THE TRANSMISSION OF AGGLUTININS OF BACILLUS
ABORTUS FROM COW TO CALF IN THE
COLOSTRUM.

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In the work on infectious abortion associated with Bacillus abortus
carried on in this Department since 1917,1,2 the blood serum and
transudates of fetuses have been tested from time to time to determine

### TABLE I.
Agglutinin Content of Blood of Dam and Aborted Fetus.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dam.</td>
<td>Fetus.</td>
<td></td>
</tr>
<tr>
<td>493</td>
<td>1:1,280</td>
<td>1:40</td>
<td>Yes.</td>
</tr>
<tr>
<td>374</td>
<td>1:1,280</td>
<td>1:80</td>
<td>” “</td>
</tr>
<tr>
<td>652</td>
<td>1:1,280</td>
<td>0</td>
<td>” “</td>
</tr>
<tr>
<td>506</td>
<td>?</td>
<td>0</td>
<td>” “</td>
</tr>
<tr>
<td>270</td>
<td>1:1,280</td>
<td>0</td>
<td>” “</td>
</tr>
<tr>
<td>590</td>
<td>1:320</td>
<td>1:40</td>
<td>” “</td>
</tr>
<tr>
<td>595</td>
<td>1:320</td>
<td>1:20</td>
<td>” “</td>
</tr>
<tr>
<td>579</td>
<td>1:80</td>
<td>1:20</td>
<td>No.</td>
</tr>
<tr>
<td>509</td>
<td>?</td>
<td>1:40</td>
<td>Yes.</td>
</tr>
<tr>
<td>518</td>
<td>1:1,280</td>
<td>1:20</td>
<td>” “</td>
</tr>
<tr>
<td>668</td>
<td>1:320</td>
<td>1:20</td>
<td>” “</td>
</tr>
<tr>
<td>671</td>
<td>1:1,280</td>
<td>1:20</td>
<td>” “</td>
</tr>
</tbody>
</table>

* From autopsy records of the Department.

the relation between the concentration of agglutinins in the blood
serum of mother and fetus. The results, given in Table I, indicate
that even when the serum of the mother has a high agglutinin content,

1 Smith, Theobald, J. Exp. Med., 1919, xxx, 325.
AGGLUTININS OF BACILLUS ABORTUS

little or none is found in the fetal blood. The agglutinin figures given represent the agglutination limits of series of dilutions.

Tests of the blood of calves within the first few days of life presented different results. In some a relatively high titer was observed. The variation from case to case was finally explained by the absorption of agglutinins in the colostrum, as the experiments reported below amply demonstrate.

The literature on the transmission of various antibodies in the milk is fairly rich. Only a few publications bear more directly on the subject in hand. For a thorough review up to 1912 the reader is referred to Famulener’s article. In his own investigations on this subject, Famulener immunized goats with sheep blood corpuscles. He tested the antibody content of the mother’s serum and colostrum at time of parturition and the blood of the kids before and after they had ingested colostrum. He found that in immunized goats the colostrum was rich in antibodies but in the kids no antibodies were present until after taking the colostrum. He observed that the titer of the colostrum in many cases was above that of the mother’s serum, and that the milk quickly dropped in antibody content. From his experiments he concluded that the hemolytic antibodies in the young are received through the colostrum and absorbed by the young from the gastrointestinal tract, but that this absorption can only take place during the first few days after birth.

Rettger and White in 1918 and Rettger in 1920 made the statement that, without exception, cows with a positive agglutination to B. abortus gave birth to calves which showed the same reaction. This statement is true only after the first feeding with colostrum.

Recently Reymann in studying the transfer of normal agglutinins from mother to young also worked with goats, but he brings out no new points concerning the transmission of agglutinins. Strangely enough he fails to refer to Famulener’s results.

EXPERIMENTAL WORK.

The experiments to be reported differ from those of others in that they deal with the naturally acquired and stored agglutinins as the result of a definite infectious disease of cows, localized in the fetal membranes. Earlier experiments deal only with agglutinins experimentally induced.

Famulener, L. W., J. Infect. Dis., 1912, x, 332.
The procedure for the collection and dilution of the blood serum for the agglutination tests is the same as described in a previous paper.\textsuperscript{5} The milk was handled as follows: The samples were centrifuged and the cream layer was removed. This was necessary in order to obtain a clear whey; however, with some samples of colostrum which were very thick the centrifuging was omitted. The samples were then warmed to about 35°C. and several drops (8 to 10) of a solution of a rennet tablet in sterile distilled water were added. The tubes were well shaken and left standing in the water bath 15 to 20 minutes. By that time a firm coagulum had formed. In order to separate the whey quickly, the tubes were then put into warmer water, at about 45°C. This caused the coagulum to shrink and a clear whey to separate. This was drawn off and used for the agglutination tests. Frequent tests have shown that the rennet does not influence the agglutinins present.

The preparation and standardization of the antigen for blood and milk was as follows:

\textit{Bacillus abortus} was grown on agar at 37°C. for 24 to 48 hours. The growth was washed off in 0.85 per cent salt solution. This was standardized to a given opacity by means of the Gates instrument.\textsuperscript{7} A depth of disappearance of 2.4 cm. was taken as the standard. Each lot of antigen was made up to this density before use.

In Table II the agglutination titers of the blood and colostrum of seven cows and their calves soon after birth are given to illustrate the conditions usually found. Of these offspring, three (Nos. 488, 619, and 484A) were tested after suckling and agglutinins found in their blood. Two were negative when tested before suckling (Nos. 484B and 625). Of two premature calves, one had agglutinins in the blood (No. 567), the other not (No. 483).

These random illustrations showed the need of determining by suitably controlled tests the relation of the ingestion of colostrum to the agglutinin titer. In Table III illustrations of such tests are given. In the first case agglutinins appeared in the blood of the calf after it had suckled a cow (not its mother) whose colostrum had a high titer. In the second, the calf was fed colostrum artificially and agglutinins appeared but of a lower titer than in the preceding calf.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1:20</td>
<td>1:40</td>
<td>1:80</td>
</tr>
<tr>
<td>Cow's blood.</td>
<td>Mar. 23</td>
<td>C.*</td>
<td>C.</td>
</tr>
<tr>
<td>Colostrum.</td>
<td>&quot; 23</td>
<td>&quot; 23</td>
<td>++++</td>
</tr>
<tr>
<td>Blood, Calf A.</td>
<td>&quot; 23</td>
<td>C.</td>
<td>++++</td>
</tr>
<tr>
<td>&quot; &quot; B.</td>
<td>&quot; 23</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&quot; &quot; &quot;</td>
<td>&quot; 24</td>
<td>C.</td>
<td>++</td>
</tr>
<tr>
<td>Cow 488 and calf which had nursed before blood test.</td>
<td>Feb. 18</td>
<td>C.</td>
<td>C.</td>
</tr>
<tr>
<td>Colostrum.</td>
<td>&quot; 18</td>
<td>&quot; 18</td>
<td>++++</td>
</tr>
<tr>
<td>Calf's blood.</td>
<td>&quot; 18</td>
<td>C.</td>
<td>++</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>&quot; 19</td>
<td>C.</td>
<td>++</td>
</tr>
<tr>
<td>Cow 619 and calf which had nursed before first bleeding.</td>
<td>June 9</td>
<td>C.</td>
<td>C.</td>
</tr>
<tr>
<td>Colostrum.</td>
<td>&quot; 9</td>
<td>&quot; 9</td>
<td>++++</td>
</tr>
<tr>
<td>Calf's blood.</td>
<td>&quot; 9</td>
<td>&quot; 9</td>
<td>C.</td>
</tr>
<tr>
<td>&quot; &quot;</td>
<td>&quot; 10</td>
<td>++++</td>
<td>++++</td>
</tr>
</tbody>
</table>

Cow 484 and twin calves A and B, born Mar. 23, 1921. A had nursed before the first bleeding; B, much weaker, had not nursed until after the first bleeding.

Cow 488 and calf which had nursed before blood test. Calf born Feb. 18, 1921.

Cow 619 and calf which had nursed before first bleeding. Calf born June 9, 1921.
Cow 625 and calf which had not nursed before first bleeding. Calf born July 3, 1921.

<table>
<thead>
<tr>
<th>Cow's blood............</th>
<th>July 5</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>++</th>
<th>++</th>
<th>++</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf's &quot;................</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&quot;</td>
<td>4</td>
<td>C.</td>
<td>C.</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>±</td>
</tr>
</tbody>
</table>

Cow 483 and 8 mo. calf (premature) which had not nursed before first bleeding. Calf born Mar. 5, 1921.

<table>
<thead>
<tr>
<th>Cow's blood............</th>
<th>Mar. 5</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>+++</th>
<th>+++</th>
<th>+++</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colostrum...............</td>
<td>5</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Calf's blood............</td>
<td>6</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&quot;</td>
<td>7</td>
<td>+++</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Cow 477 and calf which may have nursed before bleeding.

<table>
<thead>
<tr>
<th>Cow's blood............</th>
<th>May 28</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>+</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colostrum...............</td>
<td>28</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Calf's blood............</td>
<td>29</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&quot;</td>
<td>30</td>
<td>+++</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Cow 567 and premature undated calf. B. abortus found in the organs subsequently.

<table>
<thead>
<tr>
<th>Cow's blood............</th>
<th>Feb. 16</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>C.</th>
<th>+++</th>
<th>++</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colostrum...............</td>
<td>16</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Blood of fetus..........</td>
<td>16</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

* The plus signs stand for degrees of clumping from almost complete (+ + + +) to just visible clumping (+). The minus sign means less than 1:20, and no clumping in controls. The letter C stands for complete clearing of the fluid.
### TABLE III.

<table>
<thead>
<tr>
<th>No. of dam</th>
<th>Titer Blood</th>
<th>Titer Colostrum</th>
<th>Age of calf when blood was tested</th>
<th>Titer of blood</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>627</td>
<td>1:160</td>
<td>1:320</td>
<td>1 hr., 50 min.</td>
<td></td>
<td>Calf received 1 quart of milk free from agglutinins.</td>
</tr>
<tr>
<td></td>
<td>7 hrs., 10 &quot;</td>
<td>21 &quot; 30 &quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calf placed with Cow 626.</td>
<td>1:640</td>
<td></td>
</tr>
<tr>
<td>626</td>
<td>1:1,280</td>
<td>1:2,560</td>
<td>32 hrs., 46 &quot; 50 min.</td>
<td>1:640</td>
<td>Calf received 42 ounces of milk free from agglutinins.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calf received 36 ounces of colostrum.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28 hrs., 30 min. 45 &quot; 10 &quot;</td>
<td>1:40</td>
<td>Calf received 92 ounces of colostrum.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calf received 33 ounces of colostrum.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>29 hrs. 45 &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calf received milk.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 days, 16 hrs., 40 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 &quot; 16 &quot; 40 &quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calf of Cow 627, born July 7, 1921, at 9.40 a.m. Restrained from taking colostrum until after three examinations of the blood, then allowed to suckle a high titer cow (No. 626) which had given birth to a calf the same day.

Calf born of a high titer cow (No. 683), July 21, 1931, at 12.30 p.m. Restrained from taking colostrum until after two examinations of blood, then fed dam's colostrum which had been refrigerated and warmed.

Calf born of a high titer cow (No. 634), July 12, 1921, at 11 a.m. Restrained from taking colostrum until after three blood examinations, then fed dam's colostrum which had been refrigerated and warmed.

Calf born of a high titer cow (No. 657), Sept. 16, 1921, at 4.20 p.m. Restrained from taking colostrum or milk until after two examinations of the blood, then fed milk free from agglutinins.
RALPH B. LITTLE AND MARION L. ORCUTT  

TABLE III—Concluded.

<table>
<thead>
<tr>
<th>No. of dam.</th>
<th>Titer.</th>
<th>Age of calf when blood was tested.</th>
<th>Titer of blood.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blood.</td>
<td>Colostrum.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>653</td>
<td>1:20</td>
<td>1:160</td>
<td>1 hr., 35 min.</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1:20</td>
<td>(milk)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>654</td>
<td>1:320</td>
<td>1:1,280</td>
<td>18 hrs., 50 min.</td>
<td>1:320</td>
</tr>
</tbody>
</table>

Calf born of a low titer cow (No. 653), July 3, 1921, at 2 p.m. Restrained from taking colostrum until after one examination of the blood, then allowed to suckle a high titer cow (No. 654) which had given birth to a calf the same day. Milk was collected from Cow 653, 4 days after parturition, and blood 25 days after.

653 1:20 1:160 1 hr., 35 min. --
654 1:320 1:1,280 18 hrs., 50 min. 1:320

Calf born of a high titer cow (No. 655), July 23, 1921, at 5.30 a.m. Restrained from suckling until after one blood examination, then allowed to suckle dam.

655 1:640 1:1,280 5 hrs., 5 min. --
Calf placed with Cow 655.
11 hrs., 20 min. 1:160
32 " 10 " 1:640

Calf born of a high titer cow (No. 654), July 22, 1921, at 11.30 a.m. Restrained from suckling until after two blood examinations, then allowed to suckle dam.

684 1:640 1:1,280 2 hrs., 15 min. --
6 " 10 " --
Calf placed with Cow 684.
11 hrs., 50 min. 1:160
23 " 15 " 1:320

which suckled naturally. In the third illustration, the calf although fed colostrum failed to show agglutinins in its blood. In the fourth case, the colostrum of the mother had a high titer but the calf's blood was negative and remained so for nearly 6 days while the colostrum was being withheld. Later tests were interfered with by the death of the calf. The remaining cases reinforce the data given in the others. In the seventh, the agglutinins in the blood of the calf rose quite rapidly from the 11th to the 23rd hour.

In Table IV, the results of agglutination tests on the blood serum and colostrum of the mother and the blood serum of the new-born calf before and after the first meal of colostrum are presented in more detail to add to the data already presented and to show certain slight
### TABLE IV.

<table>
<thead>
<tr>
<th>No. of</th>
<th>Age of calf when blood was tested</th>
<th>Material tested</th>
<th>Dilutions</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>dam</td>
<td></td>
<td></td>
<td>1:20</td>
<td>1:40</td>
</tr>
<tr>
<td>655</td>
<td>5 hrs., 5 min.</td>
<td>Cow's blood.</td>
<td>C.</td>
<td>C.</td>
</tr>
<tr>
<td>Calf.</td>
<td>Calf's blood.</td>
<td>C.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Calf allowed to suckle dam.</td>
<td>C.</td>
<td>C.</td>
<td>++++</td>
</tr>
<tr>
<td></td>
<td>11 &quot;    20 &quot;</td>
<td>&quot;</td>
<td>C.</td>
<td>++++</td>
</tr>
<tr>
<td></td>
<td>32 &quot;    10 &quot;</td>
<td>&quot;</td>
<td>C.</td>
<td>++++</td>
</tr>
<tr>
<td>Calf</td>
<td>born of a high titer cow (No. 655), at 5:30 a.m. Restrained from suckling until after one blood examination, then allowed to suckle the dam.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 664    | 20 min.                          | Cow's blood.   | C.    | +     | +     | =      | -     | -     | -      | -       |
| Calf.  | Colostrum.                       | +++             | +++   | ++    | +     | -      | -     | -     | -      | -       |
|        | Calf's blood.                    | -               | -     | -     | -     | -      | -     | -     | -      | -       |
|        | Calf allowed to suckle dam.      | Calf's blood.   | ++    | +     | -     | -      | -     | -     | -      | -       |
|        | 4 hrs.                           | "              | ++++  | +++   | ++    | +      | -     | -     | -      | -       |
|        | 6 " 10 min.                      | "              | ++++  | +++   | ++    | +      | -     | -     | -      | -       |
|        | 14 " 30 "                        | "              | ++++  | ++++  | +++   | ++     | +     | -     | -      | -       |

| Calf   | born of a low titer cow (No. 664), at 5:20 p.m. Restrained from suckling until after one blood examination, then allowed to suckle the dam. |

Downloaded from April 14, 2017.
Calf born of a high titer cow (No. 669), at 1.20 p.m. Restrained from suckling until after one blood examination, then allowed to suckle the dam.

<table>
<thead>
<tr>
<th>Calf.</th>
<th>35 min.</th>
<th>Cow's blood</th>
<th>Colostrum</th>
<th>C.</th>
<th>C.</th>
<th>++</th>
<th>+++</th>
<th>+++</th>
<th>+++</th>
<th>++</th>
<th>+</th>
<th>-</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>2 hrs., 40 &quot;</td>
<td>Calf's blood</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calf allowed to suckle dam.</td>
<td>C.</td>
<td>C.</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&quot;</td>
<td>5 &quot; 40 &quot;</td>
<td>&quot; &quot;</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<td>&quot;</td>
<td>19 &quot; 40 &quot;</td>
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</tbody>
</table>

Calf born of a high titer cow (No. 411), at 3.30 p.m. Restrained from suckling until after one blood examination, then allowed to suckle the dam.

<table>
<thead>
<tr>
<th>Calf.</th>
<th>35 min.</th>
<th>Cow's blood</th>
<th>Colostrum</th>
<th>C.</th>
<th>C.</th>
<th>++</th>
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<tr>
<td>&quot;</td>
<td>1 hr., 50 &quot;</td>
<td>Calf's blood</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
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<tr>
<td></td>
<td></td>
<td>Calf allowed to suckle dam.</td>
<td>C.</td>
<td>C.</td>
<td>++</td>
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<td>+++</td>
<td>+++</td>
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<tr>
<td>&quot;</td>
<td>3 hrs., 50 &quot;</td>
<td>&quot; &quot;</td>
<td>+++</td>
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<td>&quot;</td>
<td>18 &quot;</td>
<td>&quot; &quot;</td>
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<td>&quot;</td>
<td>72 &quot;</td>
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irregularities in the flocculation of *Bacillus abortus* in the series of tubes containing dilutions of the colostrum and of the blood serum of the calf. These irregularities are evident in the calf's blood serum and colostrum of No. 669 and in the colostrum of No. 411. Similar irregularities are shown in Table II (Nos. 488 and 619).

In three cases of Table IV, the agglutinin titers of blood serum and colostrum of the dam were high but that of the calf's serum was negative until after the first meal. The fourth case (No. 664) presents a lower titer but the transmission of agglutinins to the calf is nevertheless in evidence. The higher concentrations of agglutinins in the colostrum than in the blood serum of the mother is indicated in three out of the four cases. In two cases the titer of the calf's serum rose above that of the mother.

**DISCUSSION.**

The tabulated observations and experiments are sufficient to establish the fact that even when the blood and colostrum of the dam have a relatively high content of agglutinins towards *Bacillus abortus*, the blood of the new-born calf, with rare exceptions, is free from such antibodies until the animal has suckled and taken in the colostrum. The only exception found is the last case in Table II. In this premature calf the autopsy record shows that the stomachs were still free from food and that *Bacillus abortus* was present in the spleen, liver, and kidneys. The antibodies which appear in the calf's blood are absorbed from the digestive tract. The precise age of the calf after which agglutinins fail to enter the blood as such has not been determined. Experiments bearing on this aspect of the subject are under way.

When colostrum was withheld and milk of a low or negative agglutinin titer substituted, agglutinins failed to appear or accumulate in the blood of the calf. The longest period following birth during which the colostrum was withheld in the various tests was 5 days.

A study of the tables shows, what has been pointed out by others, that the concentration of the agglutinins in the colostrum may exceed that of the blood at and immediately after parturition.

The rate of absorption into the blood is shown to be fairly rapid. Agglutinins began to appear slightly over an hour after the calf
had ingested colostrum. They were nearly at the maximum concentration 5 hours after feeding.

The test upon all samples was carried out as shown in detail in Table IV. The dilutions were made in series from 1:20 to 1:1,280 or 1:2,560, each tube being one-half the dilution of the preceding tube of the series. By this method certain irregularities in the agglutinin concentration in the colostrum were occasionally encountered. In certain tubes of a series the flocculation was stronger than in a higher, preceding concentration. In such cases the irregularities may appear in the blood serum of the calf after taking colostrum, but the blood serum of the mother does not present them.

CONCLUSIONS.

The agglutinins towards *Bacillus abortus* found in the blood serum of new-born calves are obtained from the mother through the colostrum. Calves at birth, unfed, are without agglutinins. The problem of the production of agglutinins by the fetus in whose tissues *Bacillus abortus* has multiplied and which is subsequently expelled prematurely is not touched by these observations.