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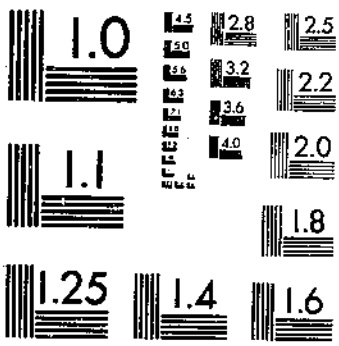

MICROCOPY RESOLUTION TEST CHART
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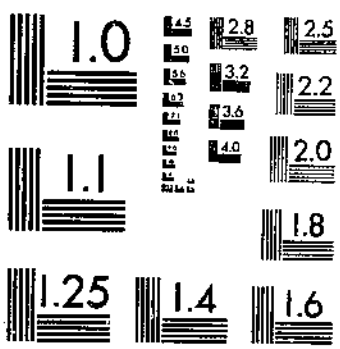

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TECHNICAL BULLETIN
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VACCINATION OF CALVES AND YEARLINGS AGAINST BANG'S DISEASE[1]

By J. M. BUCK,[2] *superintendent*, W. E. COTTON,[3] *former superintendent*, and H. E. SMITH, *associate veterinarian, Animal Disease Station, Bureau of Animal Industry*

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INTRODUCTION

The injection of *Brucella abortus* vaccine into calves as a means of rendering them more resistant to Bang's disease after they mature has received considerable attention during the last few years. Buck [4] in 1930 reported the results of an experiment in which 11 animals vaccinated during calfhood were exposed to *Br. abortus* by way of the mouth during each of two gestation periods. Use was made of five vaccinated animals as controls during the first pregnancy and five others during the second pregnancy. The results were encouraging for they not only indicated that a distinct immunity engendered during calfhood persists when the animals mature, but also that certain objectionable features which accompany the vaccination of unbred cows or of heifers near breeding age can be eliminated by the administration of the vaccine when the animals are from 4 to 8 months of age.

A second calfhood-vaccination experiment was reported by Cotton, Buck, and Smith [5] in 1934. In this experiment more vaccinated calves and more controls were used than in the preceding one, and the results obtained were equally encouraging. They strongly suggested the vaccination of calves to be a promising means of controlling Bang's disease in infected herds in which the prompt elimination or segregation of reactors is impractical.

The present experiment was conducted to gain further information concerning the efficacy and practicability of calfhood vaccination as compared with the vaccination of more mature heifers. In this study, 13 calves about 6 months old and 10 heifers from 12 to 14 months old were used. Six of the calves and five of the yearlings were vaccinated.

[1] Submitted for publication May 2, 1938.
[2] Died May 2, 1938.
[3] Retired September 30, 1937.
[4] BUCK, J. M. STUDIES OF VACCINATION DURING CALFHOOD TO PREVENT BOVINE INFECTIOUS ABORTION. Jour. Agr. Research 41: 667-689. 1930.
[5] COTTON, W. E., BUCK, J. M., and SMITH, H. E. FURTHER STUDIES OF VACCINATION DURING CALFHOOD TO PREVENT BANG'S DISEASE. Jour. Amer. Vet. Med. Assoc. 85: 389-397. 1934.

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The remainder served as controls. To simulate as nearly as possible the type of exposure that occurs in herds, a portion of the principals and controls were given severe contact exposure. Since it was feared that this method of exposure might not be entirely satisfactory, the remaining animals were given conjunctival exposure, the type that was employed in the experiment reported in 1934. The present experiment was carried on at the Experiment Station [6] at Bethesda, Md., from 1932 to 1934, inclusive.

TABLE 1.—*Results of vaccination of calves and yearlings against Bang's disease*

(Date of vaccination, Aug. 9, 1932)

VACCINATION OF CALVES

Animal No.	Strain of vaccine used	Date of breeding (1933)	Date of exposure (1934) [1]	Method of exposure	Gestation period	Outcome of pregnancy	Results of examinations for *Brucella abortus* [2]	
							Uterus	Colostrum
Principals:					*Days*			
1762	No. 19	Sept. 21	Jan. 19	Eye	272	Vigorous calf	−	−
		Oct. 10						
		Oct. 31						
1763		Sept. 29	July 19	do	279	do	−	−
		Oct. 18						
		Dec. 28						
1767		Sept. 10	Mar. 13	Contact	269	do	−	−
			Mar. 26					
			Apr. 7					
			May 9					
			May 27					
1768		Oct. 5	Mar. 9	do	275	do	−	−
			Mar. 28					
			Apr. 11					
			May 11					
			May 25					
1775	No. 618	Oct. 7	Dec. 12	Eye	270	do	−	−
1805		Sept. 21	Mar. 11	Contact	[3]			
			Mar. 24					
			Apr. 9					
			May 13					
			May 23					
Controls:								
1764		Sept. 24	Mar. 8	do	267	Weak calf	−	−
			Mar. 27					
			Apr. 10					
			May 8					
			May 28					
1765		Sept. 28	Mar. 10	do	276	Vigorous calf	−	−
			Mar. 23					
			Apr. 13					
			May 10					
			May 29					
1770		Oct. 1	Dec. 12	Eye	285	do	−	−
1776		Oct. 6	Mar. 12	Contact	279	do	+	+
			Mar. 29					
			Apr. 12					
			May 12					
			May 26					
1829		[4]	July 19	Eye	[3]	Weak calf	+	+
1838		Oct. 12	Mar. 14	Contact	279	Vigorous calf	−	−
			Mar. 25					
			Apr. 8					
			May 14					
			May 24					
1839		Oct. 4	Jan. 19	Eye	252	Weak calf	+	+

See footnotes at end of table.

[6] This station, now known as the Animal Disease Station, was moved to Beltsville, Md., in 1935.

TABLE 1.—*Results of vaccination of calves and yearlings against Bang's disease*—Continued

VACCINATION OF YEARLINGS

Animal No.	Strain of vaccine used	Date of breeding (1933)	Date of exposure (1934)	Method of exposure	Gestation period	Outcome of pregnancy	Results of examinations for *Brucella abortus*	
							Uterus	Colostrum
Principals:								
1695	No. 19	Sept. 29	Mar. 3, Mar. 31, Apr. 14, May 16, May 17	Contact	Days (2)			
1697		Oct. 3	Mar. 7, Apr. 1, Apr. 16, May 18, May 19	do	281	Vigorous calf	—	—
1795		Sept. 20	Mar. 5, Apr. 3, Apr. 18, May 20, May 21	do	281	do	—	—
1796		Oct. 17	Jan. 19	Eye	288	do	—	—
1807		Sept. 25	Dec. 12	do	278	do	—	—
Controls:								
1683		Oct. 2	Mar. 4, Apr. 5, Apr. 15, May 15, May 22	Contact	283	do	+	—
1791		Sept. 26	Mar. 2, Apr. 3, Apr. 17, May 17, May 18	do	251	Weak calf	+	—
1797		Oct. 4, Oct. 27	Jan. 19	Eye		(3)	—	—
1708		Oct. 3	Mar. 6, Apr. 4, Apr. 18, May 19, May 20	Contact	294	Vigorous calf	—	—
1806		Sept. 25	Dec. 12	Eye	220	Abortion	+	—

[1] The date of exposure for animals Nos. 1770, 1775, 1806, and 1807 is in 1933.
[2] Key: +=presence and —=absence of *Br. abortus*.
[3] No record.

VACCINES USED

Each of the two vaccines used in the experiment had a density 10 times that of tube 1 of the McFarland nephelometer. One of these was prepared with *Brucella abortus* strain 19. This strain had been artificially cultivated for about 10 years and had become much reduced in virulence. When guinea pigs injected with it were killed 2 months later, macroscopic lesions were either absent or slight and when present were confined to the spleen. The agglutination titers of the blood serums of the guinea pigs at this time were sometimes as low as 1 to 25. The other vaccine was prepared with strain 618, which produced extensive lesions in guinea pigs injected with it and caused the blood serums of all the animals to react to the agglutination test in high titers.

On August 9, 1932, five of the yearlings and three of the calves, as shown in table 1, were injected with vaccine prepared with strain 19. The yearlings received 10 cc and the calves 5 cc each, subcutaneously. At the same time, three other calves were given 5 cc of the vaccine prepared with *Br. abortus* strain 618.

EFFECTS OF VACCINATION ON AGGLUTINATION REACTIONS

Two weeks after vaccination both the calves and yearlings reacted in titers of approximately 1:2,000. A test made 6 months later, however, showed that the agglutination titers of the calves had subsided more than those of the yearlings. At this time, two of the calves reacted in a titer of 1:25 and four were negative, whereas two of the yearlings reacted in a titer of 1:200, two in a titer of 1:100, and one in 1:50.

When breeding of the cattle was commenced in September 1933, about 13 months after vaccination, the difference in agglutination titers between the calves and yearlings was still more marked. Athough the animals vaccinated when calves were at this time all negative to the agglutination test, one of the animals vaccinated when a yearling reacted in a titer of 1:25 and four in a titer of 1:100.

EXPOSURE OF ANIMALS

Examinations of the cattle on December 4, 1933, indicated that four principals and four controls of each of the two groups (calves and yearlings) were pregnant. No. 1775, vaccinated when a calf, No. 1770, a control in the same group, No. 1807, vaccinated when a yearling, and No. 1806, a control in the yearling group, were exposed to *Brucella abortus* on December 12 (table 1). Exposure consisted in depositing 3 drops, in one eye of each animal, of a suspension prepared from a 48-hour culture of the fifth transfer of strain 629 and the third transfer of strain 074. The suspension had a density of that of tube 1 of the McFarland nephelometer.

Examinations made January 16, 1934, indicated that five more animals were pregnant—a principal, No. 1762, and two controls, Nos. 1776 and 1839, in the group vaccinated during calfhood; and a principal, No. 1796, and a control, No. 1797, in the group vaccinated when yearlings. Four of these animals, Nos. 1762, 1796, 1797, and 1839, were given conjunctival exposure January 19 in practically the same manner as was previously done. In one of the principals in the group vaccinated when calves—No. 1763—pregnancy was not definitely determined until July 19, when she was also given conjunctival exposure. A pregnant unvaccinated heifer, No. 1829, was added to the experiment at this time to control the exposure of No. 1763. The remaining seven pregnant animals in the group vaccinated when calves and six in the group vaccinated when yearlings were given contact exposure only.

To provide for this type of exposure, two pregnant cows negative to the agglutination test for Bang's disease were injected intravenously with a virulent *Br. abortus* suspension on December 12, 1933, and two more on January 19, 1934. Moreover, six control pregnant heifers in another vaccination experiment were available for giving exposure if they aborted.

The animals that provided exposure aborted in box stalls in which, when an abortion occurred, the fetus, afterbirth, and soiled bedding were allowed to remain. The vaccinated and control animals were alternately placed with each aborting cow for 24-hour periods until all 13 animals were thus exposed.

Two of the six controls already mentioned as being in another experiment and three of the four cows injected intravenously were

used to give exposures. All five animals aborted and their uterine discharges and colostrum proved to be heavily infected with *Br. abortus*.

Since it required nearly 2 weeks to expose, for 24 hours, each of the 13 heifers to each of the 5 aborting cows, the order in which the heifers were exposed to each aborting animal was varied, so far as possible, to equalize the exposure. In other words, if a vaccinated heifer and a control heifer were placed with an aborting animal on the first and second days, respectively, in one instance, when exposed to the next aborting cow they were placed in the contaminated stall near the end of the 2-week period.

EXPERIMENTAL RESULTS

In the group of 13 animals, 6 of which were vaccinated when calves and 7 remained unvaccinated as controls, 5 of the vaccinated heifers produced vigorous calves and guinea-pig-inoculation results with uterine material and colostrum were negative as were also agglutination results with the blood serums of the vaccinated heifers. The remaining vaccinated animal was found not to be pregnant on April 13. She may have aborted early in pregnancy but if so the act escaped detection. Frequent tests of her blood serum during the period that she was subjected to contact exposure had always yielded negative results. Of the seven controls, three expelled weak calves and *Brucella abortus* was demonstrated to be present in the uterus and colostrum of two of them. These two animals had been given conjunctival exposure. Another heifer, although giving birth to a vigorous calf, was found to have both uterus and colostrum infected. This heifer received contact exposure. The remaining three controls in this group gave birth to vigorous calves. Two of them received contact exposure and one received eye exposure.

In the group of 10 heifers, 5 of which were vaccinated when yearlings and 5 reserved as controls, 4 of the principals gave birth to vigorous calves. Guinea-pig-inoculation results indicated the absence of *Br. abortus* in their uteri and colostrum. At time of calving the blood-serum agglutination titer of three of the animals was 1 to 100, and the fourth 1 to 200. The remaining heifer was found to be non-pregnant. Although she may have aborted early in her gestation period with the result that the fetus was not discovered, the fact that her agglutination titer remained low suggests that *Br. abortus* was not involved. Of the five controls, one aborted and one expelled a weak calf. *Br. abortus* infection of the uterus and colostrum was demonstrated in each case. One of the animals received eye exposure and the other contact. A third heifer, which received contact exposure, gave birth to a vigorous calf but *Br. abortus* was found to be present in her uterine exudate. The fetus of a fourth heifer, which received eye exposure, was not found, but she was believed to have aborted early in April since her blood serum then caused agglutination in a titer of 1 to 1,000 and her udder showed some enlargement. Guinea pigs injected with her milk on May 31 acquired abortion disease but those injected with uterine material failed to do so. The remaining control, exposed by contact, gave birth to a vigorous calf and guinea pig inoculations did not indicate the presence of *Br. abortus*.

The experiment furnished some information as to the relative severity of conjunctival and contact exposure. Although a single

conjunctival exposure transmitted Bang's disease to four of the five controls—80 percent—that received it, close contact for 24-hour periods at different times with five cows that had recently aborted resulted in the transmission of the disease to only three of the seven controls—43 percent.

SUMMARY AND CONCLUSIONS

In an experiment carried on in 1932–34 at the Experiment Station, Bethesda, Md., six calves about 6 months of age and five yearling heifers were vaccinated against Bang's disease. When pregnant, these animals and 12 unvaccinated pregnant heifers were exposed through the conjunctiva to *Brucella abortus* or by contact with infected animals.

The exposure failed to transmit Bang's disease to any of the vaccinated animals, as indicated by guinea-pig-inoculation results with uterine material and colostrum at time of calving.

The five animals vaccinated during calfhood that produced vigorous calves gave negative results to the agglutination test at time of calving. On the other hand, three of the animals vaccinated when yearlings reacted in a titer of 1:100 and the fourth in a titer of 1:200 when they produced their calves.

Close contact for 24-hour periods at different times with five cows that had recently aborted resulted in the transmission of Bang's disease to three of seven, or 43 percent, of the pregnant heifers used as controls. A single conjunctival exposure transmitted it to four of five, or 80 percent, of the control animals used.

The use of abortion vaccine in calves gives indication of having a distinct advantage over its use in more mature unbred heifers since in the former the *Br. abortus* agglutinins that are caused to appear in the blood serum by the vaccine injections disappear more promptly and more regularly.

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