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AN INVESTIGATION INTO THE TIME TAKEN TO MILK COWS.

By R. Turner.

November, 1951.

## Introduction

In a survey made by the writer of the labour problem in dairy byres (1) it was shown that more than 60 per cent of the farmers questioned regarded milking as the longest and most time-consuming job in attending to dairy stock. On small and medium-sized farms most of the available labour resources have to be concentrated in the byre at milking time, in order to finish the job in a reasonable time. The work is of a repetitive nature, being carried out in the same way every day of the year, and is therefore suitable for investigation by the techniques of work simplification. The present investigation was, therefore, directed to making detailed observations on the process of milking in order to ascertain facts which might reveal opportunities for reducing the time and labour needed for the job. It was originally hoped to obtain data from some twenty or thirty farms, but considerations of expense made it necessary to curtail the investigation. Consequently, the results cannot be regarded as highly significant, but certain trends seem to emerge, and data have been obtained, which, inadequate though they may be, are worth recording.

## Objects of the Investigation.

Only a little systematic knowledge is yet available of the time required for milking cows, both as regards man-time and the time the units remain on the cow. In the Quick Milking technique, which has been developed in America, the units remain on the cow for only 3 to 5 minutes, and the technique is said to save time in milking. It seems therefore desirable to know how long it is taking, in terms of man-time, to milk cows in this country and how long the units are kept on the udders. Further, the opinion is commonly held among farmers in this area that cows giving a high yield take longer to milk than those giving a low yield, and confirmation or otherwise of this opinion would be useful. The objects of the investigation were therefore to find out:-

- (i) The average number of minutes of man labour per cow required for milking. (man-time).
- (ii) The length of time the units remain on the udder. (Machine-time).
- (iii) The variations in Machine-time between different cows.
- (iv) The rate of milking - expressed as time required to produce a gallon of milk.
- (v) The relationship between the yield of the cow and the time required to milk.
- (vi) Any other factors which might add to or confirm our knowledge of the job of milking.

## Method.

Eight farms in Ayrshire were visited at the evening milking and the following observations were made on three successive days:-

- (a) the total time taken for milking, from the time the units entered the byre until they were taken out again after milking had finished.
- (b) the number of persons engaged in the process and the time spent by each.
- (c) the length of time the units remained on each cow.

The farms selected all had herds of between 30 and 50 cows and could be regarded as typical of the average West of Scotland dairy herd. All were milk recorded. One farm was visited twice, once early in May when milk yields were at their lowest and again late in July when yields were just past their peak, and these observations are shown as if they came from separate farms.

In addition to this, milk yields were obtained from the record sheets supplied to the farmer by the Scottish Milk Records Association. In Scotland these records are taken at intervals of approximately three weeks, and the yields quoted were taken from the test nearest the date of the time observations. It would, of course, have been desirable to make the observations on the day the yields were recorded, but this was not practicable, firstly,

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(1) R. Turner. Saving Labour in Dairy Byres. Economics Dept., West of Scotland Agricultural College. March, 1950.



firstly, because the farmer does not know the day on which the recorder will call, and secondly, because the normal milking time is then increased by the time taken to empty the buckets from each cow individually, and extra care may be taken in stripping the cows. (Observations made on the College farm showed that the average extra time taken amounted to half a minute per cow). No attempt has been made to correct the milk yields for this discrepancy, as the factors which might cause variation are too complex to be estimated.

The observations were made by the writer unaided so that where two persons were changing units, one of the records was sometimes lost if two cows were changed simultaneously. Similarly, where cows were being milked at the same time in two byres, the observations on some of the cows in the second byre were not obtained. Consequently although most cows were observed on three successive days, for some, figures are available for two days or one day only.

#### Organisation of Milking.

A brief description of the way in which the work was organised will help the reader to understand the sections that follow. The routine formed a very similar pattern on all farms. On four farms, the milking team consisted of two persons, the senior of whom changed the units while the assistant, often a youth or a girl, washed the udders, carried the milk and attended to the work in the dairy. On two of these farms, the assistant was not fully employed and had some idle time during milking. On the other four farms, (A,D,E and H - see Table 1) both workers changed units and carried milk.

Four or five milking machine units were commonly in use and most farms had a spare machine bucket. This made it possible for the unit head to be changed from a full bucket to an empty one, leaving the full one to be emptied by the assistant. Where neither of the cows in a stall were high yielders the unit could be changed from one cow to the other without emptying the bucket. On all farms the cows were housed in two byres (usually a main byre taking most of the cows, and a subsidiary one). All the byres were of the old style with a narrow passage except on farms D and G, which each had one modern byre with a wide central passageway. With the exception of the new byre on Farm D, all the byres were within a few yards of the dairy.

On farm B the washing of the cows' udders was completed before milking started and on farm E washing the udders was carried out by a third person who started before milking and finished while milking was in progress. On the remaining farms, udders were washed a few at a time during milking, before the units were put on. The strip cup was used on one farm only. On all but farm H, with its wide passageway, milking proceeded down one side of the byre and back along the other. On all farms but B, the cows were machine stripped. On farm B very little machine stripping was done and the farmer, who changed the units, sometimes had some spare moments waiting for cows to be finished. No hand stripping was done.

#### Results.

1. Total Time Required for Milking. Table I shows the time taken to complete milking on each farm, from the time the units were brought into the byre till they were taken out after milking had been completed.

Table I/

Table I

Farm	No. of Cows In milk	No. of persons at milking (1)	Time Required to milk herd.		Time Required As Average Per Cow	
			min.	sec.	min.	sec.
A.	20	2	47	16	2	21
B.1.	30	2	56	43 + 10 min. washing udders (2)	2	13 (4)
C.	35	3	74	33	2	08
D.	40	3	91	-	2	16
E.	31	3	58	46 + 5 min. washing udders (3)	2	04 (4)
F.	39	2	85	29	2	11
G.	39	2	75	06	1	56
H.	42	2	79	08	1	53
B.2.	32	2	68	04 + 10 min. washing udders (2)	2	26 (4)

- (1) Not necessarily all full time.  
(2) Washing completed before milking began.  
(3) Washing started 5 min. before milking began.  
(4) Including washing.

In order to provide a comparison between different farms, the time required for milking each herd has been calculated as an average per cow milked, and this is shown in the last column. It shows the time spent per cow, irrespective of the number of workers engaged in the job of milking.

2. Average Man-Time Per Cow. The figures in Table I, however, do not afford a true comparison of the efficiency of labour use between farms because some of the persons worked only part time on the job of milking, the rest of their time being spent on work outside the byre such as feeding calves and other stock. It is necessary, therefore, to consider the actual man-time spent on the job of milking and this is shown in Table II.

Table II

Farm	Date of Observations	Average Man- Time per cow milked	Av. production per cow - p.m. on day of Record.	Date of Milk Record
		(Minutes)	(lbs.)	
A	9-11/4/51	4.81	10.3	28/3/51
B.1	2 -4/5/51	4.11	10.2	29/4/51
C	15-17/5/51	4.26	12.2	29/4/51
D	29-31/5/51	4.6 approx. (1)	15.0	21/5/51
E	25-27/5/51	4.39	12.3	6/7/51
F	3- 5/7/51	3.87	15.4	19/6/51
G	9-11/7/51	3.85	12.0	1/7/51
H	23-25/7/51	3.65	16.8	10/7/51
B.2	30/7- 3/8/51	4.58	12.7	9/8/51

- (1) Other jobs were carried out during milking, so that time taken in milking alone is partly estimated.

In calculating the average man-time per cow, the total time spent by each worker in milking was observed and from this and the number of cows being milked, the figures in column 3 were obtained. These figures are the average of each of the three days on which the observations were made, each day being given equal weight in the final figure. A low man-time per cow, however, does not, by itself, connote efficiency in milk production, because it might well be accompanied by a low yield. In order to bring out this point, the average milk yields of the cows on each farm, at the evening milking of the day of the nearest/

nearest test, are shown in column 4. In considering these, the date at which the records were made must be taken into consideration, as the yields would be expected to rise with the improvement in the grazing from mid-May up to the middle or end of July. The yields cannot therefore be regarded as representing the average yield of the farms concerned, and in the case of farm A and B.1, they were said to be at their lowest for the year.

The average man time spent in milking cows on each farm falls within the range of  $3\frac{1}{2}$  to 5 minutes while the average for all farms was 4.24 minutes. The observations do not suggest that there is any relation between the time taken and the average yield of milk, for each herd.

3. Machine-Time per Cow. Table III shows, for all cows observed, the length of time the machine units remained on each cow. This is given as a frequency distribution, in which the time the units remained on each cow is shown in class-intervals of one minute, and the number of milking observations on each farm falling within each class is shown in the columns. Machine time was taken from the time the last teat cup was put on the udder until the first one was taken off.

Table III  
Machine Time per Cow. All Observations.

Time Interval		No. of Milking Observations on Farm												
Min.	Min. Sec.	A.	B.	C.	D.	E.	F.	G.	H.	B.2.	Total	Percentage		
2	- 2 : 59	-	7	-	2	2	-	-	-	4	15	1.7		
3	- 3 : 59	1	25	-	4	10	9	6	-	9	64	7.6		
4	- 4 : 59	4	30	1	8	16	12	18	6	26	121	14.5		
5	- 5 : 59	9	16	13	11	20	16	27	11	18	141	16.9		
6	- 6 : 59	6	7	63	19	10	16	21	23	19	184	22.0		
7	- 7 : 59	9	1	14	19	10	18	9	21	15	116	13.8		
8	- 8 : 59	6	4	9	6	5	16	7	28	1	82	9.8		
9	- 9 : 59	-	-	4	11	1	9	7	12	-	44	5.3		
10	- 10 : 59	1	-	1	6	3	6	6	5	-	28	3.3		
11	- 11 : 59	1	-	-	7	-	6	3	4	-	21	2.5		
12	- 12 : 59	-	-	-	1	-	5	2	-	-	8	1.0		
13	- 13 : 59	-	-	-	3	1	3	-	1	-	8	1.0		
14	- 14 : 59	-	-	-	1	-	-	-	-	-	1	.1		
15	- 15 : 59	-	-	-	-	-	-	-	-	-	-	-		
16	- 16 : 59	-	-	-	-	2	-	-	-	-	2	.2		
17	- 17 : 59	-	-	-	1	1	-	-	-	-	2	.2		
18	- 18 : 59	-	-	-	-	-	-	-	-	-	-	-		
19	- 19 : 59	-	-	-	-	-	-	-	-	-	-	-		
20	- 20 : 59	-	-	-	1	-	-	-	-	-	1	.1		
Total		37	90	105	100	81	116	106	111	92	838	100.0		
Average machine-														
time per cow.														
min: sec.		6:44	4:35	6:51	7:54	6:02	7:31	6:37	7:41	5:24				

The varying patterns formed by the distribution on each farm will be noted. On farm B the machines remained on the cows for from 2 to 9 minutes, while on farm D the times were spread over the whole range of the observations. Again, on farm C, 60 per cent of the observations lie between 6 and 7 minutes. For all herds the average time during which the units remained on the udder was 6 minutes 35 seconds(1) and the 6 to 7 minute interval is the modal class interval; i.e. the time interval which contains the greatest number of observations. (Were it not for the effect of farm C, however, the modal class interval would fall within 5 to 6 minutes). The 838 observations were made on 291 cows.

In/

(1) Mean of the daily averages of each herd.

In addition to the variation in machine-time between different cows, considerable differences occurred in the time the units were left on the same cow on different days. On some cows the difference in machine-time between one day and another was as much as five minutes, while in the case of other cows, the machine-times on the three days on which the observations were made were within ten seconds of each other. In some instances these differences were due to fortuitous circumstances; the unit was left on a cow probably longer than necessary because the milker was not ready to attend to it at the moment the cow had finished milking. Then, again, there seems to be no absolute test as to when a cow has finished milking and different milkers may have different ideas on this point. (On one farm the writer was told that when the byreman was milking, he left the teat cups on the cow longer than when the farmer performed this job, and this was confirmed by observation). A third reason for the difference may possibly lie in the cow herself; some minor disturbance such as a fright or the incidence of the heat period may cause her to give up her milk more slowly.

While the observations recorded in Table III show the times the teat cups actually remained on the teats, they do not represent the time that the cow requires to have the unit on her udder in order to withdraw all the milk. Some idea of this may perhaps be obtained by examining the lowest of the daily times observed for each cow. It seems reasonable to assume that the teat cups are more likely to be left on the udder too long rather than too short a time, and therefore, in the absence of better information, the lowest time observed may be taken as representing the time which the cow requires to yield up her milk. These are shown in Table IV. Cows, whose performance was observed on one day only, are omitted.

Table IV  
Machine Time Per Cow - Lowest Observations

<u>Time Interval</u>		<u>No. of Cows on Farm</u>										Total	Percentage
Min. - Min:Sec.	A.	B1.	C.	D.	E.	F.	G.	H.	B2				
2 - 2: 59	-	6	-	1	2	-	-	-	3	12	4.1		
3 - 3: 59	1	9	-	3	5	7	4	-	7	36	12.5		
4 - 4: 59	3	11	1	4	9	4	11	5	15	63	21.9		
5 - 5: 59	5	4	10	4	6	6	7	6	3	51	17.8		
6 - 6: 59	2	-	20	10	2	6	4	12	2	58	20.2		
7 - 7: 59	-	-	1	6	2	7	3	6	1	26	9.1		
8 - 8: 59	2	-	3	-	1	3	2	6	-	17	5.9		
9 - 9 :59	-	-	-	4	-	1	4	1	-	10	3.5		
10 - 10: 59	-	-	-	3	-	3	1	2	-	9	3.1		
11 - 11: 59	-	-	-	1	-	2	-	-	-	3	1.0		
12 - 12: 59	-	-	-	-	-	-	-	-	-	-	-		
13 - 13: 59	-	-	-	-	1	-	-	-	-	1	.4		
14 - 14: 59	-	-	-	1	-	-	-	-	-	1	.4		
Total	13	30	35	37	28	39	36	38	31	287	100.0		

Making the foregoing assumptions, 38.5 per cent of the cows could be milked in less than 5 minutes and a further 38 per cent could be milked in between 5 and 7 minutes. Less than 2 per cent of the cows required 11 minutes or more to milk.

#### Relation Between Lowest Machine Time and Yield.

In Table V an attempt is made to show how the lowest machine times for the cows on each farm vary with the yields as recorded at the test nearest to the date of the observations. The range of yield is given in intervals of five pounds and the average times taken to milk the cows on each farm which fall into each yield group are shown, together with the number of observations.

No attempt has been made to add together the figures for all farms, because each farm is a separate entity with different management and different cows, so that the figures for any one yield group would not necessarily be comparable on different farms. Considering all farms together, however, the figures show a definite tendency for the machine-times to be higher where the yields/

TABLE V.  
Yield and Milking Times.

Farm	A		B1		C		D		E	
Yield Range at p.m. milking. Lbs.	No. of Cows.	Av. of Lowest times. Min. Sec.	No. of Cows.	Av. of Lowest times. Min. Sec.	No. of Cows.	Av. of Lowest times. Min. Sec.	No. of Cows.	Av. of Lowest times. Min. Sec.	No. of Cows.	Av. of Lowest times. Min. Sec.
0 - 4.5	2	6 : 14	4	2 : 41	-	- -	-	- -	-	- -
5 - 9.5	2	6 : 58	10	3 : 34	13	6 : 12	7	4 : 24	6	4 : 17
10 - 14.5	6	5 : 42	11	3 : 55	12	6 : 18	11	6 : 09	14	5 : 41
15 - 19.5	1	4 : 17	5	4 : 25	10	6 : 37	9	7 : 21	5	6 : 30
20 - 24.5	-	- -	-	- -	-	- -	11	9 : 09	1	5 : 05
25 - 29.5	-	- -	-	- -	-	- -	-	- -	-	- -
30 - 34.5	-	- -	-	- -	-	- -	-	- -	-	- -

Farm	F		G		H		B2	
Yield Range at p.m. milking. Lbs.	No. of Cows.	Av. of Lowest times. Min. Sec.	No. of Cows.	Av. of Lowest times. Min. Sec.	No. of Cows.	Av. of Lowest times. Min. Sec.	No. of Cows.	Av. of Lowest times. Min. Sec.
0 - 4.5	3	3 : 26	4	4 : 59	-	- -	2	2 : 49
5 - 9.5	6	5 : 20	6	4 : 46	3	5 : 41	8	4 : 03
10 - 14.5	8	5 : 43	15	5 : 43	8	6 : 11	10	4 : 43
15 - 19.5	8	6 : 42	7	7 : 00	21	7 : 08	9	4 : 38
20 - 24.5	11	7 : 58	2	6 : 03	4	6 : 55	-	- -
25 - 29.5	1	5 : 32	-	- -	3	7 : 28	-	- -
30 - 34.5	-	- -	-	- -	-	- -	1	7 : 7



yields are higher. This provides evidence in support of farmers' opinion that, in general, cows giving a high yield take longer to milk than low-yielding cows. Further, from farm B comes some evidence to suggest that an increase in the milk yield of cows as the season advanced was accompanied by an increase in the machine-time required to milk them. On this farm the milk yield rose from 10.2 lbs per cow at the evening milking in late April (B<sub>1</sub> observation) to 12.7 lbs per cow in late July-early August (B<sub>2</sub> observation), while the average machine-time taken for milking for all observations, increased from 4 minutes 35 seconds to 5 minutes 24 seconds. (All but two of the cows in B<sub>1</sub> and B<sub>2</sub> observations were the same, but four of these had calved again before the B<sub>2</sub> observations were made).

Nevertheless examination of the machine-times of individual cows shows that a number of those giving a high yield had relatively low machine-times, so that exceptions exist to the general trend noted above.

#### Rate of Milking

In an attempt to relate the machine time and the yield of the cow, the time taken to yield up a gallon of milk has been calculated for each machine-time observation and this has been called the Rate of Milking. It represents the total period of time taken to extract a gallon of milk from the cow. It does not, however, necessarily imply a continuous rate of flow. Where a cow is stripped, if the milker is unable to begin stripping the moment the main flow ceases, there may be an interval between the end of the main milk flow and the stripping process.

As would be expected, the rate of milking of individual cows differs widely. On some farms the rates varied between 2 and 20 minutes per gallon. The high rates were usually, but not always, associated with cows near the end of their lactation, which had very low yields. For example, a cow which yielded only 2.5 lbs of milk at the evening milking took 5 min.16sec, 3 min.51sec., and 3 min. 38sec. to milk, on each of three consecutive days. The corresponding milking rates were 21.70, 15.86, 15.00 minutes per gallon. Fast rates of milking seem to be associated with high yields more than with low machine-times. A cow on the same farm as the above gave 31.5 lbs of milk at the evening milking and took 7 min. 50sec., 7min. 17sec., and 7min.18sec. respectively to milk on three successive days, and the corresponding milking rates were 2.46, 2.38 and 2.39 minutes per gallon. The rate of milking also varied for the same cow on different days but this was merely a direct reflection of the day to day differences in the machine-time.

The average rate of milking of the cows on each farm was calculated for each of the three days on which observations were made and the mean of these daily averages for each herd is shown in Table VI.

Table VI

<u>Farm</u>	<u>Average Rate of Milking</u> <u>Gallons per minute</u>
A	8.56
B <sub>1</sub>	5.71
C	6.50
D	5.78
E	5.84
F	6.22
G	6.82
H	4.99
B <sub>2</sub>	5.45

#### Discussion and Conclusions.

The data that have been collected have provided some systematic information about the job of milking. While they do not at present lend themselves to direct practical application some points arising from them are sufficiently interesting to merit further comment.

One of the most striking observations was, that in the sample of farms chosen, the routine of milking differed little between one farm and another and/

and appeared to be uniformly good. It might have been expected that differences between good and bad routines would have indicated where saving of labour could be sought, but this expectation was not realised.

From the labour saving aspect, it is the man-time per cow, rather than the machine-time, which is important. It was noticed that a considerable proportion of the man-time spent in milking was occupied in machine-stripping cows. How much of this was really necessary and how much was simply to occupy time which otherwise would have been idle, is not known. On farm B practically no stripping was done and the milker sometimes had some idle time while waiting for cows to finish. It is not the intention to discuss here the arguments for or against stripping. It is sufficient to point out that if stripping, either by machine or hand, could be eliminated or at least considerably reduced, it seems likely that the man-time per cow could be lowered.

It was mentioned earlier that there is no absolute test as to when a cow has finished milking. The sight glass of the milking machine is not regarded as always giving a correct indication of the cessation of flow because it frequently becomes clouded due to the surface tension of the milk on the glass. Some better type of indicator may yet be invented - either visible, or perhaps with an audible warning device to draw attention to the fact that the flow has ceased. Such an indicator might help to prevent teat cups being left on cows longer than necessary.

It is not always possible for the farmer to arrange which stall a newly calved cow shall occupy as she usually has to be put into whichever is vacant. Generally speaking, it is desirable not to have a number of slow milking cows close together, because, assuming the units are put on the cows in a regular manner, too many units will be taken up on slow milking cows and the milkers will have some idle time waiting for these cows to finish.

Perhaps the best arrangement would be to have slow, medium and fast milkers interspersed evenly through the byre. Some farmers, however, have found it more convenient to leave their slow milkers to the end and have them grouped at the end of the byre where milking finishes. They are then able to leave the units on the cows while they attend to work in the dairy.

The number of machine units used for milking the herds varied from 3 to 5. The number required depends on three factors:-

- (1) the number of milkers.
- (2) the routine of milking.
- (3) the average machine time of the cows.

The first two factors require little comment; it is obvious that two men can look after more units than one man, and where a worker is changing units only, he can clearly attend to more units than where he has to wash udders and carry milk as well. The number of units required is also affected by the machine-time of the cows, and where those times are long, i.e. with slow milkers, the worker can look after more units than where machine-times are short. For example, on farm B<sub>1</sub> where the average machine-time per cow was 4 minutes 35 seconds, three units were used, while on farm C, with an average machine-time of 6 minutes 51 seconds per cow, four units were used. (On both farms the milker changed units only). If the milker has much idle time waiting for cows to finish milking, it may be because the number of units in use is less than are required to fit in with the machine-time of the cows. On the other hand, if another unit were added it might result in an excess of units for the machine time, so that the units would remain longer on some of the cows than necessary. In theory, there must be, for any herd, an optimum machine-time per cow for a given number of units, but in practice, it is not feasible to alter the machine-times of the cows to suit the number of units. It will not be easy therefore to achieve the ideal balance between the number of units and the average machine-time of the cows.

The average man-time taken to milk cows lay between  $3\frac{1}{2}$  and 5 minutes per cow. The best time - 3.65 min. per cow - was recorded on Farm H where the farmer and byroman both changed units and carried milk, and there was little, if any, idle time.

Taking/

Taking the mean of all observations, the average length of time the units remained on a cow was 6.81 minutes. If, however, we consider only the lowest observations on each cow, the average time was 5.71 minutes per cow. Were it possible to milk all cows as quickly as on the occasion of the lowest observation, the reduction in time over the whole herd would be a minute per cow. This would result in a saving of man-time if the milker had some idle time waiting for the cows to finish milking.

None of the farms visited practised Quick Milking, so no practical comparisons of this and the common technique were possible. It seems, however, that speeding up the machine time of the cow would not necessarily save labour, though it might make fewer milking machine units necessary. Saving of time could result if it were accompanied by a reduction in the amount of stripping done. It may be, that much of the advantage in labour saving, which Quick Milking is said to accomplish, is due to the use of a better routine for carrying out the operation.

In Table I, it was shown that two persons were required in order to milk 30 to 40 cows. Where a third person was employed part time, there was no evident reduction in the time taken to complete the job.

#### Summary.

The results of an investigation into the time required to milk cows on eight farms carrying from 30 to 40 cows are described. Two or three men were required to milk the cows, and the time taken, for each herd, expressed as an average time per cow, varied from 1 minute 53 seconds to 2 minutes 20 seconds. For each herd, the average man-time per cow milked lay between 3.65 minutes to 4.81 minutes, while the average time the units remained on cows was 6 minutes 35 seconds for all herds. Comparing the lowest of the three days' observations of milking time with the yields of the cows, there is evidence that the high yielding cows take longer to milk than the low yielding ones. The rate of milking, expressed as the number of minutes required to produce a gallon of milk is shown to vary widely for different cows. Finally, in some comments on the practical application of the results the importance of man-time is stressed from the point of view of saving labour and some of the factors affecting the reduction in man-time are discussed.

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