

## **Ovine Anaplasmosis: The Transmission of *Anaplasma ovis* and *Eperythrozoon ovis* to the Blesbuck (*Damaliscus albifrons*).**

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### INTRODUCTION.

THE transmission of *Anaplasma marginale* and *Anaplasma centrale* to several species of South African antelopes was discussed by Neitz and du Toit (1932) and Neitz (1935). The experiments showed that *A. marginale* produced an active infection in the blesbuck, the duiker and the blackwildebeest, whereas *A. centrale* resulted in a latent infection in the blesbuck.

According to Lignières (1919) *A. marginale* produces a latent infection in sheep and goats. This observation in sheep was confirmed by Kraus, Dois and Oyarzabal (1922), Sergent, Donatien and Lestoquard (1924) and Neitz and du Toit (1932). Theiler (1910) and de Kock and Quinlan (1926), on the other hand, failed to infect sheep with *A. marginale*. Their experiments were carefully carried out, and it must therefore be concluded that sheep cannot always become infected with bovine anaplasmosis.

De Kock and Quinlan (1926) and Donatien and Lestoquard (1930) showed that cattle are not susceptible to *A. ovis*.

On account of the difference in the behaviour of the three species of anaplasma in the ruminants mentioned above, experiments were undertaken to ascertain the response of the blesbuck to *A. ovis*.

### EXPERIMENTAL OBSERVATIONS.

Three blesbuck (*Damaliscus albifrons*) were obtained through the kindness of the Provincial Administration of the Orange Free State from the Summerville Game Reserve at Theunissen. They arrived at Onderstepoort in May, 1936, and were kept in a comparatively tick free camp until they were needed. During the period that they were used for these experiments, they were kept in a stable. At first the animals were wild but they soon became so tame that the daily temperature and blood smears could be taken without great difficulty.

THE TRANSMISSION OF *Anaplasma ovis* AND *Eperythrozoon ovis*  
TO THE BLESBUCK.

The details about the subinoculations will be found in Table 1.

*Experiment 1. (S. 6382.)*

*Object.*—To ascertain whether one of the blesbuck harbours any blood parasites transmissible to sheep.

*Method.*—Blood from blesbuck 47080 was injected subcutaneously into two susceptible splenectomized sheep 41481 and 41596. Blood smears were examined daily for a period of 4 weeks.

*Result.*—No blood parasites could be demonstrated in either of the two sheep.

*Conclusion.*—Blesbuck 47080 did not harbour any blood parasites transmissible to sheep. It was assumed that since the blesbuck 47080 was free of parasites, that blesbuck 47086 and 47350 would also be free. Sufficient susceptible splenectomized sheep were not available to test each animal separately.

*Experiment 2.*

*Object.*—To transmit *A. ovis* and *Ep. ovis* to blesbuck 47080 and 47350.

*Method.*—Mixed blood of two sheep 40306 and 40326 harbouring *A. ovis* and *Ep. ovis* was injected into the two blesbuck.

*Result.*—Both antelopes reacted to *A. ovis* which was demonstrated on the 27th day in case of blesbuck 47080 and on the 32nd day in case of blesbuck 47350. Pronounced anaemia was observed clinically and microscopically in both animals. In neither of the animals could *Ep. ovis* be demonstrated microscopically. The temperatures remained normal (99-102° F.) throughout the period of observation. There was a gradual loss of condition and general weakness even after the disappearance of the parasites from the blood stream.

Blesbuck 47080 died 107 days after infection. At post-mortem this animal showed emaciation, anaemia, acute gastro-enteritis, oedema of the lungs, gelatinous infiltration of the fat and a *Bunostomum trigonocephalum* infestation.

Blesbuck 47350 died 103 days after receiving the infected blood. At autopsy ascites, hydrothorax, hydropericard, subendocardial haemorrhages, cachexia, gelatinous infiltration of the fat and oxyuriasis were observed.

*Conclusion.*—*A. ovis* could be transmitted to both antelopes. *Ep. ovis* could not be demonstrated microscopically, but may have been present as a latent infection. It is not clear to what extent the verminosis influenced the degree of anaemia. Both animals died several weeks after the disappearance of the parasites from the blood stream. It is possible that under these unnatural conditions the anaplasmosis infection was indirectly responsible for the deaths.

*Experiment 3.*

*Object.*—To confirm the microscopic diagnosis of *A. ovis* made in the previous experiment, by injecting blood from the antelopes into sheep, calves and a blesbuck.

*Method.*—(a) Blood from blesbuck 47080 was injected into two splenectomized sheep 41481 and 41596 used in experiment No. 1, into calf 7316, and into blesbuck 47086.

(b) Blood from blesbuck 47350 was injected into calf 7364.

*Result.*—(a) Sheep 41481 reacted to *A. ovis*, but three days after the appearance of the parasites, the animal died from meteorism of the rumen. *Ep. ovis* could not be demonstrated in this animal, but would probably have appeared had the animal lived longer, since this animal was known to be fully susceptible. Sheep 41596 reacted to *A. ovis* and *Ep. ovis*. A very marked anaemia developed as the result of the mixed infection, and the animal died eight days after the first appearance of the parasites.

Blesbuck 47086 reacted to *A. ovis*, but *Ep. ovis* could not be demonstrated microscopically. The infection did not produce a febrile reaction. The animal died 14 days after the first appearance of the parasites. At autopsy there were anaemia, icterus and a light *Haemonchus contortus* infection present.

Calf 7316 did not react to *A. ovis*. Three months later this calf was injected with *A. marginale* to which it reacted 21 days later.

Calf 7364 did not react to *A. ovis*. Six weeks later blood from this calf was injected into three sheep which failed to react to *A. ovis*. These sheep were later found to be susceptible to *A. ovis*. The calf reacted to *A. marginale* on testing its susceptibility.

*Conclusion.*—It was possible to confirm the microscopic diagnosis of *A. ovis* and to demonstrate a latent infection of *Ep. ovis* in one of the blesbuck by subinoculation of blood into a susceptible splenectomized sheep. The second splenectomized sheep died, and would probably also have reacted to *Ep. ovis* since it was fully susceptible.

Both the inoculated calves failed to react to *A. ovis*, and they were subsequently found to be susceptible to *A. marginale*.

## DISCUSSION.

In the appended Table II, an attempt is made to show the different characteristics of the anaplasma of the ruminants. It will be noticed that the information on this subject is incomplete, but nevertheless a number of important points are available, especially those on the susceptibility of the different species of the family

TABLE 1. (S. 6382.)

D.O.B. Number of Animal.	Injected from.	Object.	Dose of Blood.
Blesbuck 47080.....	Sheep 40306 and 40326 both carriers of <i>A. ovis</i> and <i>Ep. ovis</i> .	To transmit the parasites of the donors to the blesbuck	10 c.c. i.v., 10 c.c. subcut
41481. Susceptible splenectomized sheep	Blesbuck 47080 before receiving infective dose	To ascertain whether blesbuck harbours any blood parasites	10 c.c. i.v.....
	Blesbuck 47080 while showing <i>A. ovis</i> in the blood	To confirm the diagnosis of <i>A. ovis</i> in blesbuck	10 c.c. i.v.....
41596. Susceptible splenectomized sheep	Blesbuck 47080 before receiving infective dose	To ascertain whether blesbuck harbours any blood parasites	10 c.c. i.v.....
	Blesbuck 47080 while showing <i>A. ovis</i> in the blood	To confirm the diagnosis of <i>A. ovis</i> in the blesbuck	10 c.c. i.v.....
Blesbuck 47086.....	Blesbuck 47080 while reacting to <i>A. ovis</i> .	To transmit <i>A. ovis</i> to blesbuck.....	10 c.c. i.v.....
Bovine 7316.....	Blesbuck 47080 while reacting to <i>A. ovis</i> ..	To exclude the possibility of <i>A. marginale</i> infection in the blesbuck	10 c.c. i.v.....
	Bovine 7319, a carrier of <i>A. marginale</i> ....	To ascertain whether Bovine 7316 is susceptible to <i>A. marginale</i>	10 c.c. i.v.....
Blesbuck 47350.....	Sheep 40306 and 40326, both carriers of <i>A. ovis</i> and <i>Ep. ovis</i>	To transmit the parasites of the sheep to blesbuck	10 c.c. i.v.....
Bovine 7364.....	Blesbuck 47350 while reacting to <i>A. ovis</i> ..	To exclude the possibility of <i>A. marginale</i> infection	10 c.c. i.v.....
	Calf 7316, a carrier of <i>A. marginale</i> .....	To ascertain whether bovine 7364 is susceptible to <i>A. marginale</i>	10 c.c. i.v.....
Sheep 52872.....	Bovine 7364.....	To ascertain whether bovine 7364 harbours a latent infection of <i>A. ovis</i>	10 c.c. i.v.....
	Sheep 41835, 47079 and 46053.....	To ascertain whether sheep 52872 is susceptible to <i>A. ovis</i>	10 c.c. i.v.....
Sheep 52683.....	Bovine 7364.....	To ascertain whether bovine 7364 harbours a latent infection of <i>A. ovis</i>	10 c.c. i.v.....
	Sheep 41835, 47079 and 46053.....	To ascertain whether sheep 52683 is susceptible to <i>A. ovis</i>	10 c.c. i.v.....
Sheep 52737.....	Bovine 7364.....	To ascertain whether bovine 7364 harbours a latent infection of <i>A. ovis</i>	10 c.c. i.v.....
	Sheep 41835, 47079 and 46053.....	To ascertain whether sheep 52737 is susceptible to <i>A. ovis</i>	10 c.c. i.v.....

TABLE I. (S. 6382)—continued.

Date.	RESULT.			
	Incubation Period in Days.	<i>Anaplasma Ovis.</i>	Incubation Period in Days.	<i>Eperythrozoon Ovis.</i>
7/1/1938	27	Parasites appeared in large numbers. At the beginning of the experiment the erythrocyte count was 6 million, and the 14th day after the first appearance of the parasites, the erythrocyte count had dropped to 1.5 million. The blood showed basophilia, polychromasia anisocytosis and Jolly bodies. Parasites could be demonstrated for a period of 60 days. Blesbuck died 24/4/1938	—	<i>Ep. ovis</i> could not be demonstrated microscopically. The presence of a latent infection was shown by sub-inoculating blood into sheep 41596.
7/1/1938	—	No blood parasites could be demonstrated.....	—	—
4/2/1938	21	<i>A. ovis</i> could be demonstrated for 3 days. Sheep died from hoven 27/2/1938	—	<i>Ep. ovis</i> did not appear.
7/1/1938	—	No blood could be demonstrated.....	—	—
4/2/1938	15	<i>A. ovis</i> could be demonstrated for 8 days. Severe anaemia developed and sheep died 25/2/1938	15	<i>Ep. ovis</i> appeared in large numbers and undoubtedly complicated <i>A. ovis</i> infection.
17/2/1938	20	<i>A. ovis</i> appeared in large numbers. Animal died 21/3/1938	—	<i>Ep. ovis</i> could not be demonstrated microscopically.
26/2/1938	—	No parasites seen in blood smears for a period of 100 days	—	—
18/5/1938	21	A typical <i>A. marginale</i> infection was observed.....	—	—
26/4/1938	32	<i>A. ovis</i> appeared in large numbers, and produced marked anaemia. Parasites seen for a period of 40 days. Animal died 6/8/1938	—	<i>Ep. ovis</i> could not be demonstrated microscopically.
8/7/1938	—	No blood parasites appeared for a period of 8 weeks..	—	—
2/9/1938	12	A typical <i>A. marginale</i> infection was observed.....	—	—
22/8/1938	—	Did not react to <i>A. ovis</i> .....	—	Did not react to <i>Ep. ovis</i> .
26/9/1938	15	Reacted to <i>A. ovis</i> .....	15	Reacted to <i>Ep. ovis</i> .
22/8/1938	—	Did not react to <i>A. ovis</i> .....	—	Did not react to <i>Ep. ovis</i> .
26/9/1938	15	Reacted to <i>A. ovis</i> .....	15	Reacted to <i>Ep. ovis</i> .
22/8/1938	—	Did not react to <i>A. ovis</i> .....	—	Did not react to <i>Ep. ovis</i> .
26/9/1938	30	Reacted to <i>A. ovis</i> .....	—	Did not react to <i>Ep. ovis</i> .

TABLE 2.  
The Behaviour of the Three Species of *Anaplasma* in Ruminants.

Characteristics.	Parasite.	Cattle.	Sheep.	Goats.	Blesbuck ( <i>Damaiscus albifrons</i> ).	Blackwildebeest ( <i>Conocbaetes gnu</i> ).	Duiker ( <i>Sylvicapra grimmii</i> ).
Incubation period in days	<i>A. marginale</i> , <i>A. centrale</i> ... <i>A. ovis</i> .....	15-25 21-42 Not susceptible	Latent infection ? 20-35	Latent infection ? 20-35	25 Latent infection 20-32	38 ? ?	35 ? ?
Nature of infection...	<i>A. marginale</i> , <i>A. centrale</i> ... <i>A. ovis</i> .....	Active infection Active infection Not susceptible	Latent infection ? Active infection	Latent infection ? Active infection	Active infection Latent infection Active infection	Active infection ? ?	Active infection. ? ?
Situation of the parasites in the erythrocytes	<i>A. marginale</i> , <i>A. centrale</i> ... <i>A. ovis</i> .....	90 Per cent. marginal forms 88 Per cent. central forms Not susceptible	Latent infection ? 65 Per cent. marginal forms	Latent infection ? 65 Per cent. marginal forms	90 Per cent. marginal forms Latent infection 65 Per cent. marginal forms	90 Per cent. marginal forms ? ?	90 Per cent. marginal forms. ? ?
Number of erythrocytes that may be parasitized	<i>A. marginale</i> , <i>A. centrale</i> ... <i>A. ovis</i> .....	5-25 per cent., 5-25 per cent., Not susceptible	Latent infection ? 5-25 per cent.	Latent infection ? 5-25 per cent.	5 per cent., Latent infection 7.5 per cent.	2 per cent., ? ?	2 per cent., ? ?
Period in days during which parasites could be demonstrated microscopically	<i>A. marginale</i> , <i>A. centrale</i> ... <i>A. ovis</i> .....	10-40 10-40 Not susceptible	Latent infection ? 20-60	Latent infection ? 20-60	14 Latent infection 40-60	17 ? ?	14 ? ?
Clinical symptoms.....	<i>A. marginale</i> , <i>A. centrale</i> ... <i>A. ovis</i> .....	May be very severe Mild reaction... Not susceptible	No symptoms... ? As a rule mild.	No symptoms... ? As a rule mild.	No symptoms... No symptoms... Mild symptoms	No symptoms... ? ?	No symptoms... ? ?



*Cavicornidae*. The susceptibility of the bovine and the blesbuck to the three species of *Anaplasma* has been fully worked out, whereas in the other ruminants this information is still lacking. Cattle are susceptible to *A. marginale* and *A. centrale* only. The blesbuck is susceptible to all the three species of anaplasma. In this antelope *A. marginale* and *A. ovis* produce active infections, whereas *A. centrale* results in a latent infection. With this information one should be able to isolate *A. marginale* in a pure state from a blesbuck that harbours a mixed infection of *A. marginale* and *A. ovis* by passing the blood through cattle. On the other hand no method can be indicated for obtaining a pure strain of *A. ovis* from such a mixed infection, because all the ruminants mentioned in Table II are susceptible to *A. marginale*.

Another important fact that has been demonstrated is that the passage of these organisms through the various species of ruminants does not influence their chief characters, viz., their situation in the erythrocytes and their morphological structure.

#### CONCLUSIONS.

1. *Anaplasma ovis* produces an active infection in the blesbuck. The incubation period varies from 20 to 32 days. The parasites can be demonstrated microscopically for a period of 40 to 60 days. Anaemia resulted from the infection.
2. A latent infection of *Eperythrozoon ovis* in one of the blesbuck was demonstrated by subinoculation of blood into a susceptible splenectomized sheep.
3. The three blesbuck died. It is however not clear whether the anaplasmosis reaction was indirectly responsible for the deaths.
4. It was not possible to transmit *A. ovis* from the blesbuck to the cattle.
5. *A. ovis* did not change its characteristic morphology by passage through the blesbuck.
6. There is good reason to believe that blesbuck can act as reservoirs of *A. ovis* under natural conditions.

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