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TRANSMISSION OF EQUINE PIROPLASMOSIS BY
TICKS IN SOUTH AFRICA.

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IT was a matter of course to expect that equine piroplasmosis would be transmitted by ticks; it remained to find the species of ticks which acts as a host of *piroplasma equi*. Taking into consideration the prevalence of the disease in the various parts of the country, high and low veldt, three separate species of ticks had to be regarded as possible hosts, namely, *rhhipicephalus decoloratus* (Koch), the "common blue tick"; *rhhipicephalus evertsi* (Neumann), the "red-leg tick"; and *hyalomma ægyptium* (Koch), the "bont pot tick." This last changes its host in its intermediate stages; in its larval stage it seeks birds and small mammalia (rabbits), and leaves them as engorged nymphæ. It was for this reason that I excluded it from the experiments. The remaining two species are found in the high veldt, where equine piroplasmosis is also found in freshly imported horses, and under these circumstances I decided to experiment firstly with these two species. It is quite possible that other species, for instance, *rhhipicephalus appendiculatus*, *simus*, *capensis*, and *nitens*, may act as hosts. The observations I made on the veldt, however, exclude these as principal propagators of the disease. The experiments were, therefore, only made with those species which from observations in practice proved to be most conspicuous.

EXPERIMENTS WITH *RHHPICEPHALUS DECOLORATUS* (KOCH).

(a.) *Infection of Ticks with Piroplasma Equi.*

(1.)—To note whether the larvæ of blue ticks, the progeny of females which have been sucking on a horse during the piroplasmosis reaction, transmit the disease to susceptible horses.

Horse 598. Argentine, six years old, was infected on 14th October 1904 with blue tick larvæ, whose mothers had engorged on Ox 262. The eggs were laid on 30th September 1904. Re-infestations with larvæ of the same lot were made daily from 16th to 23rd October 1904. The first adult male blue tick was noticed on 3rd November 1904, twenty days after the first infestation. This horse was injected on 4th November 1904 with a mixture of defibrinated blood of Horses 442, 523, and 599, all of which had passed through an attack of biliary fever at some earlier date. (Compare article "Further Notes on Piroplasmosis of the Horse, Mule, and Donkey" in the *Journal of Comparative Pathology and Therapeutics*, Vol. XVIII., Part 3, September 1905, p. 229). Engorged adult ticks began to drop on 6th November 1904, and continued daily until 22nd November 1904. The febrile reaction due to the injection of immune blood started on 8th November 1904. Piroplasma equi was noticed for the first time on 13th November 1904, on which date the typical rosettes were present. The piroplasmata were noticed during four days, viz., 13th, 14th, 15th, and 16th November, but none were noticed from 17th November 1904 until 23rd November 1904, during which time the fever reaction was not present, and engorged ticks were collected in great numbers.

The collected ticks were separated into four different lots, viz. :—

1. Those which dropped from the 7th to 10th November, at a time when no piroplasmata were seen in Horse 598, although a slight fever reaction was noticed.
2. Those which dropped from the 10th to 12th November, during which time no piroplasmata were found, but a distinct reaction was present.
3. Those which dropped from the 12th to 14th November, during which time piroplasmata were present, and
4. Those which dropped from the 16th to 22nd November. The piroplasmata were only present at the beginning of this stage, 16th November 1904.

(b.) *Infestation of Horses with Infected Blue Ticks.*

The larvæ of lot No. 3 were placed on :—

Horse 604. Argentine, daily from the 16th to 19th January 1905 in large numbers. Rise of temperature of an irregular character ensued from the fourth day after tick infestation, and continued for about eight days. The adult blue ticks started to drop on the twenty-second day after first tick infestation, and continued for about eight days, 7th to 14th February 1905. Temperature again rose from the twentieth day after tick infestation and reached 104·8° F. and 105·6° F. on the twenty-ninth and thirty-third days respectively. Examination of the blood during the fever reaction showed neither the presence of piroplasmata or any other blood parasite, and the reaction was put down to the heavy infestation with the blue ticks. This horse was submitted to the simultaneous injection of serum and horse-sickness virus on 17th April 1905. Preserved blood of Horse 726, several months old, was used as virus; the serum was fresh and contained red corpuscles. Horse-sickness reaction followed, and on the fourteenth day after inoculation piroplasma equi was

noticed. The horse died on 3rd May 1905. *Post-mortem* revealed the typical lesions of biliary fever.

Horse 718. Argentine, infested with ticks of lot No. 3 on the 17th, 18th, and 19th January 1905. Irregular temperature noticed from the eighth day after infestation. A high reaction started on the eighteenth day, and lasted for about three weeks. Examinations of the blood proved to be negative. The reaction was attributed to the infestation of the ticks, which were present in enormous numbers, and the horse showed a well-marked œdematous swelling under the abdomen. The engorged ticks dropped from the twenty-first day after infestation, and continued dropping for nine days. The further history of this horse is very interesting, inasmuch as it developed an attack of biliary fever on 15th March 1906, the temperature rising on this date to 105.6° F., and *piroplasma equi* were present in great numbers. The animal did not recover from this attack; it became very poor and had to be killed on account of debility. When the attack of biliary fever was noticed a search was made for other than blue ticks, and an adult red-leg tick was discovered under the tail. This tick must have been picked up in the paddock into which the horse had been turned, after the experiment with the blue ticks was finished.

Donkey 743. Argentine, infested on the 17th and 18th January 1906 with larvæ of lot No. 3. Adults began to drop on 7th February and were collected until 14th February 1906. Irregular temperature elevations ensued during the time the females were dropping, and continued even after the females had left the animal.

Horse 725. Argentine, infested on the 17th, 18th, and 19th January 1905 with blue tick larvæ of lot No. 4. Adults began to drop on 17th February 1905, and continued detaching up to the 15th. No reaction was noticeable. (Compare experiments with *rhhipicephalus evertsi*). The horse died on 27th July 1905 from horse-sickness.

Horse 601. Argentine, infested on 17th January 1906 with blue larval ticks of lot No. 4. Engorged females dropped from the 7th to 15th February 1906. Irregular temperature elevations were noticeable at the time the adults were dropping. Secondary reaction was observed three weeks after the ticks had finished to drop. Temperature reached 105.4° F. during this latter reaction. Examinations of the blood proved negative. This horse was used for horse-sickness experiments on 17th April 1906. It developed a horse-sickness reaction complicated by *piroplasmosis*, and *piroplasma equi* was noticed on 1st May 1906, fourteen days after injection of serum. Died during the following day.

Horse 722. Argentine, infested on 3rd February 1905 with blue tick larvæ of lot No. 4. Engorged females began to drop on 25th February 1905, twenty-two days after infestation. Temperature rise was observed shortly before and during the dropping of adults. Examinations of the blood proved negative. (For further history of this horse compare experiments with *rhhipicephalus evertsi*).

Mule 588. Argentine, infested with larval blue ticks of lot No. 4 on 3rd February 1905. The mule was able to rub the ticks off, and only a few engorged females were collected. Was injected on 12th March 1905 with 10 cc. defibrinated blood of Horse 422 (immune

against biliary fever). No reaction. Re-injected on 21st March 1905 with 10 cc. defibrinated blood of Horse 722. Reaction was noticeable twelve days later. Examinations of the blood proved negative.

Donkey 742. Argentine, infested on 3rd February 1905 with blue tick larvæ of Horse 598, lot No. 4. Adults started dropping on the twenty-first day after infestation. Irregular temperature ensued during this time, but otherwise the animal was normal.

Conclusions.

In the foregoing experiments *rhhipicephalus decoloratus* (Koch) did not transmit *piroplasma equi* through its progeny from sick horse to healthy susceptible horse, mule, or donkey. As *rhhipicephalus decoloratus* passes all its three stages on one and the same host, no other way of transmission would therefore be possible. We may therefore conclude that this tick does not act as a host of *piroplasma equi*.

EXPERIMENTS WITH *RHIPICEPHALUS EVERTSI* (NEUMANN).

(1.)—To note whether adult red-leg ticks which as larvæ and nymphæ had been feeding on a horse suffering from biliary fever will transmit the disease to healthy animals.

(a.) Infection of Red-leg Ticks with Piroplasma Equi.

Horse 721. Four years old, Argentine, was infested on the 9th February 1905 with red-leg larvæ, the offspring of females taken from oxen in Nelspruit on the 4th December 1904. On the 15th February 1905 injected with 10 cc. blood of Mule 592, which passed through the biliary fever reaction in November and December 1904. Rise of temperature started six days after this injection, and continued for seven days, on which date—26th February 1905—the animal died from piroplasmosis. *Piroplasma equi* appeared for the first time on the 23rd February 1905, and was subsequently noticed daily. Engorged nymphæ began to drop on the first day of the appearance of the piroplasmata, or fourteen days after tick infestation; they continued dropping until death, whereupon those which were still attached were collected. These nymphæ were placed in glass dishes, and began to moult on the 26th March 1905, when the adults were used for the following experiments:—

(b.) Infestation of Horses with Infected Red-leg Ticks.

Horse 719. Four years old, Argentine, infested on the 30th March 1906 with red-leg adults which, as larvæ and nymphæ, had been feeding on Horse 721, then suffering from biliary fever. A second, third, and fourth infestation took place on the 1st, 5th, and 8th April 1905 respectively. *Piroplasma* was found on the seventeenth day after the first infestation. Fever reaction was present, and the clinical diagnosis was certain. The disease lasted six days, when the horse recovered.

Horse 725. Four years old, Argentine, infested on the 31st March 1905 with red-leg ticks, adults, which as larvæ and nymphæ had been feeding on Horse 721 during the piroplasmosis reaction. Four re-

infestations took place, on the third, fifth, sixth, and eighth days. The adults fed well. Twenty days after the first tick infestation, or twelve days after the last one, a rise of temperature was noticed. Examinations of the blood gave negative results. Died later from horse-sickness. (This animal is referred to in the experiments with *rhhipicephalus decoloratus*, *q.v.*)

Horse 722. Four years old, Argentine, infested with red adult ticks on the 3rd April 1905, which as larvæ and nymphæ had been feeding on Horse 721. A second and third infestation took place on the fifth and eighth days afterwards. Sixteen days after the first infestation, or nine days after the last, the temperature began to rise, and a reaction of six days in length ensued, at the end of which the animal died. *Piroplasmata* were noted from the 19th April until death. *Post-mortem* revealed the typical lesions of biliary fever.

Donkey 742. Two years old, Argentine, infested on the 30th March 1905 with adult red-leg ticks, which as larvæ and nymphæ had been feeding on Horse 721, during the fever reaction due to the presence of *piroplasma equi*. Re-infestations took place on the 3rd and 5th April 1905. The adults were found attached and feeding on the 31st March 1905. No fever reaction ensued. The donkey was killed on the 5th November 1905 on account of glanders.

Conclusions.

Of three horses infested with adult *rhhipicephalus evertsi* (Neumann), which in their larval and nymphal stage were feeding on a horse suffering from *piroplasmosis*, two contracted the disease. One horse and one donkey which must be considered susceptible, although proof to that effect is wanting, were not infected by ticks belonging to the same lot.

(a.) Infection of Red-leg Ticks with Piroplasma Equi.

(2.)—Horse 403. Argentine, four years old, was infested on the 9th, 10th, and 11th January 1906 with numerous red tick larvæ, the progeny of adults taken from cattle at Linwood, and with adults taken from a horse suffering from *piroplasmosis*. Injected subcutaneously on the 14th January 1906 with 10 cc. blood of Horse 406, which had recently suffered from biliary fever. Temperature rose on the 23rd January 1906, viz., nine days after injection of blood. *Piroplasma equi* was noticed on the same day; it remained for the four following days, but in rare numbers. This horse recovered. Nymphæ began to drop on the 24th January 1906, and continued for six days. They were placed in glass dishes and kept at the temperature of the room. The moulting into adults began on the 16th February 1906—after a lapse of twenty-two days.

(b.) Infestation of a Horse with Infected Red-leg Ticks.

Horse 1833. Three years old, Argentine, infested with adults from Horse 403 on the 1st March 1906, viz., twelve days after moulting. Engorged females began to drop on the 8th March 1906—seven days later—and were collected in considerable numbers. No reaction noticeable. Injected subcutaneously on the 20th March 1906 with 5 cc. blood of Mule 589, which had recently passed through an attack of *piroplasmosis*. Temperature rose after the lapse of nine days,

following which a reaction lasted seven days. *Piroplasma equi* noted during this reaction, for the two days 3rd and 4th April 1906. The horse recovered after it had passed through a second reaction, which started on the 16th April 1906.

Conclusion.

The red adults infected on Horse 403 did not transmit piroplasmosis to susceptible Horse 1833. No reason can be given for this failure. (The adult red-leg ticks were only twelve days old when placed on susceptible Horse 1833, viz., older than in previous experiments.)

(a.) Infection of Red-leg Ticks with Piroplasma Equi.

(3.)—Horse 1401. Argentine, directly imported, and four years old. Infested on the 16th February 1906 with numerous red-leg larvæ, the progeny of adults collected from cattle on Linwood farm. Injected subcutaneously twenty-four hours later with 10 cc. blood of Mule 589, immune against piroplasmosis. Temperature reached 103.2° F. in the evening of the 26th February 1906. *Piroplasma equi* was present in the blood on the same and following days, but was not seen again. The horse recovered. Nymphæ began to drop on the 25th February 1906—ten days after infestation. They continued for five days during the fever reaction, and were subsequently placed in glass dishes and kept at the temperature of the room. These nymphæ moulted into adults on the 22nd March 1906, viz., twenty-five days after collecting. The adults were used for the following experiments:—

(b.) Infestation of Horses with Infected Red-leg Ticks.

(A.)—Horse 1904. Argentine, five years old, supposed to have been recently imported and on station since 14th March 1906. Infested on the 5th April 1906 with adults collected on the 26th February 1906, viz., on the first day of the presence of *piroplasma equi*. Engorged females began to drop on the 11th April 1906. No reaction ensued from this infestation. Re-infested on the 23rd April 1906 with adults off Horse 401—thirty-two days after moulting, and collected on various dates from the 25th February 1906 to the 3rd March 1906. Engorged females began to drop on the seventeenth day after this infestation. Reaction noticeable on the twenty-second day. *Piroplasma equi* was noticed on the twenty-third day; it was present for the next four days, and the horse recovered from the attack.

(B.)—Horse 1906. Argentine, aged, supposed to have been recently imported and on station since the 14th March 1906. Infested on the 5th April 1906 with red adult ticks from Horse 401, collected on the 28th February 1906—on the third day after the appearance of *piroplasma equi*. Engorged females dropped on the seventh day. No reaction. On the 23rd April 1906 this animal was re-infested with red adult ticks from Horse 401, collected on the various days between the 26th February 1906 and the 2nd March 1906, viz., thirty-two days after they had moulted. Engorged females dropped on the seventh day. No reaction. This horse was tested as to its immunity to piroplasmosis by an injection of 5 cc.

blood of Mule 589—immune against piroplasmosis—into the jugular vein, on the 22nd May 1906. Temperature rose after an incubation period of sixteen days. Reaction lasted eight days. Blood was examined during this reaction, but *piroplasma equi* was never found.

(C.)—Horse 1910. Argentine, eight years old, supposed to be recently imported and on station since 15th March 1906. Infested on the 5th April 1906 with red adults collected on the second day of the appearance of *piroplasma equi* from Horse 401—27th February 1906. Engorged females dropped on the seventh day. No reaction. On the 23rd April 1906 red adults off Horse 401, collected on various dates from the 25th February 1906 and 3rd March 1906, and which had moulted thirty-two days earlier, were placed on Horse 1910. Engorged females began to drop on the seventh day. Temperature began to rise on the sixteenth day after infestation. It was very high for six days, culminating at 106° F. *Piroplasma equi* was noticed for the first time on the 12th April 1906, viz., nineteen days after tick infestation, and was present for eight days. The animal recovered.

(D.)—Horse 1905. Argentine, aged, supposed to have been directly imported and on this station since 14th March 1906. Infested with adults off Horse 401 on the 17th and 18th April 1906; the adults were collected on the 26th, 27th, and 28th February 1906, and moulted twenty-six days previously. Engorged females dropped on the ninth day. On the twenty-second day a reaction was noticeable, lasting for ten days. Microscopical examinations gave a negative result. Temperature reached 104.2° F. This was probably quite an accidental occurrence and cannot be attributed to the tick infestation. Injected on the 22nd May 1906 with 5 cc. defibrinated blood of immune Mule 589, into the jugular vein. On the eighteenth day after this inoculation a reaction occurred, lasting six days, the temperature rising to 104° F. The blood was examined microscopically during this reaction, but no *piroplasma equi* was found.

(E.)—Horse 1913. Argentine, two years old. Supposed to have been directly imported from the Argentine, and on station since 14th March 1906. Infested on the 17th and 18th April with red adults off Horse 401, collected on the 1st, 2nd, and 3rd March 1906, viz., after *piroplasma equi* had disappeared. Engorged females began to drop on the eighth day. On the nineteenth day after infestation the temperature rose and a typical reaction resulted. *Piroplasma equi* appeared for five days subsequent to the reaction, viz., 8th to the 12th May 1906. The animal recovered.

(F.)—Horse 1907. Argentine, aged. Supposed to have been directly imported from the Argentine, and on station since the 14th March 1906. Infested on the 27th April 1906 with red adults off Horse 401, collected on various dates between the 25th February and the 3rd March 1906, and thirty-five days after moulting. Engorged females dropped on the eighth day. No reaction. Tested on the 22nd May 1906 by an injection of 3 cc. defibrinated blood of immune Mule 589. No reaction.

(G.)—Horse 1908. Argentine, aged. Supposed to have been directly imported from the Argentine, and on station since the 14th March 1906. Infested on the 27th April 1906 with red adults off Horse 401, collected on various dates between the 25th February

and 3rd March 1906, and thirty-five days after moulting. No reaction. Tested on the 22nd May 1906 by an injection of 5 cc. defibrinated blood of immune Mule 589. Reaction ensued fourteen days after this injection, and continued for eleven days. Examinations of the blood were frequently made, but no *Piroplasma equi* could be found.

Conclusion.

Of six horses, supposed to be susceptible to piroplasmosis, infested with adult red-leg ticks fed in their larval and nymphal stage on a sick horse, three contracted the disease. The remaining three, which did not contract the disease, were tested with immune blood, but *Piroplasma equi* was not found in any of them.

Remark.—It was discovered later that the aged Argentine horses were not directly imported, but had been resident in South Africa for some considerable time.

(a.) Infection of Red-leg Ticks with Piroplasma Equi.

(4.)—Horse 1831. Argentine, four years old. Infested on the 1st March 1906 with numerous larvæ of the red tick, hatched on 31st January 1906. The mother ticks originated from cattle and were collected on the 17th December 1905. Injected subcutaneously on the 4th March 1906 with 10 cc. blood of Horse 653, which at that time was suffering from biliary fever, and had *Piroplasma equi* in its blood. Temperature rose after an incubation period of six days—1st March 1906. *Piroplasma equi* appeared on the 11th March 1906, and was present until the 20th March 1906. Engorged nymphæ dropped on the 11th March 1906, ten days after infestation, and continued dropping for nine days. This horse died on the 24th March 1906 from piroplasmosis.

(b.) Infestation of Horses with Infected Red-leg Ticks.

Horse 2062. Two-year-old gelding. Directly imported from Argentine to Cape Town, and immediately transported by rail to the Laboratory stables. Infested on the 17th June 1906 with 25 red-leg adult ticks from Horse 831, collected on the 13th March 1906 and moulted on the 20th April 1906. Engorged females began to drop on the 30th June 1906. Further infestations on the 20th June 1906 with same lot of ticks. Temperature rose on the 8th July 1906—twenty-one days after first infestation. *Piroplasma equi* noted on the 10th July 1906. Temperature rose higher. First reaction on the 15th July 1906. Second reaction on the 24th July 1906. This horse died from piroplasmosis, complicated with septic pneumonia, on the 27th July 1906.

Horse 2064. Infested on the 17th June 1906 with 25 red-leg adult ticks from Horse 831, collected on the 13th March 1906 and moulted on the 20th April 1906. Only a few attached themselves. Re-infested on the 4th July 1906—seven days after first infestation. Temperature rose and *Piroplasma equi* was noted on the 5th July 1906; was present until the 13th July 1906. This horse died from piroplasmosis on the 14th July 1906.

Conclusion.

The two horses recently imported and susceptible to piroplasmosis, when infested with adults fed in their larval and nymphal stages on Horse 831, suffering from piroplasmosis, contracted the disease and died.

- (5.)—EXPERIMENTS WITH LARVÆ OF RHIPICEPHALUS EVERTSI, THE PROGENY OF FEMALES COLLECTED FROM HORSES SUFFERING FROM BILIARY FEVER.

Horse 832. Argentine, four years old. Directly imported, and on station since 12th February 1906. Infested on the 15th February 1906 with numerous red larvæ, the progeny of adults taken from a military horse, suffering at that time from biliary fever, by Captain Olver, A.V.D. Engorged nymphæ began to drop on the 27th February 1906—twelve days after infestation. No reaction. Injected subcutaneously with 5 cc. blood of immune Mule 589 on the 20th March 1906. Reaction began after eleven days. Piroplasma equi was noticed during the reaction on three occasions. Second reaction took place twenty-five days after infestation, again accompanied with piroplasma equi. This horse died on the 4th May 1906. Autopsy revealed biliary fever.

Conclusion.

Red larvæ, the progeny of adults fed as such, on a horse suffering from biliary fever, did not transmit the disease to a susceptible horse.

- (6.)—EXPERIMENTS WITH RED ADULTS FEEDING IN THEIR LARVAL AND NYMPHAL STATE ON A HORSE IMMUNE AGAINST EQUINE PIROPLASMOSIS.

(a.) Infection of Red-leg Ticks with Piroplasma Equi.

Horse 405. Three years old. Freshly imported from the Argentine on the 20th January 1906. Injected intrajugularly with 20 cc. defibrinated blood of a Burchell's zebra, taken on the same day. After an incubation period of nine days a typical piroplasmosis reaction ensued, during which piroplasma equi was very frequent. On the 1st March 1906 infested with numerous red larvæ, the progeny of adults taken from cattle. Adults began to drop on the 14th March 1906—thirteen days after infestation. Moulded on the 20th April 1906.

(b.) Infestation of Horses with Infected Red-leg Ticks.

Horse 968. Not freshly imported from the Argentine. Infested with numerous adults of above lot from Horse 405. No reaction.

Horses 2065 and 2068. Both two years old. Freshly imported from the Argentine to Cape Town, and directly entrained to Pretoria, where they were kept in the stables of the Laboratory. Infested with numerous adults off above Horse 405.

Horse 2068. No reaction.

Horse 2065. Soon after its arrival it showed a high fever reaction, and all the symptoms of pneumonia developed and were present thirty-five days after infestation with the ticks. This animal died on the 22nd July 1906, having shown on this day and the two previous

days *piroplasma equi* in its blood. It is difficult to say when the fever reaction started, as the horse constantly had a high temperature, and the diagnosis of pneumonia somewhat delayed the microscopical examination. *Post-mortem* revealed the typical lesions of septic pneumonia and piroplasmosis.

Conclusion.

Of two horses which had to be considered as susceptible to biliary fever, one contracted the disease from adult red-leg ticks which in their larval and nymphal stage had been feeding on a horse immune against piroplasmosis. This case was somewhat masked by the appearance of pneumonia, but the animal was always kept stabled, so that no other infection was possible.

RESUMÉ.

In no instance did *rhhipicephalus decoloratus* transmit equine piroplasmosis, and it therefore cannot be considered as a host of *piroplasma equi*.

Rhipicephalus evertsi transmitted it in its adult stage, after feeding as larvæ and nymphæ on a sick horse, in seven out of nine horses which had to be considered susceptible to equine piroplasmosis.

Notwithstanding the fact that the only experiment failed, there is not yet sufficient proof to show whether piroplasmosis is transmitted through the egg of a tick.

Rhipicephalus evertsi is a host of *piroplasma equi*.

PIROPLASMA MUTANS (N. SPEC.) OF SOUTH AFRICAN CATTLE.

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IN a former article, entitled "The *Piroplasma Bigeminum* of the Immune Ox," I made the following statements:—

(1) The injection of blood into a susceptible animal, taken from an ox immune against ordinary redwater or Texas fever, usually gives rise to a primary and a secondary reaction, during which period the typical pear-shaped *piroplasma bigeminum* makes its appearance.

(2) Either with the second reaction or shortly afterwards endoglobular parasites appear in the shape of rings and rods, which resemble the *piroplasma parvum* of East Coast fever.

(3) These rings and rods are seen in the majority of all cattle living in a redwater infected area and in those which, at one time or another, have been injected with blood of cattle immune against redwater.

(4) The presence of the rings and rods in the blood of an ox proves immunity against redwater.

(5) When rings are observed in cattle injected with blood of cattle suffering from, or immune against, East Coast fever, then they are due to the simultaneous injection of immune blood of ordinary redwater.