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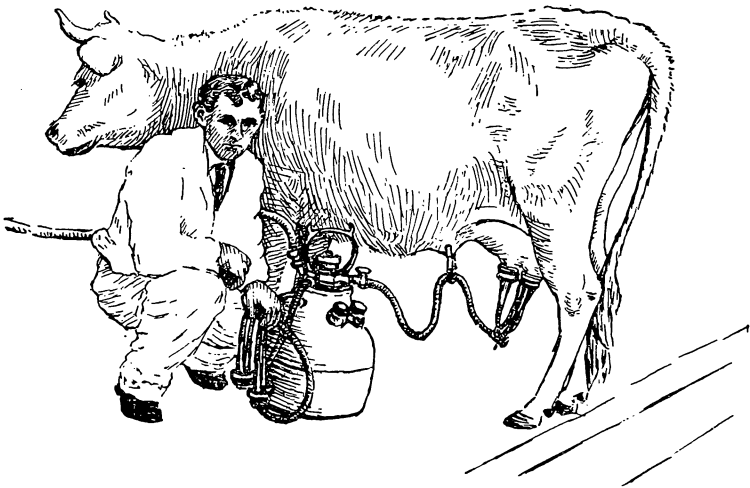
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# New York Agricultural Experiment Station.

GENEVA, N. Y.



MACHINE MILKING DOES NOT AFFECT MILK FLOW

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SUMMARIZED BY

F. H. HALL

FROM BULLETIN BY

G. A. SMITH AND H. A. HARDING

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\*Riverhead, N. Y. †Absent on leave. ‡Connected with the Chautauqua Grape Work.

POPULAR EDITION.\*

OF

BULLETIN No. 353.

## MACHINE MILKING DOES NOT AFFECT MILK FLOW.

F. H. HALL.

**Milking  
machines merit  
attention.**

The dairy industry of today needs the milking machine. In dairying, as in other lines of farming, the labor problem is difficult of solution; and herd owners would welcome gladly an economical, efficient machine that would enable them to milk their cows with fewer men or permit an increase in the size of the herds without adding to the labor pay-roll. Inventors and manufacturers realize this need and have tried to meet it by putting on the market milkers of many makes and types. Some of these machines have now reached an advanced stage of mechanical perfection, so that they really milk cows easily, rapidly and completely. But before any of these machines can be pronounced an unqualified success it must receive long, careful trial and be studied from different standpoints.

**Pure milk a prime  
consideration.**

In any factory a new machine, to secure attention, must promise economy in labor without material lowering of quality. In some cases the machine-made product may not be quite so good as the hand-made article it replaces, but the cost reduction be great enough to more than counterbalance the slight falling off in quality; and the machine is installed. In the dairy, however, quality is the essential consideration. With the present day demand for clean, sweet, healthful milk, any mechani-

\* This is a brief review of Bulletin No. 353 of this Station, on Milking Machines: Effect of Machine Method on Milk Flow, by G. A. Smith and H. A. Harding. Anyone specially interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete bulletin. Names of those who so request will be placed on the Station mailing-list to receive future bulletins as issued, popular or complete edition as desired. Bulletins are published at irregular intervals, as investigations are completed, not monthly.

cal device whose use increased the numbers of bacteria in the milk produced would not be generally used however efficient and economical it might be in milking the cows. This was a serious defect in milking machines first on the market. The first machine tested at this Station, the Globe, could not be kept clean easily, which, with other faults, condemned it; and with the earlier types of the milker now in use, the Burrell-Lawrence-Kennedy, much care was necessary in order to secure clean milk. With the improved forms of this milker, however, as shown by repeated careful tests announced in Bulletin 317 of this Station, there need be no difficulty in keeping the counts of bacteria as low as in ordinary hand milking.

The precautions necessary in securing clean milk with the improved form of this milker are few:

(1) Those parts of the machine through which the milk passes must be rinsed thoroughly after each milking, using in succession cold water, hot sal-soda solution or similar cleansing material, and hot water; and the teat cups and rubber tubes must be kept, between milkings, in a strong brine solution (10 per ct.) or similar germ destroyer. Once a week all parts of the machine touching the milk should be thoroughly washed and steamed.

(2) The ample, but few and simple, air-filters must be kept well filled with fresh, dry cotton to prevent entrance into the machine of germ-laden dust.

(3) Dropping teat-cups on the floor or any similar carelessness in handling the machine must be avoided, since such accidents produce marked increases in the bacterial counts of the milk.

**Previous  
studies of effect  
on flow.**

Milking-machine studies at colleges or stations began as long ago as 1895 and since that time ten or twelve tests have been reported in which direct or indirect data were secured relative to the effect of the machines on milk

flow. On the whole, the differences in quantity of milk produced by machine milking and hand milking were not great. In these tests, in many cases the numbers of cows were small; in others the periods were short so that it was impossible to say whether any shrinkage shown was due to the character of the milking or merely to a change in method; and in many instances the in-

fluences of advancing lactation were not properly balanced. Yet the summarized conclusion which might have been drawn from these tests — that the milking machine exerts only slight, if any, adverse influence upon milk flow — is well sustained by the much more numerous, longer, carefully-balanced comparisons made in the Station tests here reported.

**Machines  
used.**

In two of the earlier tests at other stations the machines used and rejected differed from the type used in all later tests, including those at this Station. One of the early milkers used was a nonpulsating, suction machine, and the other exerted a combined pressure and suction effect. All the other machines whose tests have been reported, in America at least, have used the principle of the interrupted vacuum, by which the action of the calf's mouth is imitated rather than that of the hand milker's fingers. This is the principle employed in the B-L-K machines, which are the ones tested at the Station and which are at least typical of, if not the same as, those used in a great majority of the other tests. In these machines the application and relaxation of the vacuum-produced suction is controlled by a "pul-sator" which forms an integral part of the head of the pail used. The teat-cups, by which direct attachment to the udder is made, are conical or funnel-shaped metal tubes with wide-flanged mouths to receive the teats. These mouths are partially closed with ring-shaped, heavy rubber curtains which make air-tight connections with the udder. In the older types of machines from six to eight sizes of teat-cups were required to fit all the cows of our herd, but with the new form one size of cup milks the herd more efficiently than did the many sizes previously used. This, of course, simplifies work with them and shortens the time needed. With these cups, also, the amount of "strippings" from the cows has been reduced to a practically negligible amount; and with them two cows were satisfactorily milked that would have been dropped from a hand-milked herd.

**Station tests on  
milk flow.**

In 1906-7 the cows in the Station herd were milked by hand and in 1907-8 by machine, but since such alternate-year comparisons of hand and machine milking could not equalize

the influence of advancing age of the cows and climatic conditions

affecting food supply, it was thought best to divide the herd in halves as the cows freshened in 1908-9 and to milk each cow by hand and machine in alternate periods of lactation. In this division the herd was balanced as carefully as possible with regard to age and productive ability; and in subsequent changes due to the dropping out of cows by reason of age, accident, illness, sterility, etc., and the addition of others to maintain the herd, the same idea of preserving the balance has been kept in mind.

The work has now been carried through the lactation periods for 1910-11. In all, 29 cows have been compared during two or more lactation periods, including five periods each for five cows, four periods each for three cows, three periods each for nine cows and two periods each for twelve cows, making 88 complete lactation periods. During 43 of these periods the cow was milked by hand and during 45 by machine. Taking the data just as they stand and comparing the yields when any cow was milked by the two methods during successive periods, it would appear that 32 such comparisons favor hand milking and 23 favor machine milking. But it is hardly fair to include all the data. In the several years through which the tests ran, the yields of several of the cows were abnormal for at least one lactation period, owing to mishaps of one kind or another. Six young cows calved prematurely and three suffered so severely from indigestion that their yields were seriously affected. Leaving out these abnormal lactation periods there remain 24 comparisons in favor of hand milking and 19 favoring the machine. These figures apparently indicate a slight gain in production in favor of hand milking; but, as will be shown later, the actual mathematical differences in yield are so slight, considering the two groups as a whole, that the omission of a very few cows whose yield showed great fluctuation would shift the balance in either direction.

As shown in Table I, which includes all the data unaffected by noticeable disturbing factors, the final balance in favor of hand milking is only 6,000 lbs., merely the slightest fraction over 1 per ct. of the total production.

In making the table several of the cows were included that were milked more periods by one method than by the other, which might be considered unfair; so in Table II the comparison is restricted to an equal number of lactation periods for each cow by each method.

TABLE I.—ANNUAL AND TOTAL VARIATION IN MILK YIELD APPARENTLY DUE TO METHOD OF MILKING.  
(Includes all satisfactory data.)

Number.	Hand, 1906.	Ma- chine, 1907.	Hand, 1908.	Ma- chine, 1908.	Hand, 1909.	Hand, 1908.	Ma- chine, 1909.	Hand, 1910.	Ma- chine, 1909.	Hand, 1909.	Ma- chine, 1910.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	5,821	6,456	6,085	7,455	7,595	7,595	7,595	7,595	7,595	7,595	5,666
2	5,247	4,765	6,918	6,310	6,310	6,310	6,310	6,310	6,310	6,310	6,310
3	7,009	4,208	4,208	4,208	4,208	4,208	4,208	4,208	4,208	4,208	4,208
4	4,870	3,431	3,431	3,431	3,431	3,431	3,431	3,431	3,431	3,431	3,431
5	3,836	4,187	5,305	7,366	7,366	7,366	7,366	7,366	7,366	7,366	7,366
6	8,541	7,583	7,434	9,059	9,059	9,059	9,059	9,059	9,059	9,059	9,446
7	7,649	7,434	7,434	7,434	7,434	7,434	7,434	7,434	7,434	7,434	7,434
8	11,596	9,795	9,795	9,795	9,795	9,795	9,795	9,795	9,795	9,795	9,795
9	6,557	10,751	6,027	7,170	7,170	7,170	7,170	7,170	7,170	7,170	7,170
10	6,943	7,170	7,170	7,170	7,170	7,170	7,170	7,170	7,170	7,170	7,170
11	7,844	8,881	7,792	7,792	7,792	7,792	7,792	7,792	7,792	7,792	7,792
12	5,429	5,588	7,136	7,136	7,136	7,136	7,136	7,136	7,136	7,136	7,136
13	6,601	5,704	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
14	7,106	7,067	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027
15			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
16			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
17			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
18			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
19			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
20			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
21			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
22			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
23			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
24			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
26			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
29			6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920	6,920
Totals	98,936	101,056	48,609	26,715	28,326	32,156	29,782	37,138	32,960	44,923	44,342
Group balance		2,120	562		1,611	2,374		4,178		581	
Annual balance		2,120	562			3,985				4,759	

Final balance (in favor of hand milking), 6,062 lbs.—1 per ct. of total (574,114).

TABLE II.—YIELDS OF COWS MILKED BY HAND AND MACHINE.  
(Including only balanced periods for each cow.)

Number.	Hand, 1906.	Machine, 1907.	Hand, 1908.	Machine, 1908.	Hand, 1909.	Machine, 1909.	Hand, 1910.	Machine, 1910.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1.....	5,821	6,456	7,455	7,595	.....	.....	.....	.....
2.....	5,247	4,765	.....	.....	.....	.....	.....	.....
3.....	7,009	6,918	.....	.....	.....	.....	.....	.....
4.....	4,870	4,208	6,310	.....	.....	3,502	.....	.....
5.....	3,836	3,431	.....	.....	.....	.....	.....	.....
6.....	4,187	5,305	.....	.....	.....	.....	.....	.....
7.....	8,541	7,583	.....	.....	.....	.....	.....	.....
8.....	7,649	7,434	7,366	.....	.....	6,746	.....	.....
9.....	11,596	9,795	.....	.....	.....	.....	.....	.....
10.....	6,557	10,751	.....	.....	.....	.....	.....	.....
11.....	6,643	7,170	6,027	.....	.....	6,988	.....	.....
12.....	7,844	8,881	.....	.....	.....	.....	.....	.....
13.....	5,429	5,588	.....	7,136	8,492	.....	.....	.....
14.....	6,601	5,704	.....	.....	.....	.....	.....	.....
15.....	7,106	7,067	.....	.....	.....	.....	.....	.....
16.....	.....	.....	6,920	.....	.....	6,808	.....	6,683
17.....	.....	.....	.....	.....	7,217	.....	.....	.....
18.....	.....	.....	.....	.....	.....	7,382	4,302	.....
19.....	.....	.....	.....	.....	.....	8,156	8,175	.....
20.....	.....	.....	5,533	.....	.....	5,798	.....	.....
21.....	.....	.....	.....	.....	.....	.....	.....	.....
22.....	.....	.....	.....	5,783	5,344	.....	.....	.....
23.....	.....	.....	.....	.....	6,369	.....	.....	6,589
24.....	.....	.....	.....	6,391	6,895	.....	.....	.....
26.....	.....	.....	.....	.....	5,121	.....	.....	6,778
29.....	.....	.....	.....	.....	.....	.....	8,021	.....
Totals.....	98,936	101,056	32,156	26,715	47,033	58,872	25,283	20,050

Total machine..... 206,693  
Total hand..... 203,408

Balance (in favor of machine)..... 3,285 = 0.8 per ct. of total (410,101).



As will be seen, this method of handling the data throws the balance toward machine milking, but again the difference is too slight to have any meaning, since it is less than 1 per ct. of the whole yield. In other words, the effect of milking upon the productivity of the cows is less than the normal fluctuation in yield from year to year due to such marked variation in yield of individual cows as might occur in any herd of considerable size. Of four cows milked by machine in 1906-'7 and again in 1907-'8 after division of the herd, one showed a change of 1,000 pounds in flow the second year, and another a change of 1,500 pounds; while data from Maine Station reports show a change of 5.6 per ct. in yield of a herd of 13 cows in successive years, and similar data from Wisconsin from a herd of 27 cows show a change of more than 1 per ct.

**Machine  
milking does not  
change flow.**

course, poor management of the machines and careless handling might bring down yields; but so also a careless, inefficient hand milker may "dry off" a good cow in a few weeks.

**Experts not  
necessary  
for milkers.**

From this work, then, extending over five years and including a large number of lactation periods, the only conclusion possible to draw is that machine milking, if properly done, does not influence the flow of milk to any extent capable of measurement. Of course, poor management of the machines and careless handling might bring down yields; but so also a careless, inefficient hand milker may "dry off" a good cow in a few weeks.

It is undoubtedly true that not every good hand milker would be able to handle a machine with equal success; but no remarkable qualities are necessary for efficient machine management. During the tests of the B-L-K machines at the Station, six men have run them for periods varying from three months to three years and none of them has failed to do fairly satisfactory work with the milkers. These men probably represent fairly well the better class of farm workmen; and none of them was selected for any special ability to operate machinery. The essential qualities in running a milking machine are merely carefulness, willingness to follow instructions and reasonable intelligence.

**Time-saving  
by machines.**

In Station work it has been necessary to weigh and record each cow's milk separately; so that it has been inadvisable for one man to handle more than two machines, each milking two cows; and the operations have undoubtedly been done a little more carefully and a little slower than would be necessary in a commercial dairy. The data given for labor are, therefore, very conservative. They are based on accurate records of the time consumed by each step of the afternoon milking on 144 days in 1911; and on records of the time required each day for a month in washing and otherwise completing the cleaning of the machines, this last work being done in the dairy building, not at the barn.

Based on the use by one man of two machines in milking 15 cows, the time consumed each day would be as follows:

Preparing machines night and morning.....	6.72	minutes
Milking 30 cows (15 night and morning)....	88.20	minutes
Rinsing machines at barn night and morning.	15.36	minutes
Cleaning teat-cups and tubes (done weekly).	2.61	minutes
Washing remaining parts of machines.....	8.13	minutes
<hr/>		
Total time required to milk 30 cows....	121.02	minutes
Average time required to milk one cow.	4.034	minutes

Under commercial conditions this time could be decidedly lessened; and the advantage would increase as the number of cows milked increased. Fifteen is probably as small a number as will be found profitable in connection with present machine milking; since with this number of cows approximately one-third of the time is spent in operations other than the actual milking. As the number of cows increased this extra consumption of time would become relatively less and the average time required for each cow would decrease. It is possible, also, where detailed records are not kept, that one man could handle more than two machines and thereby reduce the labor cost.

**Economy.** As Station figures show that it takes seven minutes for a hand milker to milk a cow, record the weight and pour the milk on the cooler, it is evident that the machines do economize labor. As to

whether, or under what conditions, their installation would be financially profitable, data are lacking. Owing to rapid and repeated changes and improvements in the milkers used in these tests and the substitution of new pails and parts, it has been impossible to measure the deterioration of the machines or to get any very definite idea as to the cost of maintenance. Until these data can be secured, possibly not for a long period of time, each herd owner will have to decide for himself whether the saving in labor indicated above will justify him in installing machine milkers.

The Station experience proves that such machines, at least the one used by us, can be readily handled by the better grade of farm laborers, that they can easily be made to produce milk with very satisfactory bacterial counts, that they do not injuriously affect the flow of milk and that they will lessen the amount of human effort necessary to milk cows.