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Rinderpest in Buffaloes.—The Immunizing Value of Dried Goat Spleen Vaccine.

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THE value of the Burmese buffalo as a working animal is limited by considerations of shade and water. He is very sensitive to the sun, and for that reason for draught purposes is worked in the dense forest shade, and elsewhere is not used during the heat of the day. Opinions differ as to the relative merits of the buffalo and the ox for draught purposes, but there is no question about the great superiority of the buffalo in swampy ground and in ploughing paddy fields, for in the ploughing season paddy fields are mud baths, and mud baths and ponds are essential for the health of the buffalo. During the heat of the day the buffalo likes to wallow in ponds, with often only his nose above water, or in mud baths, from which he emerges with a protective covering of mud.

In a previous article (Pfaff, 1938) the position in regard to the effects of dried goat spleen vaccine on buffaloes was stated to be a little uncertain. Because of severe reactions field inoculators had reduced the dose for buffaloes, and considered that the smaller dose was less severe than the 0·0025 gram used for cattle. Since at that time there were no facilities at the laboratory for the investigation of this question, the reports from the field were acted upon, and the dose for buffaloes was reduced to 0·0004 gram, even though investigations had shown that in cattle the quantity of the virus did not influence the reaction. It was also reported from the field that spread of the disease from inoculated buffaloes had occurred, and that in many instances buffaloes had long-drawn-out reactions, leading to great loss of condition. The experimental investigation of these reports is now recorded.

Experiment 1, *Table* 1.

A preliminary experiment to determine the influence of the dose of vaccine on the reaction was done on young Indian buffaloes purchased in the neighbourhood of the laboratory. Frequent outbreaks of rinderpest had occurred in the areas from which the animals came, so they were expected to have some resistance to the disease. Although the buffaloes were kept in an open shed and were fed on green fodder, the conditions were not ideal, because there was

no water or mud in which the animals could wallow. Fifteen buffaloes were divided into five groups of three; one group was kept as controls and the others given vaccine in doses of 0·25 gram, 0·0025 gram, 0·00025 gram, and 0·000025 gram.

Details of the experiment are given in Table 1. This shows that two of the three animals that got 0·25 gram were immune to rinderpest, but the reaction of the third buffalo was no more severe than that caused by 0·00025 gram in three other animals. The reaction following the injection of 0·000025 gram was milder and occurred three or four days later than that caused by the larger doses.

Virulent blood was given 30 days after the vaccine with the following result:—

In the 0·25 gram group all proved immune.

In the 0·0025 gram group two proved immune and one died, but this animal developed no thermal reaction to the virus. It was considered that death was due to the severe reaction set up by the vaccine.

In the 0·00025 gram group all proved immune.

In the 0·000025 gram group one proved immune, one reacted and recovered, and one died.

Of the three control animals one died, and the other two recovered after reacting severely.

Although the animals had a considerable degree of resistance, this experiment indicated that the severity of the reaction was not related to the dose employed, but the minimum effective dose was probably 0·00025 gram: a solution estimated to contain one-tenth of that amount failed to immunize, probably because it contained no virus.

During the rains of 1939, forty adult Burmese buffaloes were brought from an area which had been free from rinderpest for many years. Throughout the experiment they were kept in a paddock in which there were many trees, providing deep shade, and a large pond in which they could wallow; green fodder was fed in abundance, and since the experiment was carried out at the beginning of the cold weather, conditions were ideal for buffaloes.

The following experiments were done:—

Experiment 2, Table 2.

To determine the influence of the dose of vaccine on the reaction. Four groups of four buffaloes got 0·25 gram, 0·0025 gram, 0·00025 gram and 0·000025 gram. Table 2 shows that the reaction provoked by 0·25 gram was no more severe than that provoked by 0·000025 gram. 0·000025 gram failed to immunize one animal which subsequently died of rinderpest in the immunity test, and in the other three animals in this group the reaction occurred slightly later than in those animals getting a bigger dose. The susceptibility of the animals is shown by the death from rinderpest within ten days of all three control animals.

Experiment 3, *Table* 2.

To determine if buffaloes can develop immunity to rinderpest by contact with buffaloes reacting to dried goat spleen vaccine. Three buffaloes, numbers 77, 53 and 79, were kept in close contact with sixteen buffaloes reacting to the vaccine. They developed no temperature reaction and on the 35th day were given cattle rinderpest virus. All died of rinderpest, so it must be concluded that in these three animals no transmission had occurred and no immunity had developed by contact with reacting buffaloes.

Experiment 4, *Table* 3.

To determine if long-drawn-out reactions may be caused by infection with rinderpest contracted soon after inoculation. Eight buffaloes were given cattle rinderpest virus three days after receiving varying doses of vaccine. The temperature of all returned to normal by the 18th day, whereas the temperature of animals not receiving virus returned to normal about ten to twelve days after inoculation.

Discussion.

During the course of the experiment all the inoculated buffaloes lost a lot in condition, and this notwithstanding the fact that they were kept under ideal conditions. Those that got cattle virus three days after they were inoculated lost most in condition. Coccidiae were not detected, but three animals had attacks of surra: in two of these the disease was detected soon after the animals arrived, and they were subsequently used as controls; in the third animal the disease flared up 21 days after inoculation. Surra may, therefore, be a complicating factor in the inoculation of buffaloes. The quantity of vaccine given does not affect the reaction, but it is possible that a very severe and long-drawn-out reaction may be due to infection soon after inoculation.

In buffaloes the mortality from rinderpest varies greatly; in some outbreaks it may be only 10 per cent. while in others it may approach 100 per cent. Experience has shown that in areas where the mortality is low goat spleen vaccine does not cause unduly severe reactions, but deaths may be expected in districts where outbreaks of the disease have not occurred for many years. The three control buffaloes in Experiment 2 and the three buffaloes used in Experiment 3 all died of rinderpest within eleven days. This, and the loss of condition in those animals given dried goat spleen vaccine, show that the Burmese buffaloes used in these experiments were more susceptible to rinderpest than the young Indian buffaloes used in Experiment 1; they were more susceptible than the most susceptible Burmese cattle. Nevertheless the vaccine killed none of the Burmese buffaloes, probably because they were in very good condition at the time of inoculation and were kept under ideal conditions. These experiments indicate that the vaccine may safely be used for buffaloes in good condition, provided they are well cared for and given at least thirty days' rest after inoculation.

SUMMARY.

1. The dose of dried goat spleen vaccine has no influence on the reaction produced.

2. Immunity is not acquired by contact with reacting buffaloes.

3. Long-drawn-out reactions may be due to infection soon after inoculation.

4. Buffaloes require adequate care and rest after inoculation.

ACKNOWLEDGMENT.

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REFERENCE.

PFAFF, G. (1938). Immunization against Rinderpest, with Special Reference to the use of Dried Goat Spleen Vaccine. *Onderstepoort Jnl. Vet. Sc. and An. Indust.*, Vol. 11, No. 2, pp. 263-330.

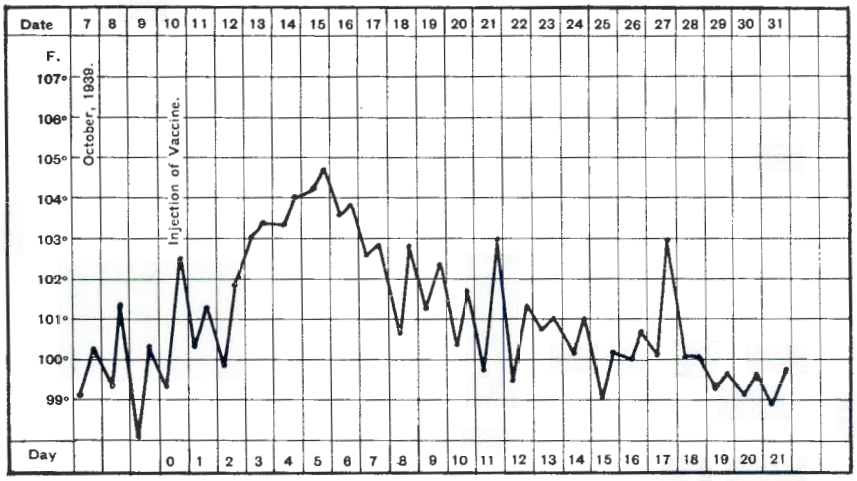

Fig. 1.—Temperature Chart of Buffalo 63, injected with 0·25 gram dried Goat Spleen Vaccine.

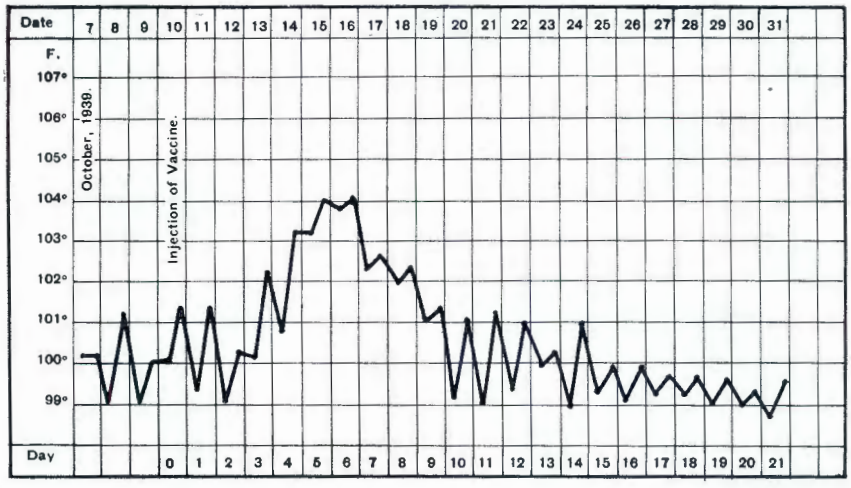

Fig. 2.—Temperature Chart of Buffalo 60, injected with 0·0025 gram dried Goat Spleen Vaccine.

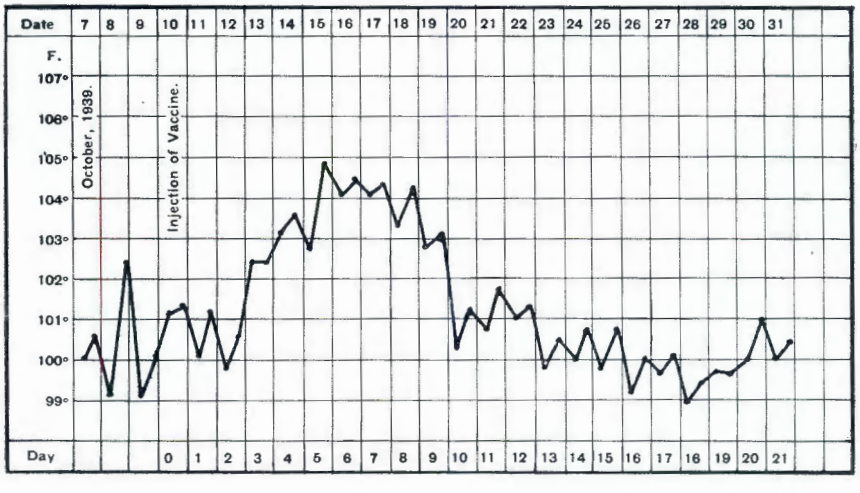

Fig. 3.—Temperature Chart of Buffalo 78, injected with 0·00025 gram dried Goat Spleen Vaccine.

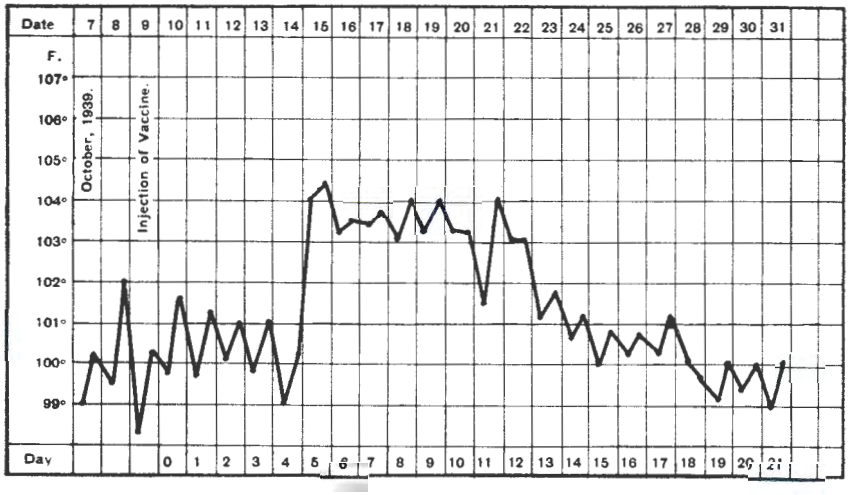

Fig. 4.—Temperature Chart of Buffalo 54, injected with 0·000025 gram dried Goat Spleen Vaccine.

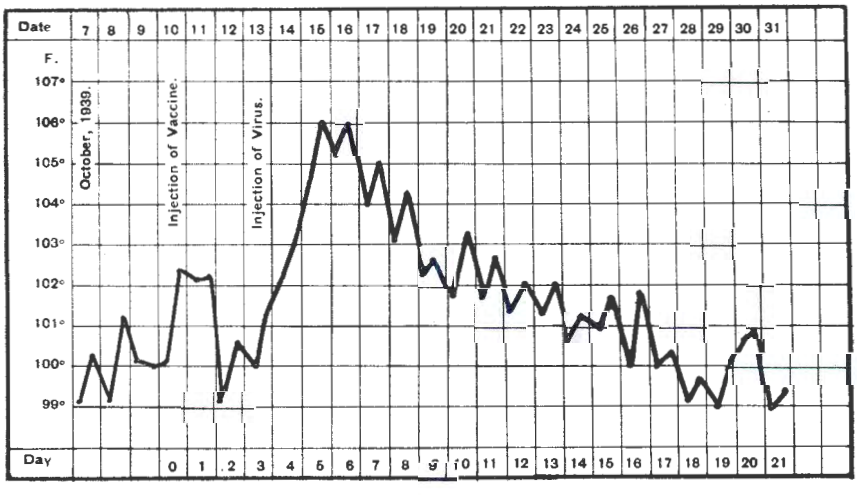

Fig. 5.—Temperature Chart of Buffalo 68, given virulent Cattle Rinderpest Virus 72 hours after injection of 0·00025 gram dried Goat Spleen Vaccine.

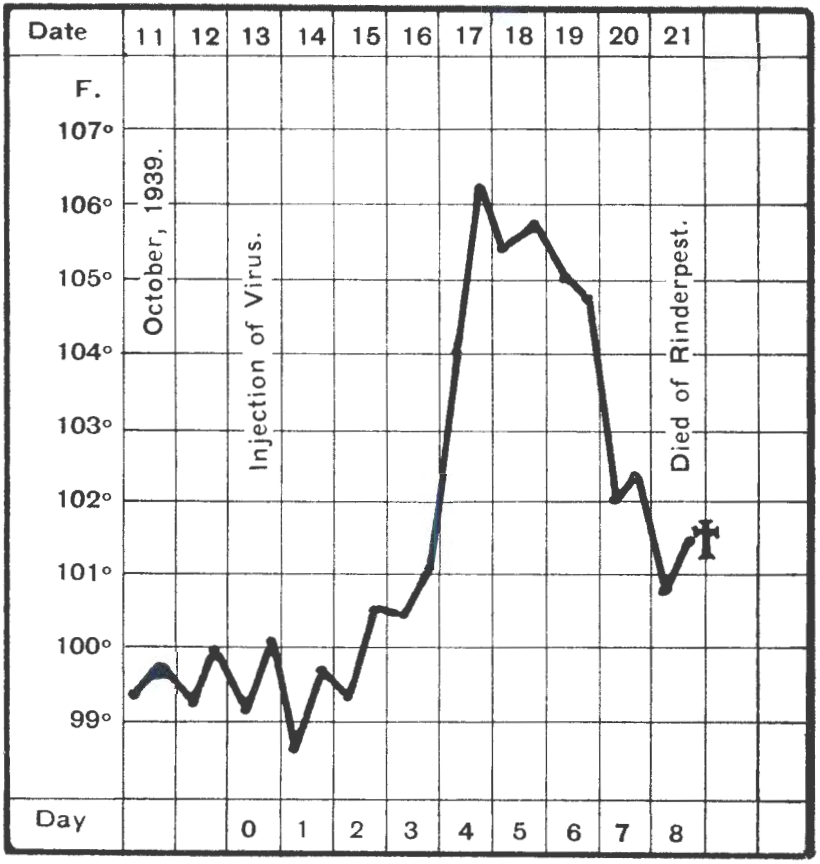

Fig. 6.—Temperature Chart of Control Buffalo 61, given virulent Cattle Rinderpest Virus.

APPENDIX.

Tables 1 to 3. Giving Details of Experiments described in the Text.

Note.—1. In Tables 1 to 3 the temperature in all cases refers only to that recorded before eight o'clock in the morning, the evening temperature being probably accentuated by the heat of the day and for that reason being disregarded.

2. In immunity tests "Immune" indicates no reaction whatever.

TABLE 1.

Experiment 1.—To determine the effect of varying quantities of dried goat spleen vaccine on the reaction and immunity produced.

Buffalo.		Injection of Dried Goat Spleen Vaccine.		Reaction.					Injection of Virulent Cattle Rinderpest Virus.			
Number.	Age.	Date Injected.	Weight of Dried Goat Spleen in Grams.	Day of Initial Rise.	Day Peak Reached.	Peak Temperature.	Rise in Temperature.	Result.	Day Temperature Returned to Normal.	Date Injected.	Quantity of Virulent Blood.	Result.
35	20 months.	15/12/38	0·25	—	—	—	—	No reaction...	—	13/1/39	2·5 c.c.	Immune.
38	18 months.	15/12/38	0·25	2nd	5th	102·6	2·4	Recovered....	14th	13/1/39	2·5 c.c.	Immune.
34	12 months.	15/12/38	0·25	—	—	—	—	No reaction...	—	13/1/39	2·5 c.c.	Immune.
36	24 months.	15/12/38	0·0025	4th	6th	102·6	2·0	Recovered..	13th	13/1/39	2·5 c.c.	Immune.
39	18 months.	15/12/38	0·0025	5th	5th	100·8	0·8	Recovered (mild reaction)	9th	13/1/39	2·5 c.c.	Immune.
46	12 months.	15/12/38	0·0025	1st	7th	102·8	2·4	Died on 40th day	24th	13/1/39	2·5 c.c.	No temperature reaction to virus.
37	28 months.	15/12/38	0·00025	4th	9th	102·0	2·0	Recovered....	17th	13/1/39	2·5 c.c.	Immune.
40	12 months.	15/12/38	0·00025	3rd	5th	102·0	3·0	Recovered....	12th	13/1/39	2·5 c.c.	Immune.
47	12 months.	15/12/38	0·00025	4th	5th	103·6	3·0	Recovered....	8th	13/1/39	2·5 c.c.	Immune.
43	36 months.	15/12/38	0·000025	7th	8th	101·4	2·0	Recovered....	12th	13/1/39	2·5 c.c.	Severe reaction; destroyed on 19th day because of emaciation.
41	12 months.	15/12/38	0·000025	6th	6th	102·2	3·0	Recovered....	11th	13/1/39	2·5 c.c.	Immune.
48	12 months.	15/12/38	0·000025	10th	10th	100·4	1·4	Recovered (very mild reaction)	12th	13/1/39	2·5 c.c.	Recovered after reaction.
44	18 months.		Control..							13/1/39	2·5 c.c.	Recovered after severe reaction.
45	12 months.		Control..							13/1/39	2·5 c.c.	Recovered after severe reaction.
50	6 months.		Control..							13/1/39	2·5 c.c.	Died of Rinderpest on 10th day.

TABLE 2.

Experiment 2.—To determine the effect of varying quantities of dried goat spleen vaccine on the reaction and immunity produced.

Buffalo Number.	Injection of Dried Goat Spleen Vaccine.		Reaction.						Injection of Virulent Cattle Rinderpest Virus.		
	Date Injected.	Weight of Dried Goat Spleen in Grams.	Day of Initial Rise.	Day Peak Reached.	Peak Temperature.	Rise in Temperature.	Result.	Day Temperature returned to Normal.	Date Injected.	Weight of Dried Bovine Spleen.	Result.
80	10/10/39	0·25			No reaction				13/11/39	0·01	Immune.
75	10/10/39	0·25	3rd	5th	102·6	3·6	Recovered...	10th	13/11/39	0·01	Immune.
67	10/10/39	0·25	3rd	7th	104·4	4·4	Recovered...	10th	13/11/39	0·01	Immune.
63	10/10/39	0·25	3rd	5th	104·2	4·2	Recovered...	11th	13/11/39	0·01	Immune.
56	10/10/39	0·0025	3rd	5th	105·0	5·2	Recovered...	10th	13/11/39	0·01	Immune.
72	10/10/39	0·0025	4th	6th	104·2	3·0	Recovered...	11th	13/11/39	0·01	Immune.
52	10/10/39	0·0025	3rd	4th	103·0	3·6	Recovered...	12th	13/11/39	0·01	Immune.
60	10/10/39	0·0025	3rd	6th	103·8	3·8	Recovered...	10th	13/11/39	0·01	Immune.
58	10/10/39	0·00025	3rd	6th	104·4	4·4	Recovered...	13th	13/11/39	0·01	Immune.
78	10/10/39	0·00025	3rd	6th	104·0	4·0	Recovered...	13th	13/11/39	0·01	Immune.
59	10/10/39	0·00025			Doubtful reaction mild.				13/11/39	0·01	Immune.
81	10/10/39	0·00025	3rd	6th	104·0	4·0	Recovered...	11th	13/11/39	0·01	Immune.
55	10/10/39	0·000025			Irregular and doubtful mild reaction.				13/11/39	0·01	Died of Rinderpest on 10th day.
62	10/10/39	0·000025	4th	7th	103·2	3·2	Recovered...	15th	13/11/39	0·01	Immune.
54	10/10/39	0·000025	5th	5th	104·0	4·0	Recovered...	15th	13/11/39	0·01	Immune.
74	10/10/39	0·000025	6th	7th	103·6	4·0	Recovered...	18th	13/11/39	0·01	Immune.
61		Control..							13/11/39	0·01	Died of Rinderpest on 9th day.
70		Control..							13/11/39	0·01	Died of Rinderpest on 6th day.
69		Control..							13/11/39	0·01	Died of Rinderpest on 10th day.

Experiment 3.—To determine if buffaloes can develop immunity by close contact with buffaloes reacting to dried goat spleen vaccine.

77	Kept in close contact with animals in Experiment 2						No reaction..		13/11/39	0·01	Died of Rinderpest on 11th day.
53							No reaction..		13/11/39	0·01	Died of Rinderpest on 10th day.
79							No reaction..		13/11/39	0·01	Died of Rinderpest on 10th day.

TABLE 3.

Experiment 4.—To determine if long-drawn-out reactions may be caused by infection with rinderpest contracted soon after inoculation.

Buffalo Number.	Injection of Dried Goat Spleen Vaccine.		Reaction.				Injection of Virulent Cattle Rinderpest Virus.		Day Temperature Returned to Normal.	Result.
	Date Injected.	Weight of Dried Goat Spleen in Grams.	Day of Initial Rise.	Day Peak Reached.	Peak Temperature.	Rise in Temperature.	Date Injected.	Weight of Dried Bovine Spleen.		
65	10/10/39	0·25	4th	7th	104·2	4·2	13/10/39	0·01	17th	Recovered.
64	10/10/39	0·25	3rd	4th	104·4	4·4	13/10/39	0·01	17th	Recovered.
76	10/10/39	0·0025	4th	5th	104·8	4·8	13/10/39	0·01	13th	Recovered.
73	10/10/39	0·0025	3rd	6th	104·0	4·4	13/10/39	0·01	18th	Recovered.
71	10/10/39	0·00025	3rd	4th	105·2	5·2	13/10/39	0·01	17th	Recovered.
68	10/10/39	0·00025	4th	6th	105·2	5·2	13/10/39	0·01	16th	Recovered.
57	10/10/39	0·000025	3rd	6th	104·6	4·6	13/10/39	0·01	18th	Recovered.
66	10/10/39	0·000025	4th	6th	105·0	5·0	13/10/39	0·01	16th	Recovered.

Note.—The 16 buffaloes in Experiment 2, which received injections of dried goat spleen vaccine on the same day as the above animals, may be regarded as the "*vaccine only*" controls: and the 3 buffaloes in Experiment 2 (Nos. 61, 69 and 70) which received virulent cattle rinderpest virus, as the "*virus only*" controls to Experiment 4.