MILKING MACHINES:

VI. LEAKAGE FROM THE VACUUM PIPE LINE INTO THE PAIL AS A SOURCE OF CONTAMINATION OF MILK

ROBERT S. BREED AND JOHN W. BRIGHT
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ROBERT S. BREED AND JOHN W. BRIGHT *

SUMMARY

Following up the detection and correction of trouble from contamination from the vacuum pipe line in the milking machines in use at the Station, a series of experiments have been made to determine the amount of contamination derived from similar sources in other milking machines.

In beginning the work, a single unit of a commonly-used inflation teat-cup type of milker was placed in daily use in the Station stable, and observations were made in various ways to determine whether foul condensation water from the stanchion hose succeeded in passing thru the check valve on the pail top into the milk in the pail. Leakage of several drops of this material was found to occur during each operation of the unit in milking.

Bacteriological tests were made under various conditions to determine the effect of this condensation water upon the germ content of the milk. It was established that, under bad conditions, the amount of leakage was sufficient to make it impossible to keep within the bacterial count standards required for certified milk (less than 10,000 per cc.), or to cause loss of premiums in the production of Grade A milk even where, in all other respects, perfect sanitary conditions were maintained.

Tests have since been made of a series of pulsators whereupon it was discovered that the check valves on these pulsators leaked under severe service conditions. Under favorable conditions this leakage was not sufficient to prevent the production of milk of fair quality; but as leakage is unnecessary, manufacturers have been urged to change the construction of the check valves in such a

* Formerly Assistant Bacteriologist at this Station.
way as to give better protection against contamination. This has already been accomplished in some cases.

Simple directions are given whereby any dairyman can determine for himself whether the machine that he is using is equipped with a leak-proof valve. Greater care should be taken than is ordinarily the case to keep the check valves and stanchion hose clean and free from foul material.

INTRODUCTION

It has taken more than 50 years of experimental work to bring the milking machine to the mechanical perfection that is shown at the present time.\(^1\) During the greater part of this period the machines were not sufficiently satisfactory from a mechanical standpoint to have been used in a practical way. It is, therefore, not surprising that there are few practical dairymen in America today who have used mechanical milkers continuously for as long a period as 15 years.

Because of the difficulties involved in perfecting a machine that could milk as satisfactorily as the hand milker, manufacturers have usually given the greater part of their attention to perfecting the mechanical operation of the machines and only a few have given real attention to the problem of devising methods of cleaning and operating the machines so as to produce milk that would measure up to the exacting sanitary requirements of the modern city.

Bacteriologists and sanitarians have, however, realized the importance of milking machines as a possible source of the bacterial contamination of milk almost from the time they were first tried out under practical conditions. This is shown by the review of literature dealing with the subject that has appeared in a previous bulletin of this Station.\(^2\) Manufacturers have shown an increasing interest in this matter, especially those who have learned by years of experience that milking machines must be more than a mechanical success. Unfortunately machines are still being introduced whose inventors do not understand even the simplest principles of sanitation.

There is a considerable chance for improvement in perfecting mechanical parts so as to prevent contamination and permit easy

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cleaning, and in the selection of materials for the metal and rubber parts that are the most satisfactory for their purpose even in the best machines. It is the object of this bulletin to discuss one of these details, which has apparently played a part in causing an undesirable bacterial contamination of the milk drawn into the milker pails. The danger referred to is that of the contamination of the milk by the entrance into the pail of condensation water from the vacuum pipe line.

HISTORICAL

In many of the earlier types of vacuum line milking machines, no check valve was placed in the pail top to prevent the inrush of air at the time when milking was completed and the vacuum in the pail was broken. It is now known that this direct opening allowed the condensed milky vapor and water to return from the vacuum line into the milk in the pail. This irregularly-introduced contaminating material was undoubtedly the cause of the irregular high bacterial counts noted by early observers.3

As there is a marked difference in the amount of rarified air passing thru the vacuum line of the different types of machines, the amount of condensation water that accumulates in the pipe lines during milking varies with the type of machine used as well as with variations in the temperature and humidity of the atmosphere. Since machines of the type in use in the Station stables are so constructed that a current of air passes continuously into the vacuum line during milking thru an opening in the teat-cup connector, the pipe lines in the Station stable contain a noticeable quantity of condensation water at the end of milking. Where the temperature and the humidity of the air favor condensation, this may be as much as a pint or more for each milking. For this reason, it is not surprising that the manufacturers of this machine were among the first to realize that some protection should be devised to prevent the return of moisture into the milk in the pail.

At first, however, it was believed that the contamination came primarily from the inrush of stable air when the connecting hose extending from the pail to the metal pipe line was pulled off of the stanchion stop-cock on the pipe line. Consequently, the first efforts

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to stop this contamination consisted of placing cotton filters on the pail lid at the junction between the connecting hose and the pail lid. The development of the filters is described in a previous bulletin (No. 317) and need not be repeated. It was not until 1914, when Moak 4 made a study of these machines in connection with the production of certified milk, that it was realized that the contamination was really caused by the entrance of condensation water itself, and that the amount of water which may enter the milk from each cow may be as much or even more than a tablespoonful. The cotton filters caught only a small part of this water.

As a result of the observations made by Moak, the manufacturers devised a moisture trap (Fig. 1) that was attached to the pail lid at the junction between the connecting hose and the pail, and later experiments reported in Bulletin No. 450 of this Station have shown that this trap is sufficient to prevent the entrance into the milk of moisture from the vacuum line under ordinary barn conditions. It was also shown in the same work that the dust of the air was an insignificant source of contamination of the milk, even in this type of machine where air passed thru the pail continuously during milking. Air as a source of contamination has been over-emphasized in this field in the past just as in the case of medical and surgical work.

Meanwhile, manufacturers of milking machines using an inflation type of teat-cup, in which the amount of condensation moisture gathering in the pipe lines appears to be less than that found in the vacuum lines of other types of machines had also placed a so-called check valve on the pail lid at the junction between the connecting hose and the pail. The primary purpose of this valve in most cases, however, was to prevent an inrush of air into the pail when the connecting hose was detached from the stanchion stop cock. The reten-

tion of the vacuum in the pail allowed the dairyman to lift the pail full of milk by means of the handle on the pail cover, a convenience when the teat-cups are attached to the milker.

PRESENT INVESTIGATIONS

So far as the authors of this bulletin are aware, no one has previously published the results of investigations of check valves of this type to determine whether condensation moisture might pass back thru them into the milk pail. A test was made, therefore, with a machine of the inflation teat-cup type which was placed in operation in the Station stables. This was operated by attachment to the vacuum pipe line already installed in the stable to operate the Station machines and was, therefore, operated on a line containing an abundance of condensation moisture.

PRELIMINARY TESTS WITH AN EXPERIMENTAL MACHINE OF THE INFLATION TEAT-CUP TYPE

Some preliminary tests with this machine were made by placing methylene blue (a common laboratory dye) in the stanchion or connecting hose. At the same time a piece of clean white gauze was fastened to the under side of the pail lid over the opening leading to the check valve chamber. The stanchion hose was then attached to the vacuum pipe line and the pulsator set in operation. This suction naturally tended to draw the methylene blue up the stanchion hose to the main pipe line. After a few minutes of operation the stanchion stop cock was closed and the stanchion hose disconnected, thereby causing the check valve to close. Air was then admitted to the pail and the gauze examined. It was found to be stained with a few drops of the methylene blue solution showing that under the conditions tested there had been a small amount of leakage. This was later confirmed by placing an empty dry beaker on a tripod directly under the check valve during the operation of the milker. When the vacuum was shut off and the milker pail opened, drops of moisture were found in the beaker.

* The name of this machine is not given as the result of the tests showed that improvements were needed before the check valve could be regarded as entirely satisfactory. As this fact might be used to injure the business of a manufacturer whose machines were no more defective than were those of many competitors at the time, and as this manufacturer has spent much time and effort in perfecting valves that would be satisfactory, it is felt that this is the only fair course to pursue.
Bacteriological tests were also made to verify the fact that leakage of this small amount of water did actually cause a measurable amount of contamination. The tests were made by analyzing samples taken from a liter of sterile water placed in the pail of the milker. Sample 1 was taken immediately after the water had been rinsed about in the pail, Sample 2 was taken from the same water after the pulsator had been placed on the pail and operated by means of the vacuum for five minutes, and Sample 3 was taken after the pulsator had been operated for a second five-minute period. In a few instances a fourth sample was taken after the water in the pail had been further contaminated by adding from 3 to 4 drops to 1 cc. of the condensation water from the pipe line.

The samples were plated in suitable dilutions on plain agar and incubated for five days at 25° C. Plates having more than 300 colonies were regarded as too crowded for counting, and, where possible, plates having less than 20 colonies were also disregarded. The figures given are usually the average of two or four plates. The counts given in the tables are not to be regarded as showing how many bacteria were present per cc., but merely the number of colonies per cc. of water that would have developed on agar if an entire cc. of the water had been examined. These counts represent a fairly definite fraction of the actual number of bacteria present and may be regarded, therefore, as showing the relative amount of bacterial contamination.

An examination of the results given in Table 1 shows that in 17 trials the sterile water, after it was added to the milker pail, developed an average of 297 colonies per cc. This average plate count increased to 1,880 per cc. after the operation of the pulsator for five minutes, one excessive count being omitted from the average. A second five-minute period of operation again increased the count in each instance, the average plate count for 14 trials being raised to a little more than 4,500 per cc., one excessive count being omitted as before. On March 11, 4 drops of condensation water taken directly from the pipe line were added to the water after the second five-minute period of operating the pulsator. This raised the plate count from 7,200 to 10,000 per cc. On two successive days, 1 cc.

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6 The medium contained 3 grams Liebig's meat extract, 5 grams Difco peptone, and 1.5 per cent air-dried agar. It gave the following reaction, p H = 6.5 to 6.6.
of condensation water was added under similar circumstances. In these cases, the plate count was raised to 1,000,000 or more per cc.

There was no evident source for these increased counts other than leakage of condensation water back thru the check valve, and the size of the counts obtained are all in harmony with a belief that the increases were caused in this way. Moreover, this conclusion was confirmed by actual observation in the following manner: A heavy glass jar was substituted for the milker pail and the pulsator set in operation by attaching to the vacuum line. Occasional drops of condensation water were seen to fall into the glass jar during the time that the pulsator was operating, and when the vacuum was shut off the dripping increased for a short time.

**Table 1.** Observations on the Increase in Bacterial Count in Water Placed in Milker Pail, Caused by Successive Operations of the Pulsator of a Milking Machine with an Imperfect Check Valve.

<table>
<thead>
<tr>
<th>DATE (1919)</th>
<th>Number of Colonies Developed Per CC. of Agar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water after being rinsed about in pail</td>
</tr>
<tr>
<td>March 1</td>
<td>10</td>
</tr>
<tr>
<td>March 5</td>
<td>890</td>
</tr>
<tr>
<td>March 6</td>
<td>2,000</td>
</tr>
<tr>
<td>March 7</td>
<td>140</td>
</tr>
<tr>
<td>March 10</td>
<td>370</td>
</tr>
<tr>
<td>March 13</td>
<td>190</td>
</tr>
<tr>
<td>March 31</td>
<td>7</td>
</tr>
<tr>
<td>April 4</td>
<td>26</td>
</tr>
<tr>
<td>April 9</td>
<td>51</td>
</tr>
<tr>
<td>April 10</td>
<td>34</td>
</tr>
<tr>
<td>April 11</td>
<td>23</td>
</tr>
<tr>
<td>April 12</td>
<td>390</td>
</tr>
<tr>
<td>April 14</td>
<td>35</td>
</tr>
<tr>
<td>April 18</td>
<td>30</td>
</tr>
<tr>
<td>April 19</td>
<td>780</td>
</tr>
<tr>
<td>April 21</td>
<td>39</td>
</tr>
<tr>
<td>April 24</td>
<td>110</td>
</tr>
<tr>
<td>April 25</td>
<td>34</td>
</tr>
<tr>
<td>AVERAGES</td>
<td>207†</td>
</tr>
</tbody>
</table>

† Tests made on April 24 omitted from these averages.
Six samples of the condensation water drawn directly from the vacuum line were analyzed between April 9 and 19. The bacterial counts from these samples varied from 304,000 to 2,400,000 per cc., averaging 1,000,000 per cc. The counts from these samples were somewhat lower than those made in 1917 from the same pipe line as noted in Bulletin No. 450, p. 138. Numerous counts made at that time showed a count in excess of 1,000,000 per cc. in almost all cases, and several counts in excess of 10,000,000 per cc. with a maximum count of 95,000,000 per cc. It would not take more than a few drops of such material to produce the increases in the count noted in Table 1. While the increases are not large enough to be very significant in the production of a Grade B milk, they are large enough to affect the premium paid at many Grade A plants and would be very troublesome in the production of certified milk.

The machine employed in these experiments was being used at the same time for regular milking, therefore it was decided to study the bacterial counts obtained from the milk itself to see whether they gave the same indication of outside contamination that was shown by the experiments just described. The teat-cups, tubes, and pulsator of the machine were first taken apart and given a thoro cleaning. The metal parts were sterilized in the autoclave or steam chest and the rubber parts in a strong chloride of lime solution. The machine was then assembled with extreme care to prevent contamination. Previous experiments had shown that the precautions used were sufficient to sterilize the machine itself. The operation of the sterilized machine was then studied by means of the analysis of a series of samples taken as follows: Sample 1 was taken from a liter of sterilized water which was used to rinse out the milker pail. Sample 2 was taken from 10 liters of sterilized water after it was poured into an artificial udder (Fig. 2). Sample 3 was
taken from 5 liters of this same water after it had been sucked into the milker pail from the artificial udder, the machine being attached to a stanchion cock where no condensation water was present. Sample 4 was taken under similar conditions from a second portion of 5 liters of sterile water drawn into the milker pail. Sample 5 was a composite sample of the foremilk of the first cow regularly milked with this machine. Sample 6 was taken from the milk of this cow after it was drawn into the milker pail. In this case, the milker was attached to the regular pipe line at a point where condensation water was regularly present.

The bacterial counts obtained from growth on plain agar after incubation of the plates for 5 days at 25° are given in Table 2. From these counts it will be seen that the samples taken from the milker

<table>
<thead>
<tr>
<th>DATE (1919)</th>
<th>Rinse water from milker pail</th>
<th>Water from artificial udder</th>
<th>First milking water from artificial udder</th>
<th>Second milking water from artificial udder</th>
<th>Foremilk from cow</th>
<th>Milk from milker pail</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 14</td>
<td>25</td>
<td>9</td>
<td>29</td>
<td>. . .</td>
<td>. . .</td>
<td>8,100</td>
</tr>
<tr>
<td>April 2</td>
<td>10</td>
<td>7</td>
<td>13</td>
<td>22</td>
<td>1,900</td>
<td>26,000</td>
</tr>
<tr>
<td>April 8</td>
<td>8</td>
<td>0</td>
<td>10</td>
<td>3</td>
<td>5,000</td>
<td>17,000</td>
</tr>
<tr>
<td>April 15</td>
<td>6</td>
<td>4</td>
<td>9</td>
<td>4</td>
<td>70</td>
<td>11,000</td>
</tr>
<tr>
<td>April 22</td>
<td>14</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>6,900</td>
<td>64,000</td>
</tr>
<tr>
<td>AVERAGES</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>3,500</td>
</tr>
</tbody>
</table>

|                     | Milk from milker pail        | 25,000                     |

before its use on the cow show in every case that the machine itself in all of its parts was as nearly perfectly sterile as could be expected under the circumstances. When, however, the average count of the fresh milk as drawn from the udder into sterile test tubes (as shown in the next to the last column of the table) is compared with the average count of the same milk as it was in the milker pail (as shown in the last column of the table) the marked increase indicates that bacteria were added in noticeable numbers to the milk in its passage into the milker pail. As the machine itself was known to
be sterile in each case, the most probable source of the increased number of bacteria was from leakage thru the check valve of condensation water from the vacuum line.

From February 28 to April 28, numerous comparative tests were made between counts obtained from milk drawn with the machine with the leaky check valve and those obtained from milk drawn with the milkers in regular operation in the stable. During this period the experimental machine was subjected to the same general system of cleaning that is generally followed with the Station machines, the teat-cups and tubes being attached to a faucet so that cold water passed thru them continuously between milkings. Immediately after each milking, cold water, hot soda water, and clean hot water was sucked thru the tubes, and once each week they were given a more thorough cleanup. In addition to this, the machines were completely sterilized on the four dates noted in Table 2.

The two Station machines received only the usual routine cleaning, that is they were cleaned as specified above immediately after each milking, and once per week were given the thorough cleanup. At the beginning of the period both sets of tubes from the two units were kept between milkings in a crock containing brine and chloride of lime. After March 11, however, one set of these tubes, as indicated in Table 3, was placed in running cold water with the tubes from the experimental machine.

The cows whose milk was sampled were selected at random and were not changed during the period under observation. As the counts were low from the cows milked with the two Station units, it is evident that the number of bacteria in their milk as it left the udder was not unusual. Also, as shown in Table 2, the four tests made from the foremilk of Cow 1, which was milked with the experimental machine, were not excessive, giving an average of 3,500 per cc.

A glance at the counts given in Table 3 for the milk obtained with the experimental machine shows them to be higher than those obtained from the milk drawn with the Station units regardless of the method used in caring for the tubes between milkings. In all, only 7 counts of the 32 tests made from the experimental machine were as low as 10,000 per cc., while 39 counts out of 52 tests from the Station units were 10,000 per cc. or less. Three counts out of the
32 from the experimental machine were in excess of 50,000 per cc. with a maximum of 84,000 per cc., while but 1 count (62,000) out of the 52 from the Station units was in excess of 50,000 per cc.

Table 3.—Comparison between bacterial counts of milk drawn with two station machines and a machine known to have an imperfect check valve.

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Date (1919)</th>
<th>Number of colonies developed per cc. of agar</th>
<th>Machine No. 1 †</th>
<th>Machine No. 2 ‡</th>
<th>Machine with imperfect valves §</th>
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<tr>
<td></td>
<td></td>
<td>Cow 1</td>
<td>Cow 2</td>
<td>Cow 3</td>
<td>Cow 4</td>
</tr>
<tr>
<td>1</td>
<td>Feb. 28</td>
<td>3,400</td>
<td>7,000</td>
<td>2,700</td>
<td>11,000</td>
</tr>
<tr>
<td>2</td>
<td>Mar. 4</td>
<td>16,000</td>
<td>13,000</td>
<td>15,000</td>
<td>2,600</td>
</tr>
<tr>
<td>3</td>
<td>Mar. 7</td>
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<td>26,000</td>
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</tr>
<tr>
<td>4</td>
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<td>7,000</td>
<td>3,800</td>
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</tr>
<tr>
<td>5</td>
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<td>10,000</td>
<td>4,900</td>
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</tr>
<tr>
<td>6</td>
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<td>2,600</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>April 21</td>
<td>7,000</td>
<td></td>
<td>11,000</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>April 22</td>
<td>13,000</td>
<td></td>
<td>2,600</td>
<td></td>
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<tr>
<td>23</td>
<td>April 24</td>
<td>5,400</td>
<td></td>
<td>3,100</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>April 25</td>
<td>7,000</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>25</td>
<td>April 28</td>
<td>4,900</td>
<td></td>
<td>6,100</td>
<td></td>
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</table>

† Milker tubes kept in crock containing strong brine and chloride of lime until March 11. After that kept in cold running water at a temperature below 45° F.
‡ Milker tubes kept in crock containing strong brine and chloride of lime.
§ This machine, in addition to the regular cleaning, was taken completely apart and sterilized on March 17 and April 2, 8, 15, and 22, while the Station machines received no extra cleaning.

The milker tubes were also kept in cold running water at a temperature below 45° F.

For several days after the observations were begun, the milk of the second cow milked with each of the three units was also analyzed. In the majority of cases the milk gave a slightly lower count than did the milk of the first cow. This is in accord with previous observa-
tions (Bulletin No. 450, p. 170) and was doubtless due to the fact that the first milking washed the machines free from a portion of their bacterial contamination.

These comparative counts show that for some reason the experimental machine gave rather consistently higher counts than did the Station units and as the differences are quite in accord with those noted where conditions were so controlled as to make it practically certain that the higher counts were due to leakage and as no other satisfactory explanation of the differences is evident, it is believed that the higher counts obtained from the experimental machine were due to leakage back thru the check valve.

In comparing these counts with others it should be remembered that while they were made by the use of standard agar, the plates were incubated for 5 days at 25°C. so that many of the counts were larger than they would have been if made by the standard routine technic with incubation for 2 days at 37°C. The increase in count in the experimental machine from leakage could not have been large in any case, as all of the milk drawn into it would readily have met the bacterial standards set for Grade A pasteurized or even, in many cases, those set for Grade A raw milk. It would, however, have been difficult if not impossible to produce certified milk in our stable with this machine as even on the five days when the machine was perfectly sterilized, only one of the five counts was under 10,000 per cc.

TESTS OF CHECK VALVES OF VARIOUS MILKING MACHINES COMMONLY USED IN NEW YORK STATE

Tests of machines of the inflation teat-cup type.— The above tests having shown conclusively that leakage of foul condensation water into the milk from the vacuum pipe line did occur under severe service conditions with the trial machine, it was decided to test a series of milker pulsators having similar check valves. These tests have been continued as various types of valves were submitted up until the time of publication of this report, the manufacturers of machines having shown commendable interest in perfecting satisfactory valves.

No bacteriological tests were made in connection with these trials as it was felt that the work just reported was sufficient proof of the effect produced by the leakage. The tests made were such as would determine whether leakage of the check valve would occur under the severest possible service conditions and did not establish what happens under the less severe conditions that usually obtain on dairy farms.

The trials of this series of pulsators were made by substituting a glass jar for the ordinary milker pail thus permitting the observer to watch what took place during the operation of the pulsator. An inspection glass was also inserted in the stanchion hose between the check valve and the stanchion cock. This allowed the observer to watch the behavior of the condensation water in the stanchion hose. In order that conditions might be severe, a half pint or more of water was poured into the upper end of the stanchion hose in each case before attaching this to the stanchion cock. The pulsators were then put into operation by attaching the stanchion hose and opening the stanchion cock. This caused the greater part of the water to be sucked into the main line at once, but some could be seen at times to trickle down the side of the observation glass against the current of air, or else it surged violently in the lower part of the stanchion hose.

In some cases leakage occurred with each pulsation, and amounted to a tablespoonful or more; in other cases a few drops only or no water at all passed back into the pail during the time the pulsator was operating. In all of the cases mentioned and figured, however, there was a greater or less amount of leakage at the time that the stop cock was closed and the stanchion hose detached.

Two styles of check valves each were tested for Machine No. 1 (one illustrated in Fig. 3), Machine No. 2 (Figs. 4 and 5), and Machine No. 3 (Figs. 6 and 7); and one style each for Machine No. 4 (Fig. 8) and Machine No. 5 (Fig. 9). Other pulsators would have
been tested if it had not been for the fact that it involved considerable expense in the installation of new equipment. This was not felt to be necessary in as much as the matter of testing the efficiency of the valves is so simple that it can be done by any user of a machine.

This test can be made by the dairyman in his own stable in the following way: Set up the machine as usual, making sure that the milker pail is perfectly dry. Insert an inspection glass in the stanchion hose. Attach the stanchion hose to a stall cock where condensation water usually accumulates. Start up the pulsator of the machine in the usual manner. After operating this, close the stanchion cock and allow the machine to stand for a few moments before releasing the vacuum in the pail. If the check valve leaks, it will be shown by drops of water in the milker pail when it is opened. If the valve leaks, the matter should be taken up with the manufacturer of the machine for adjustment.

A more severe test can be made by pouring water into the stanchion hose before this is attached to the stanchion cock.
Machines of the individual pump type.—Trouble may also occur in machines where each unit is operated by an individual pump as there is no check valve between the pail lid and the vacuum line in these machines. The entire vacuum line in this case consists of 5 feet of rubber hose which extends from the milker pail to the pump. An inspection glass placed in this line shows that a certain amount of milky vapor passes up in this stanchion line hose and, condensing in the line, runs back into the milk chamber. Unless this vacuum hose is kept in a sterile condition by means of satisfactory disinfectants or by the hot water method, this condensed milky vapor carries back undesirable contamination into the milk.

In this way a noticeable amount of contamination of the milk occurs unless the entire vacuum hose is kept in as cleanly a condition
as any part of the machine outfit. Some of the manufacturers of
machines of this type realize this possibility, and properly emphasize
the necessity of keeping the stanchion hose in sanitary condition,
so that users who get into trouble from poor quality milk caused by
neglect in cleaning this vacuum line have only themselves to blame.

CONCLUSION

The results of these tests have shown that many of our commonly
used mechanical milkers have not been equipped in the past with
check valves that close perfectly enough to prevent entirely condensa-
tion water and foul material from the vacuum line getting back into
the milk. While this contamination does not seem to be large in
amount in any of the machines tested, it is a contamination of an
unnecessary and undesirable sort. It is of sufficient importance,
moreover, to be of real significance in the production of high grade
milk, such as certified milk, and may frequently make it difficult
for dairymen to secure the highest premiums at Grade A plants.

A visit to 50 dairies in Grade A districts in the State during the
summer of 1921, showed that there was no one thing in the care of
the milking machines so generally neglected in these regions as the
cleaning of the check valves, stanchion hose, and vacuum lines.
Dirty valves may not act perfectly in preventing leakage even if
properly constructed, and the presence of foul material in the air
lines only invites trouble. Conditions such as these in the better dairy
districts indicate still worse conditions in regions where there is less
insistance upon cleanliness. Users of milking machines should make
sure that their machines are equipped with proper valves and should
then make sure that these are cleaned after every milking.