the time included the travel from the point of completion of the previous job and the travel to return the tools or equipment to their proper place.

Feeding

Silage preparation included travel into and out of the silo, forking silage from the silo, and sweeping the silo room floor.

Grain preparation included all labor in moving grain from storage and emptying sacks, etc.

Hay preparation included all labor in moving hay from storage to the feed floor.

Feeding included the actual distribution of each kind of feed to the cows. For instance, the care of grain included the travel to the grain cart, the pushing of the cart to the feed alley, the actual dishing out of grain, and finally the pushing of the cart to the usual storage place.

Pushing Feed to Cows

Pushing feed to cows included the labor involved in pushing back feed which had been nosed out of the manger by the cows.

Sweeping Manger

Sweeping the manger included cleaning the manger by sweeping or other means and removing the material.

Cleaning

Manure disposal included all labor in removing the manure from the gutter directly to the manure spreader or to the manure pile. It did not include the labor involved in getting the tractor and spreader to the proper place, the trip to the field to spread the manure, or driving the tractor back to its usual storage place. Where barn cleaners were installed, manure disposal included the time of the man operating the tractor during the period in which the cleaner was operating. It also included all labor associated with opening doors and moving ramps, before and after starting the cleaner.

Appendix II

In exploring ways and means of doing each essential task easily and quickly, and in studying chore management problems, some attention was given to ideas and the development of ideas that were beyond the scope of the study—at least beyond the available funds and training of the leaders.

The ideas may or may not be practical. However, the authors are describing several of them with the hope that researchers with engineering skill and capacity to take risks

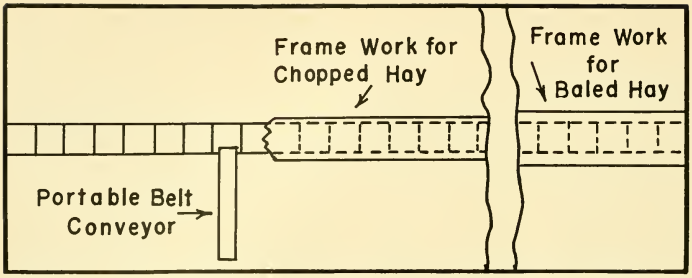


Fig. 62. This diagram is shown to describe the continuous mow outlet opening. Research and trial are suggested.

may explore their possibilities.

The following descriptions of four untried ideas are made merely as recommendations for further exploration and research by agricultural engineers:

1. The continuous mow outlet opening: (a) designed for chopped hay, and (b) designed for baled hay.
2. Facilities for emergency alternatives to daily hauling and distribution of manure.
3. Easier silage preparation.
4. Special milk strainer.

Continuous Mow Outlet Opening

This idea suggests a continuous four-foot wide opening, or more accurately, a continuous series of 4 x 4 foot openings the full length of the barn in the middle of the mow floor (Fig. 62). These would be immediately over the feed floor of the cow stable. A double joist on four-foot centers would permit individual openings about 4 feet x 3 feet 8 inches. Below these openings, eight-foot long double doors each two feet wide would be hinged at the ceiling. Each set of double doors would close two mow openings from below.

This arrangement seemed to open up a number of combinations or possibilities in moving chopped hay or baled hay out of the mow to the feed floor. Two of the possible structures over the openings and extending the full length of the barn will be mentioned. The first is designed for chopped hay and the second, for baled hay.

The first type (Fig. 63) would be a framework three feet high and six feet wide to protect the openings from the weight of hay above. These could be built so as to have free clearance on the sides. Ignoring for the moment how one might start the process of getting hay out, several possibilities might be explored. A portable moving belt conveyor on the mow floor extending from the mow opening to the side of the mow would be pushed to the hay. The hay would be raked down on to the three-foot belt which would deliver it to the opening. Another possibility considered was a portable moving conveyor or rake pivoted near the mow opening and raking the hay from the top downward. This portable conveyor could be moved along the barn as necessary.

The second type of structure (Fig. 64) designed for baled hay would be a framework about eight feet high and eight feet wide. The space under this could be filled with baled hay laid on two by fours over the openings. The framework would protect this area from the weight of hay above. This arrangement would make the hay in the protected area available from the stable floor by one

means or another.

Baled hay would be piled on top of the framework. This hay could be brought down to the protected area through trap doors and arranged so that it would be available from the stable floor. From time to time the hay in other areas of the mow could be moved to the protected area and made available to the operator from the stable floor. A portable conveyor might save some labor in moving baled hay from the side of the mow to the center area. No attempt is made here to describe in detail the methods that an operator might use in getting a feed of hay out of the mow without leaving the feed alley. The major advantage sought in exploring the possibilities of the continuous hay mow opening has been that of making the use of available labor more flexible. For instance, if the operator can make arrangements in one trip to the mow for a week's supply at push button availability, he has shifted this same labor requirement from the daily night and morning busy chore work periods to a convenient slack period one day a week. He can then do the essential daily chores more quickly.

Manure Disposal

As indicated in this bulletin, on farms with barn cleaner installations, the dairymen have to haul out the manure every day. They permit themselves no alternative.

One alternative might be a large carrier, without hoisting mechanism, operating on a track with sufficient pitch to take advantage of gravity in moving full loads. This carrier might hold about 1000 pounds, enabling the operator to move the day's supply of manure directly from the elevator in four loads. The carrier tub could have a self-dumping device. The operator of a 40-cow farm will usually have two manure spreader loads a day. He has to stop the cleaner while one load is spread. With the suggested arrangement to be used only occasionally in an emergency, he would have to stop the cleaner three times while he moved the carrier and dumped the load. A moving conveyor belt might be made to take the material direct from the cleaner elevator, but this would have the disadvantage of freezing up in cold weather. The belt arrangement would have to be quite long because of health regulations for some markets specify considerable distance from the barn.

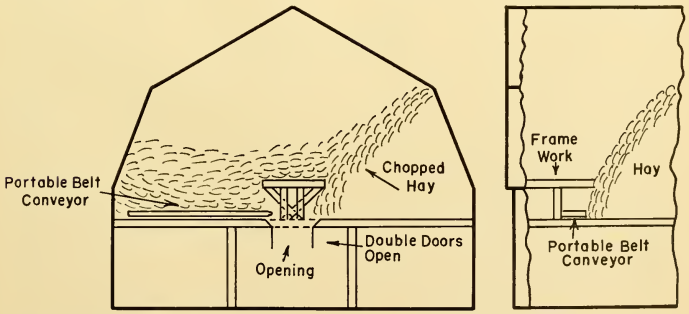


Fig. 63. For chopped hay a framework about four feet high would protect the opening from the weight of hay above and still leave unrestricted space at the sides. Research and trial are suggested.

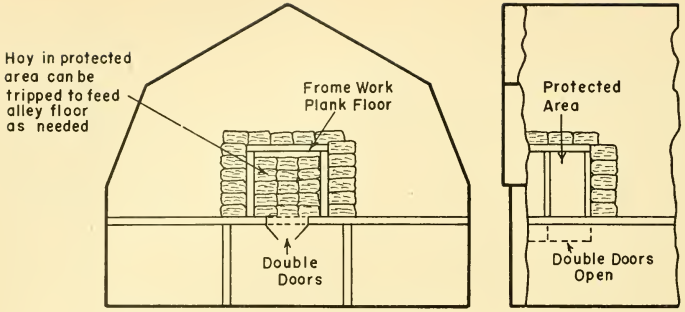


Fig. 64. For baled hay a framework about seven feet high would protect the opening from the weight of hay above and would give sufficient height for a worker to operate unhampered. The hay in the protected area could be dropped or tripped through the opening by one means or another by the operator on the stable place.

One man with a homemade belt type cleaner ran the conveyor some distance from the barn and dumped over a bank into a manure pit. In this case there was no provision for loading the manure spreader directly except when the pit was empty.

Silage Preparation

A simple method of getting out several feeds with one trip to the silo would be helpful. There are complications due to need of keeping the surface somewhat level but lower around the edges. This is done to prevent spoilage in warm weather and to curtail freezing in sub-zero weather.

A light portable belt conveyor pivoted at the silo door would lighten the physical effort and save some time, especially in a large silo. The operator might be able to throw down one feeding and put another feeding on top of this belt in such a way that it would move out the door when the switch was turned. This might not work in freezing weather.

Another idea suggested was a belt type conveyor that would operate in reverse, loosening the silage immediately underneath and dragging it to the door. If this conveyor was pivoted at the silo floor it could be moved in a limited way to take considerable silage. Once every two or three days the operator would have to level off the silage. Some arrangement might be found so that one trip to the silo would prepare for two or more feedings. These trips to the silo could be made in a slack period.

Straining Milk in the Barn

In most large dairy barns, the milk house is at a considerable distance from some of the cows. Even with an ideal location of the milk house, considerable travel and time are required to carry milk in pails from the more distant areas of the stable. It is very difficult for the operator, under these circumstances, to take full advantage of rapid milking techniques. He can't get back to the cows to machine strip at the proper time. For instance, one operator milking 46 cows alone used three single units. He was able to carry the milk when operating on the near side of the barn but had to have a man carry milk when he operated on the far side. While this second person was not busy all the time, the

task of carrying milk accounted for about 30 minutes each milking or about one hour a day.

Observations in a few cases where the operators strained milk in the stable indicated an advantage in ease and time of milking. The operator could dispose of milk in 0.2 of a minute instead of 1.0 minute and get back to the cows quickly. But the health regulations of most markets prohibit the straining of milk in the stable. The objective of the regulation is to hold the absorbtion of stable air and odors by the milk to a minimum. If the shipping cans are sterile and tightly covered when leaving the milk house and if the strainers are covered, the milk would have a minimum contact with stable air and would be protected from dust and flies. The relaxation of the regulation to those who carried out special practices would save time and travel.

A simple device to indicate when the shipping cans are full would make it unnecessary to lift the strainer until ready to put the can cover on. In fact, a means of indicating by weight would enable the operator to know when he had enough milk in the strainer to fill the can. If the shipping can filled with milk plus the strainer weighs 100 pounds, the worker could pour into the strainer until the 100 pounds were registered. A simple device could be made to indicate a definite weight.

The shipping cans filled with milk can be transported to the milk room by a special two-wheeled hand truck. Either one or two cans could be transported in one trip.

On large farms in California, sanitary steel vacuum pipes are installed on each row of 28 stanchions in the milking shed and they convey the milk direct from teat cups to the milk room. With the use of hot water and special detergents the equipment is kept sanitary without dismantling. Due to the expense of installation and maintenance this equipment probably is not practical in a conventional type dairy barn. On the other hand engineers can make a real contribution to the dairy industry by developing a practical way of conveying milk from the cows to the milk house. Perhaps some of the special equipment now in use in milking parlors and western milking sheds can be redesigned for use in stanchion barns.

Summary

1. Greater chore efficiency is needed on specialized dairy farms to balance the improved technology of field work.

2. Adjustments that enable the operator to prepare certain chore tasks in advance of the usual period give flexibility to labor requirements and can result in greater efficiency of labor.

3. Each task performed should be reexamined and reappraised as to its need and how best to do it.

4. The grouping of chore activities around work centers and arrangements to do individual chores by circular travel simplifies the total work load.

5. Milking takes more than one-half the total chore man hours on most farms and must be done at definite periods twice daily. Concentration of the operator on improved methods can eventually reduce this chore to less than six man minutes daily per cow milked.

6. High efficiency in feeding requires a good layout so that feed can be moved from storage easily and quickly. Greater use of mechanical

means and gravity can reduce time in feeding. Total feeding in winter months, including preparation, can be reduced to one and one-half man minutes per cow on most farms and to one man minutes on a few farms.

7. The labor of cleaning and sanitation can be reduced on most farms by using proper tools and doing this job less frequently. Cleaning can be reduced to one and one-half man minutes per cow on most farms. With barn cleaners it can be reduced to one-half man minutes on a few barns.

8. Proper storage facilities represent the key to efficient bedding practices.

9. Since the two miscellaneous tasks, currying and turning out cows, can be done at slack periods in the middle of the day, there is considerable flexibility in the use of labor.

10. The individual chores can be fitted into a pattern so that each worker has a definite schedule. This avoids confusion and reduces travel and time. This is especially important in large barns where several men are working.

11. In fall and spring much of the feeding of roughage can be done outside. Hay can be fed in self-feeders and silage can be fed in bunks with low labor cost.

12. In remodeling barns or building new ones, an operator can afford to give intensive consideration to his future program. A good layout can mean a large saving in labor each year.

13. Young calves need special attention. However, in feeding them, advantage can be taken of special practices to reduce man minutes.

14. Young stock over six months can be housed loose in pens in a separate building from the cows. Advantage can be taken of labor saving practices such as hay self-feeders. If housed in stanchions in the same barn with the cows, there is less flexibility in the use of labor.

15. Few operators are in a position to adopt all the potential efficient practices immediately. It is important, however, that individual dairymen initiate a program of acquiring the ideas, "know how," and skills essential to such a program and continually study the possibility of making adjustments and improvements.

16. The financial benefits from greater efficiency in chore work will depend on how well the operator reorganizes his entire operations. More efficient chore work provides an opportunity for the farmer to do more field work or take care of more cows with the same man power. It is an aid in increasing output without hiring additional labor.