IN VIVO COMPARISON OF
EPERYTHROZOON OVIS AND EPERYTHROZOON WENYONI

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by
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IN VIVO COMPARISON OF
EPERYTHROZOOON OVIS AND EPERYTHROZOOON WENYONI

by
Roger Woods

Approved by Committee:

[Signatures]

Dean of the Graduate Division
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CHAPTER I

INTRODUCTION

The Eperythrozoa are blood parasites that are very similar to the Haemobartonella in many particulars. They occur in at least eight vertebrates and may cause a fatal anemia but usually produce a very mild anemia. The typical infection will be visible for only a short time and then becomes latent. Splenectomy upsets the host-parasite equilibrium and will generally cause a relapse in a latently infected animal.

The classification of these parasites has been much debated. The name Eperythrozoon indicates a protozoan affiliation. Weinman considered them to be similar to Bartonella and Haemobartonella.\(^1\) Neitz suggested that they should be classified in the Family Anaplasidae.\(^2\) Bergey classifies them in the Class Microtaterobotes, Order Rickettsiales, Family Bartonellaceae.\(^3\)


Eperythrozoonosis is an infectious disease caused by a small rod or ring shaped organism, 0.5 to 1.0 \( \mu \) in diameter. These are situated upon the surface of the erythrocytes or free in the plasma. They may occur in numbers exceeding 20 per single red blood cell. Differentiation between Eperythrozoan and Haemobartonella is difficult and may be arbitrary. Eperythrozoa are characteristically round, with numerous annular and disk-shaped elements, and with the rod form being very rare. Haemobartonella rarely occur as ring forms. Eperythrozoon species occur with about equal frequencies in the red blood cell or in the plasma. Eperythrozoon do not contain a nucleus, endoplasmic reticulum, mitochondria, or other organelles.\(^1\) Haemobartonella commonly occur in chain that cover the red blood cells.

The primary problem of this thesis was to investigate the host-specificity of two closely related Eperythrozoons. E. ovis has been reported to be non-infective when inoculated into cattle and E. wenyonii has been reported to be non-infective when inoculated into sheep.\(^2\) These two organisms have been shown to possess some common antigens.\(^3\)


\(^3\)Kreier and Ristic, loc. cit.
CHAPTER II

HISTORICAL REVIEW

Eperythrozoon ovis was first reported in 1934 by Neitz, Alexander, and Du Toit. They were the first to recognize E. ovis as a distinct parasitic entity. Neitz considered it very probable that De Kock and Quinlan in 1926 observed Eperythrozoon in splenectomized sheep. It is quite probable that several other persons may have seen this parasite but discarded it as stain precipitate, artifacts, or something else. Following Neitz's publication, E. ovis was subsequently reported from South Africa, Algeria, Iran, France.

1Neitz, Alexander, and Du Toit, loc. cit.
3Neitz, Alexander, and Du Toit, loc. cit.
North America,\textsuperscript{1} and Australia.\textsuperscript{2} It seems possible that it
may be fairly well distributed in most areas.\textsuperscript{3} Recently the
organism has been reported in Norway,\textsuperscript{4} Scotland,\textsuperscript{5} and
England.\textsuperscript{6} The majority of work in this field was done
before 1944.

The host range of \textit{E. ovis}, as determined by experi-
mental inoculation studies, includes domestic sheep, eland,
and possibly goats.\textsuperscript{7} The deer (Dama virginia) has been
shown to be susceptible.\textsuperscript{8} Neitz demonstrated that
splenectomized dogs, rabbits, and guinea pigs were not
susceptible.\textsuperscript{9}

\begin{itemize}
\item \textsuperscript{1}Jensen, op. cit., 1.
\item \textsuperscript{2}I. R. Littlejohns, "Eperythrozoonosis in Sheep," The
Australian Veterinary Journal, XXXVI (June, 1960) 260.
\item \textsuperscript{3}Weinman, op. cit., 326.
\item \textsuperscript{4}J. Overas, "Eperythrozoonosis Found in Norway,"
Nordisk veterinaermedicin, XI (September, 1959) 791.
\item \textsuperscript{5}A. Foggie, and D. I. Misbet, "Studies on Eperythrozoon
Infection in Sheep," Journal of Comparative Pathology,
LXXIV (January, 1964) 45.
\item \textsuperscript{6}B. Rouse, and R. Johnson, "Eperythrozoon ovis,"
The Veterinary Record, LXXIX (August, 1966) 223.
\item \textsuperscript{7}Weinman, loc. cit.
\item \textsuperscript{8}Kreier and Ristic, loc. cit.
\item \textsuperscript{9}Neitz, op. cit., 13.
\end{itemize}
Eperythrozoon wenyoni was first described, also in 1934, by Adler and Ellenbogen in the blood of cattle in Palestine. Neitz and Quinlan reported the parasite in South Africa. It was rather quickly reported from Iran, France, Equatorial Africa, and North America. E. wenyoni was recently reported from Kenya. E. wenyoni has been reported to occur from only the blood of domesticated cattle. Some other animals have been inoculated without much success. Sheep, goats, and deer have reported as not susceptible.

1 S. Adler, and V. Ellenbogen, "A Note of Two New Blood Parasites of Cattle; Eperythrozoon and Bartonella," Journal of Comparative Pathology, XLVII (June, 1934) 219.


3 Delpy, loc. cit.


6 Jensen, loc. cit.


8 Malbrant, Bayrou, and Rapin, loc. cit.

9 Kreier and Ristic, loc. cit.
CHAPTER III

MATERIALS

It was necessary to use experimental animals as free as possible of both endo- and ecto-parasites and to maintain these animals in this condition, as far as possible, for the duration of the test.

All experimental sheep and calves (except field cases) were obtained from a northern section of Minnesota. It is generally assumed that most species in the family Bartonellaceae are better adapted to the southern climate than to the colder northern sections.

Several reports have stated that an arthropod vector may transmit Eperythrozoa.¹,²,³ For this reason all experimental animals were housed in insect free barns to eliminate the possibility of this undesirable type of transmission.

The animals, upon arrival at the holding area, were dipped for the removal of any ectoparasites that may have been picked up during transportation. They were wormed to eliminate any heavy parasitic infection. The animals were

¹Jensen, loc. cit.
²Weinman, loc. cit.
³Neitz, loc. cit.
held for three weeks before being splenectomized to be certain that they had no disease in the latent stage.

All animals used were splenectomized. Splenectomized animals were used for two reasons: (1) to establish the negativity of the test animals by eliminating any positives and (2) to make the experimental animals a little more susceptible to infection by decreasing its ability to produce antibodies for a short period of time. Reports indicate animals may harbor a latent infection and the only means of diagnosing the parasite, in the latent condition, is the change brought about by the splenectomy.¹

All animals were held for a period of at least 3 to 5 weeks after splenectomizing before they were used.

Acridine orange stain, Type A, obtained from the National Analine Company, was used to stain the material on slides. Slides used were those with a single frosted end, 1.2 to 1.5 mm, obtained from local sources. The anticoagulant that was used was Sodium heparin, 4 units per ml.

A Zeiss fluorescence microscope with an Osram 200 mercury vapour burner was used to examine slides. For microscopic observation a 100x oil immersion lens was used in connection with a UG 5 and GG4 barrier filters.

¹Weinman, loc. cit.
Miscellaneous equipment included: syringes and needles for inoculation purposes, various bottles, tubes, and vials for working with the blood.

The field case animals were obtained from local sources and had been splenectomized. These animals were obtained from Diamond Laboratories and through the courtesy of Dr. C. J. Welter.
CHAPTER IV

METHODS

Splenectomy of the animals was performed under the direction of a Doctor of Veterinary Medicine. Splenectomy was accomplished by a ligature around the helix of the spleen. After the ligature was set, the non-functional portion of the spleen was cut off and discarded. Subpassages were made without checking the compatibilities of the blood of the donor and recipient. Transfusions were made on the basis of body weight of the recipient animal. One-fourth of ml. of whole blood was infused for each pound of body weight. All subpasses were made using this quantity as a follow-up to the work of Kreier and Ristic.¹

An intramuscular route was selected as a compromise between subcutaneous and intravenous routes. An intramuscular inoculation has been found to be absorbed much faster than a subcutaneous one and is not as prone to causing shock as an intravenous inoculation. An intramuscular inoculation will sever some capillaries and allow the blood stream to pick-up the parasite. Inoculations were given intramuscularly in two or three locations depending upon the amount, to reduce the possibility of creating a sterile abscess.

¹Kreier and Ristic, loc. cit.
Standard hematological determinations included: packed cell volume (PCV), blood films, temperatures of the animals, and general observation based on their physical appearance.

The packed cell volume is referred to as that percent of the circulating blood that is red blood cells. The PCV was determined every day for each animal. Blood was collected from a jugular vein puncture and a small amount was collected in a heparinized micro-hematocrit tube. The PCV was determined by using an International Centrifuge Laboratory model with micro-hematocrit head number 266. The centrifuge was run at 3,000 rpm for ten minutes. The PCV reading was made on a micro-hematocrit card reader.

Temperatures were taken daily on all animals. Animals were considered normal if the temperature was less than 103.5°F.

Blood films were collected at the same time as the PCV was taken. Films were made by placing a drop of blood on the slide and then using another slide to make a film. Blood films were allowed to air dry and then were stained with a one percent solution of the acridine orange stain. The films were then examined using the UV microscope. The film examinations were the first place where the parasite could be found. The peak parasitized erythrocytes is referred to as the PPE, which is the highest percentage of erythrocytes found in any one infection.
General physical symptoms were recorded on a daily basis to give a physical indication of the animals health. Physical symptoms were taken to see if there was a correlation between the hematological pattern and the clinical symptoms.

Experiments with *Eperythrozoon ovis*

A summarized table (p. 27) includes all subpasses and animals used in the study of *E. ovis*.

**Subpass I.** This pass involved a transfusion from the field case animal to a clean splenectomized sheep (I). Sheep I weighed 187 pounds and received forty-seven mls. of whole infected blood from the field case animal. This animal was followed hematologically until it developed a case of eperythrozoonosis.

**Subpass II.** Sheep II received forty-two mls. of blood from sheep I. Sheep II was followed hematologically until it became a positive reactor.

A splenectomized calf (I) was inoculated with whole blood from sheep I. This calf received eighty-five mls. of infected blood. Standard hematological data were collected on this animal.

**Subpass III.** Thirty-six mls. of acutely infected blood was inoculated intramuscularly into sheep III. Normal hematological data were collected on this calf.

Calf II received one hundred and five mls. of acutely
infected blood from calf I. Standard hematological data were collected on this calf.

Sheep IIIA received thirty-eight mls. of acutely infected blood from calf I. This pass was intended to demonstrate that the diseased calf, presumably infected by *E. ovis* derived from a sheep, harbored an *Eperythrozoon* capable of reinfecting a sheep.

**Subpass IV.** Sheep IV received thirty-six mls. of acutely infected blood from sheep III. Standard hematological determinations taken included: PCV, temperature, blood film examinations, and physical appearance.

Thirty-five mls. of infected blood was transfused from calf II into sheep IVA. This subpass was made to alter the characteristics of the *E. ovis*. Standard hematological data were collected on this sheep.

**Experiments with Eperythrozoon wenyoni**

The calf subpasses were very similar to the sheep subpasses except that they required more time and they were not as severe.

Table I on page 27 lists the animals and the subpass sequence used in the study of *E. wenyoni*.

**Subpass I.** Eighty mls. of whole infected blood was subpassed from the field case calf to calf A. The blood was inoculated in three different locations (both hind legs and the neck). Calf A was followed hematologically until it developed an acute case of eperythrozoonosis. After
it became acutely infected, blood was subpassed to calf B and sheep A.

**Subpass II.** Ninety-three mls. of blood was transfused from calf A into calf B. This calf was injected intramuscularly in three locations. Standard hematological data were collected on this calf.

Thirty-three mls. of acutely infected blood was transfused from calf A into sheep A. Sheep A was followed hematologically until a subpass was made to sheep B.

**Subpass III.** As calf B reached its peak parasitemia one hundred and twenty-one mls. of blood was removed and inoculated into calf C. This was the last direct subpassage from calf to calf. Standard hematological data were collected on this calf.

Forty-four mls. of acutely infected blood was subpassed from sheep A to sheep B. This pass was made to determine if the parasite was viable but unable to express itself. Standard hematological data were collected on this sheep.

**Subpass IV.** One hundred and five mls. of acutely infected blood was subpassed from sheep B to calf D. This pass was intended to demonstrate that the diseased sheep, presumably infected by *E. wenyoni* derived from a calf harbored an *Eperythrozoon* capable of infecting a calf. Standard hematological data were collected on this calf.

Smears were taken from nasal secretions on every
sheep and calf as they approached their peak parasitemia. This was an attempt to demonstrate another possible mode of transmission besides the direct inoculation or by arthropods as has been reported. These smears were made by using a cotton tipped swabs and swabing the nasal passages and then swabing the slides. These slides were treated as were the blood films for staining and for observations.
CHAPTER V

RESULTS

Experiments With *Eperythrozoon ovis*

The blood of the field case animal was not exhibiting parasites on the day that the subpass was made. A relapse occurred in the field case sheep three days after the subpass had been made. The sheep demonstrated a very mild relapse as judged by the infection developed in subsequent sheep.

**Subpass I.** An infection was observed in a blood film examination eleven days after the sheep was inoculated. Twenty percent of the red blood cells were infected on this initial sighting and within four days the percent had reached its peak of 90%. The peak parasitemia as previously mentioned is the number of infected erythrocytes in any one infection. This peak is referred to as the peak parasitized erythrocytes or PPE. *E. ovis* was found to be present attached to the erythrocytes and free in the plasma. No reticulocytes were noted in any blood films presumably because the PCV only dropped from an initial 32% to 29% seventeen days post-inoculation. The PCV rose to pre-inoculation levels very rapidly. Nasal secretions collected at or near the peak of parasitemia contained bodies that were identified as those of *Eperythrozoon*. 
No physical symptoms of the disease were observed in the sheep during the parasitemia or at any other time.

Subpass II. An almost immediate drop occurred in the PCV of sheep II after it received blood from sheep I. The PCV of sheep II, twenty-four hours after inoculation, had dropped from 32% to 18%. The PCV had started to rise when Eperythrozoa were observed in a blood film examination nine days after it was inoculated. The Eperythrozoa reached a peak of 80% infection twelve days post-inoculation. A limited number of parasites were found in the plasma. This sheep never demonstrated any real physical symptoms although the PCV never reached the pre-inoculation level. Sheep II had a relapse thirty-two days post-inoculation. During this relapse the PPE reached 100% with many erythrocytes having as many as twenty parasites per cell with the plasma containing about an equal number. Smear examination of nasal secretions demonstrated bodies that appeared to be Eperythrozoa but no positive identification was made.

Eperythrozoa were observed in a blood film examination from calf I twelve days post-inoculation. Within six days the PPE had reached 100%. Parasites were observed to occur both attached and free in the plasma. The PCV dropped from 39% to 33%. This drop occurred eight days after the first parasites were observed in the blood. This drop was not large enough to be called an anemia of any significance. No physical symptoms were observed in this calf. E. ovis
was able to propagate itself in a foreign host that had previously been considered not susceptible. There was no significant clinical or hematological symptoms of a virulent nature. Bovines are susceptible to E. ovis.

**Subpass III.** Eperythrozoa were observed in a blood film slide from sheep III five days after it was inoculated. Within two days after the first sighting 100% of the red blood cells were infected. The plasma contained numerous parasites. Nasal secretions contained several bodies that appeared to be Eperythrozoa but a positive diagnosis was not made. Sheep III exhibited a fever on days 8, 9, 10. The maximum temperature was on day eight (106.4°F.) On days nine and ten the temperature was over 103.5°F. The PCV dropped from 32% to a low of 12% eleven days post-inoculation. This low was maintained for three days before it started to rise. Reticulocytes were noted in the blood film at about the same time that the PCV started to rise. It took two weeks for the PCV to return to pre-inoculation level. Physical symptoms included: general weakness, jaundice, fever, and a low food consumption. The organism appeared to elicit a stronger response in sheep III than in either of the two previous subpasses.

An infection was detected in the blood films of calf II fourteen days post-inoculation. The maximum parasitemia (100%) was reached six days after the initial infection was detected. The PCV dropped from 38% to 20%. Reticulocytes
were observed on the blood films taken from this domestic calf during its recovery. Calf II exhibited physical symptoms that included a weakness, nervousness, and fever; it was off feed for three days. The maximum temperature reached was 105.6°F. Complete recovery required about three weeks. Calf II demonstrated a mild reaction to the parasite.

Sheep IIIA, who received acutely infected blood from calf I, developed eperythrozoonosis five days post-inoculation. It reacted very nearly in the same pattern as did sheep III. The PCV dropped from 33% to 22%. The animal was weak, off feed, and exhibited a temperature for four days (maximum 105.2°F.). Sheep IIIA required about three weeks for complete recovery.

Subpassage IV. Sheep IV demonstrated a very significant drop in its packed cell volume twenty-four hours after it received acutely infected blood from sheep III. The packed cell volume dropped from 35% to 16%. Eperythrozoa was found in the blood of this sheep seven days post-inoculation and reached a maximum of 100% within another two days. The parasitemia persisted for three weeks and was at its peak for six days. Physical symptoms observed were weakness and fever; it was very icterous. The PCV never fully recovered. This animal indicated it was possible to make a sequential subpassage of E. cvis in sheep. It appeared that the strain became more virulent as it was subpassed.

Eperythrozoa were observed no later than nine days post-inoculation in the blood of sheep IVA. This sheep
received blood from calf II when it was acutely infected. The PCV dropped from an initial 38% to 18%. This figure indicated a mild anemia. Sheep IVA demonstrated the following physical symptoms; weakness, low food consumption, and a fever. The maximum temperature reached was 106.6° F. and was over 103.5° F. on four other days. The Eperythrozoa were highly infective for sheep after it had been subpassed twice through calves and then returned to its normal host. The sheep demonstrated a severe reaction. Subpassages do not appear to have any detrimental effect on the strain except to make it more virulent.

Experimental Results Obtained With E. wenyonii

Table three gives a general summary of the experimental work involving the subpasses made with E. wenyonii. This table is located on page 29.

Subpass I. Eperythrozoa bodies were found in the blood film of calf A sixteen days after it was inoculated. It demonstrated a very mild infection that could have been missed had the slides not been examined daily. The PCV did not significantly drop. A subpass was made on day three of the parasitemia because the parasitemia was expected to reach greater heights. No more than 4 to 5 parasites were observed per cell. This figure was considerably lower than the 15 to 20 per cell seen in the sheep infections. The Eperythrozoa were located only on the edge of the cell and they were not grouped as they were in the sheep. The
calf and sheep strain were very similar morphologically.

Subpass II. The infection that calf B developed was much stronger than that of calf A. The parasites were first found in the blood film slides twenty-two days post-inoculation and reached a maximum of 60% four days later. The duration of the parasitemia was eight days. There were no physical symptoms and only a mild drop in the PCV (42% to 32%). No extra-cellular parasites were observed and the nasal secretion slides were negative.

Sheep A, which received blood from calf A, did not demonstrate any indication of the disease during a four week observation period so a subpass was made to sheep B. Sheep A did not demonstrate any parasites for an additional four week period after the subpass. At the end of the second four week period the sheep was inoculated with the sheep strain. Sheep A did not react or demonstrate any parasites during an additional four weeks after receiving the sheep strain. This sheep may have been non-susceptible but was capable of maintaining E. wenyoni in an infective condition.

Subpass III. Nineteen days post-inoculation calf C demonstrated parasites in a blood film. The PPE was 80% and was reached twenty-three days post-inoculation. No physical symptoms were observed in this calf. Nothing other than the parasite was observed in the dematological blood determinations.

Eleven days after the subpass from sheep A to sheep B
Eperythrozoa were found in the blood of sheep B. The infection reached a peak of 75% six days after it was first observed. The infection was not typical of that observed in the sheep because the blood contained very few extracellular forms, and the normal erythrocytes contained 6 to 8 parasites instead of the 15 to 20 of the E. ovis. No physical symptoms were observed in this sheep. The infection did respond within the normal limits of the particular parasite and it appeared that the parasite was capable of growing in sheep, the foreign host. This pass and the growth of the parasite in sheep completed the basic problem of this thesis.

Subpass IV. Calf D, an animal that received acutely infected blood, became a positive carrier sixteen days after it was inoculated. The PPE of 39% was reached three days later. No parasites were observed in the plasma. No gross clinical or hematological changes (other than the infection) were noted in this animal.
CHAPTER VI

DISCUSSION

The primary purpose of this study was to investigate two closely related species of Eperythrozoa and the concept of host-specificity in these two parasites. Both of these Eperythrozoa demonstrated the ability to infect the normal host of the other. These parasites were able to propagate in the foreign host and return to the normal host without evidence of adverse effects.

In the experiments with E. ovis, the strain was readily transmissible by experimental inoculation of infected blood into another sheep or calf. It was transmissible from sheep to sheep, sheep to calf, and calf to sheep. No host-specificity was demonstrated by E. ovis during experimental inoculation studies. The strain appeared to become a little more virulent with each subpassage. Sheep IV demonstrated both hematological and physical symptoms whereas sheep I had very mild hematological symptoms and no physical disturbances.

Experiments involving E. wenyonii demonstrated that it was capable of infecting another host, the sheep. This strain was able to reinfect a calf after two passes in sheep. The organism appeared to become a little more virulent as it was subpassed, for the third calf had a greater drop in its packed cell volume than did calf A.
The *E. wenyoni* strain may not have been as virulent as the *E. ovis* strain. No symptoms other than the infection were noted during the subpassages with this strain. The *E. ovis* strain produced several physical symptoms in sheep and in calves that became infected. It is highly probable that the *E. wenyoni* strain also would have produced symptoms if it had been subpassed more than three times.

*In vivo* subpasses may be used to keep the organism in a viable and infective condition. During this subpassage work two sheep demonstrated a significant drop in their PCV. This drop was attributed to either an incompatibility or the presence of a toxin associated with the parasite. An incompatibility could result between the donor and the recipient if they had different blood types and one type of blood would not transfuse safely into the other. This incompatibility could result in the red blood cells of the recipient being hemolysed. A second possibility, that a toxin is involved, is no less probable. A toxin could be carried by the parasite or absorbed on the erythrocytes of the donor animal. When this toxin is introduced into the recipient animal it could cause the erythrocytes to be lysed. A toxin would not be visible and would not need to express itself at every subpass level as was the case. This is possible because of the animals immunity or it may resist the toxins adverse effect.
A new mode of transmission has been suggested by the fact that Eperythrozoa were found in the nasal secretion of at least one animal and possible in two others. These bodies were found when the infections were in the acute stage. The name Eperythrozoa suggests that the parasite is located on the surface of the cell and they could be filtered from the plasma or the erythrocyte as they passed through the lungs and then work their way back up the respiratory tract. The organism could then drop from the animal with the nasal secretions and contaminate surfaces. A non-infected animal might be exposed to the parasite by coming in contact with the same surface. This mode could include transmission by skin contact, face flies, and the common salt block. The parasite could remain in a viable condition due to its moist environment. This mode of transmission could easily expose an entire herd if one animal had a latent infection and then a relapse.
CHAPTER VII

SUMMARY

Experimental studies involving *E. ovis* and *E. wenyoni* were carried out in splenectomized sheep and calves. A series of inoculations was designed to expose cattle to *E. ovis* and sheep to *E. wenyoni* with parallel controls to demonstrate the validity of the strains being used. Experimental inoculation studies indicated *E. ovis* could infect both sheep and cattle without inoculation problems. *E. wenyoni* was capable of infecting sheep as well as its normal host, cattle. Subpasses with *E. ovis* produced symptoms that included both physical as well as hematological symptoms. *E. wenyoni* did not produce any physical symptoms and only mild hematological symptoms.

In vivo subpasses resulted in an increase in the virulence of both strains. The *E. ovis* strain was able to propagate itself faster in animals than the *E. wenyoni*. The peak parasitemia reached by *E. ovis* was greater than that reached by *E. wenyoni*. Parasitemia reached 100% in both calves and sheep that had been infected with *E. ovis*. In animals infected with *E. wenyoni* parasitemia was 80%.

Morphologically the two parasites appeared very similar. A possible undescribed mode of transmission is suggested for *E. ovis*. This mode is by means of nasal
secretions. Eperythrozoa in the nasal cavity and mucus of one sheep were positively identified. The two other sheep mentioned also demonstrated bodies that appeared to be Eperythrozoa. These do not appear at any other time than during the acute stage.
TABLE I
EXPERIMENTAL INOCULATIONS WITH E. OVIS

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<th>Sheep II</th>
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<th>Calf II</th>
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* = Subpassage level.

TABLE IA
EXPERIMENTAL INOCULATIONS WITH E. WENYONI

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<td>39</td>
<td>33</td>
<td>12</td>
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<tr>
<td>Sheep III</td>
<td>Sheep II</td>
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<td>32</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Calf II</td>
<td>Calf I</td>
<td>105</td>
<td>38</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>Sheep IIIIA</td>
<td>Calf I</td>
<td>38</td>
<td>33</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>Sheep IV</td>
<td>Sheep III</td>
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<td>36</td>
<td>20</td>
<td>6</td>
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<tr>
<td>Sheep IVA</td>
<td>Calf II</td>
<td>35</td>
<td>38</td>
<td>18</td>
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</tbody>
</table>
### TABLE III

**EXPERIMENTAL EVALUATION OF E. WENYONI**

<table>
<thead>
<tr>
<th>Animal Number</th>
<th>Donor</th>
<th>Inoculum</th>
<th>Packed Cell Vol.</th>
<th>Prepatent Period</th>
<th>Peak Parasitemia</th>
</tr>
</thead>
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<tr>
<td>Calf A</td>
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<td>80</td>
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<td>39</td>
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<td>Calf B</td>
<td>Calf A</td>
<td>93</td>
<td>42</td>
<td>32</td>
<td>22</td>
</tr>
<tr>
<td>Sheep A</td>
<td>Calf A</td>
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<td>36</td>
<td>34</td>
<td>ND*</td>
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<td>Calf B</td>
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<td>Sheep A</td>
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<tr>
<td>Calf D</td>
<td>Sheep B</td>
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<td>40</td>
<td>32</td>
<td>16</td>
</tr>
</tbody>
</table>

*ND* * This animal never demonstrated any hematological symptoms.
BIBLIOGRAPHY
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A. BOOKS


B. PERIODICALS

Adler, S., and V. Ellenbogen, "A Note on Two New Blood Parasites of Cattle, Eperythrozoon and Bartonella," Journal of Comparative Pathology, XLVII (June, 1934) 219-221.


