

RÉSUMÉ.

Heifer No.	Particulars.	Results when exposed to natural infection of Ordinary Redwater.
428	Not immune to English redwater ...	Reaction with piroplasma bigeminum ; died of ordinary redwater.
430	Immune to English redwater ...	Reaction ; recovered.
429	Immune to ordinary redwater ...	Reaction ; recovered.
432	Immune to ordinary redwater ...	Reaction with piroplasma bigeminum ; recovered.
431	Immune to ordinary redwater, but susceptible to English redwater	Reaction ; recovered.
433	Immune to both English and South African redwater	Reaction ; died of sequel of ordinary redwater.

As already stated, I am of the opinion that English redwater does not protect against South African redwater, and the above statement furnishes additional support to this conception. In every case a new reinfection occurred, in two instances accompanied with piroplasma bigeminum.

“C.”—FURTHER TRANSMISSION EXPERIMENTS WITH EAST COAST FEVER.

In my Annual Report for 1903-4, I enumerated various experiments, the conclusions of which were as follows:—

Rhipicephalus decoloratus (the common blue tick) is not a host of *piroplasma parvum*.

Rhipicephalus evertsi (the red tick) is not a host of *piroplasma parvum*.

Rhipicephalus simus is a host of *piroplasma parvum*.

Amblyomma hebraeum may be a host of *piroplasma parvum*.

Rhipicephalus appendiculatus (the brown tick) is the principal host of *piroplasma parvum*, and it was further stated that brown ticks transmit the disease principally in their imago stage, after having fed as nymphæ on sick beasts; less so as nymphæ, after having fed as larvæ, and not at all as larvæ originating from a mother tick removed from a beast infected with East Coast fever. In other words, *piroplasma parvum* does not pass from the female imago into the egg and from this into the larvæ, as is the case in Texas fever. These experiments were carried out almost simultaneously with those of Mr. Lounsbury, of Capetown, and as a result the facts were established that the blue tick under no conditions acts as a host of *piroplasma parvum*, and that the brown tick (the tick with three hosts) is the principal carrier of the disease.

In 1906 Mr. Lounsbury published a further series of experiments which proved that, besides the ticks mentioned, others transmit the disease, viz., *rhipicephalus nitens*, *evertsi* and *capensis*. In *Mense's Handbuch der Tropenkrankheiten*, 1906, a contribution appeared by Luhe regarding the protozoa parasite in the blood, and in regard to my statement that “*piroplasma parvum* does not pass through the egg,” he makes the objection that in my experiments the larvæ which were employed were too young, and he quotes a communication of Professor Koch, who exposed larval ticks hatched in the laboratory,

on a pasture, and thus created a new herd of infection. Professor Schilling in his contribution on piroplasmosis in the *Handbuch der Pathogenen Mikroorganismen* said that Gray and Robertson had already expected that *rh. decoloratus* (blue tick) had to be considered as a carrier of the disease. From former experiments Koch knew that the German East African Coast fever which had proved to be identical with the Beira Coast fever was transmitted by ticks. Koch took female ticks which had repleted themselves on sick cattle and placed them in a warm and humid atmosphere for the laying of the eggs; these larvæ were placed on a pasture on which hitherto only a few animals had become infected with East Coast fever. The young ticks did not leave the pasture, but were waiting on the tops of the grasses until the cattle passed by in order to attach themselves. Soon after, and on this very pasture, grave cases of East Coast fever began to appear, and it was possible to infect every fresh susceptible animal which was liberated on this place.

It is apparent from the above communication that the opinions of Mr. Lounsbury and myself (who do not consider the blue tick as a carrier of the disease) are the reverse to those of Professor Koch. In Koch's experiment, as cited by Schilling, he speaks of ticks in general, but at the Inter-Colonial Veterinary Conference, held at Bloemfontein in 1903, Koch, in referring to this particular experiment, speaks exclusively of the blue tick.

It must be stated here that the experiment as carried out by Professor Koch does not withstand strong criticism. It was performed by placing young larval ticks on a pasture on which hitherto only a few animals had become infected, that is to say, on an East Coast fever infected pasture. Accordingly, with the introduction of fresh susceptible cattle the spread of the disease had naturally to be expected, and would have taken place even if the new ticks had not been liberated. Indeed it is probable that between the first and second exposure of susceptible cattle, the larval and nymphal ticks already present had moulted, and thus were responsible for the increase of the disease.

With regard to my statement that an animal immune against East Coast fever does not act as a propagator of this disease, Professor Schilling says: "In his last report Theiler's experiments would prove that salted cattle do not infect the ticks (which species?). This is directly contradictory to the history of the introduction of the disease into Rhodesia. From which cattle did the animals imported from New South Wales contract the infection, if not by means of ticks from the herds grazing in the neighbourhood of Beira, amongst which, as Koch has proved, carriers of parasites were constantly present."

The results of my experiments proving that salted cattle do not transmit the infection were published in my Annual Report for the year 1904-5, and also in the *Journal of Comparative Pathology and Therapeutics* in the year 1905, under the title, "Do salted cattle contain *piroplasma parvum* in their blood?" In this article it was proved that the brown tick (*rh. appendiculatus*) neither in the nymphal nor the imago stage is capable of transmitting East Coast fever after having fed as larvæ or nymphæ on an immune animal. These results were corroborated by Lounsbury in his investigations published in 1905-6 under the title, "Ticks and African Coast Fever." Lounsbury experimented 16 times on nine different animals with ticks, of which

he was sure that they were acting as hosts of *piroplasma parvum*, viz.:—*Rh. appendiculatus* in their nymphal and imago stage, with *rh. nitens* and *evertsi* in their imago stage, and in no case could he transmit the disease from the immune animal to the susceptible one. Convincing proof can be found in practice, since it is frequently noted that immune animals have been grazing with susceptible ones for years on one and the same pasture, and yet the latter have never contracted the disease.

We are in possession of ten immune oxen which in 1902 were the survivors of a herd of 500 head destroyed by the disease. These ten oxen have been repeatedly exposed on an infected area, thereby proving their immunity. For over four years they constantly grazed with a herd of about 50 susceptible animals on a non-infected pasture, on which brown and red ticks were present, but hitherto no disease has been noted. This experiment was purposely continued for this length of time in order to exclude every possibility of coincidences. Therefore the occurrence in Beira can only be interpreted in a different manner. From Mr. Gray's report to the Rhodesian Government, it clearly follows that the Australian cattle imported into Beira were only suffering from redwater (Texas fever), and this was the reason for bringing them to the higher town of Umtali, in which case the extraordinary appearance of East Coast fever was noted. The cattle grazing in Beira had nothing to do with the infection with the cattle in Umtali. Indeed it has to be accepted that at least at that time Beira was not infected with East Coast fever, and in proof of this it must be mentioned that Madagascar oxen which were imported into Beira almost simultaneously with the Australian herd never suffered or died of East Coast fever, and not even after the Australian cattle had been removed to Umtali. Madagascar cattle are equally susceptible to East Coast fever as Australian cattle, but the former are immune to ordinary redwater, whereas the latter are not.

From the communication of Mr. Orpen, which I have detailed on page 9, it is clear that Beira was infected with redwater, and later it appeared that slaughter cattle from East Africa were imported direct from Umtali, and probably brought East Coast fever with them.

The following experiments were partially carried out for the purpose of corroborating my former communications; some of the experiments of Lounsbury were repeated, and the opinion of Luhe was considered as correct, and accordingly taken into consideration. The ticks for these experiments were collected on the coast at Durban from cattle which were all visibly suffering from East Coast fever, the diagnosis being confirmed either by post-mortem or by microscopical examination.

EXPERIMENT NO. 1.

To prove that ticks collected on the coast of Natal from sick animals are capable of transmitting East Coast fever.

(a) *Experiments with brown imagines.*

N.B.—The brown nymphæ used for infesting the following animals were all collected on the 16th December, 1906, in Durban. "A," *Ox* 358.—Two years old; from Cape Colony. Infested with 12 brown imagines about 20 days old on the 17th January, 1907.

On the 28th January a fever reaction started, and on the following day *piroplasma parvum* was present, daily increasing in numbers until the 10th of February, on which day the animal died of East Coast fever.

Post-mortem Examination.

Condition:—Fair. Rigor mortis present. Beef somewhat pale. Lymphatic glands in groin and in front of shoulder enlarged.

Lungs:—Oedematous; considerable amount of yellow liquid in pleural cavity; yellow liquid in intersepta; mediastinal tissue infiltrated; glands also infiltrated.

Heart:—A few hæmorrhagic patches on epicard and in left ventricle.

Spleen:—Normal.

Liver:—Thicker than normal; section yellowish; gall bladder small; bile yellow and viscid; lymphatic glands enlarged.

Kidneys:—Calix infiltrated; small white infarcts about the size of a pin's head and a few petechiæ on surface.

Stomach:—Fourth mucosa pale, and containing a few hæmorrhagic ulcers the size of a pea. Contents of third stomach soft.

Intestines:—Cæcum and colon mucosa pale; black patch on ileo-cæcal valve; mucosa of small intestines partially black.

"B," Ox 387.—From the Cape Colony. One year old.

Infested on the 1st March, 1907, with nine brown male imagines, about 27 days old.

Temperature commenced to rise on the 11th March, and *piroplasma parvum* was noted six days later, daily increasing in numbers until the death of the ox on the 26th March, 1907.

Post-mortem Examination.

Condition:—Poor. Rigor mortis set in; lymphatic glands of left shoulder enlarged; beef normal.

Lungs:—Slightly œdematous.

Heart:—Yellow liquid in peritoneal cavity; left endocard echymosed; a few hæmorrhages on right endocard.

Spleen:—Enlarged and congested.

Liver:—Enormously enlarged, soft, and of a peculiar red colour.

Kidneys:—Congested, and containing a few white infarcts. Urine clear.

Bladder:—Gall bladder filled with yellow bile.

Stomach:—Mucosa diffusely congested and swollen; contents dry.

Intestines:—Diffuse congestion of cæcum and colon; small intestines diffusely hæmorrhagic.

Lymphatic glands of liver:—Considerably enlarged.

"C," Bull 327.—Two years old; animal from Potchefstroom, a district hitherto free from East Coast fever.

Infested on the 4th April, 1907, with brown imagines about 62 days old, and in the morning of the 15th April the temperature commenced to rise. The disease lasted until the 24th day after the infestation, on which date the animal died. *Piroplasma parvum* was noted daily in the blood from the 19th April up to the time of death, on which date *piroplasma bigeminum* also appeared.

Post-mortem Examination.

Condition:—Rigor mortis not complete; blood of a brownish hue and not completely coagulated; serous membranes and fasciæ of a yellowish colour; mediastinal glands infiltrated with gelatinous liquid.

Lungs:—Slight œdema.

Heart:—Both endocarids normal.

Spleen:—Enlarged and soft.

Liver:—Enlarged and thick; contained yellow spots.

Kidneys:—A few white infarcts; yellow spots.

Bladder:—Thick bile of a greenish colour in gall bladder.

Stomach:—Folds of mucosa infiltrated and thickened; omasus filled with dry food.

Intestines:—Mucosa of small intestines swollen and bile stained. Longitudinal slate-coloured stripes on colon and cæcum.

“*D*,” *Heifer* 416.—Born on the station; about one year old.

Infested on the 19th March with male and female imagines about 45 days old. After an incubation time of about 10 days the temperature started to rise, culminating in the death of the animal on the 13th April, 1907. *Piroplasma parvum* noted daily from the 3rd day after rise of temperature.

Post-mortem Examination.

Condition:—Fair; peritoneal cavity contained non-coagulated blood.

Lungs:—Oedematous; foam in trachea.

Heart:—Left endocard normal; white spots in tissue.

Kidneys:—Contained red and white infarcts; capsula infiltrated with blood.

Bladder:—Gall bladder contained bile of a thick and dark greenish colour.

Stomach:—Congestion of mucosa of fourth stomach, with a few hæmorrhagic ulcers.

Intestines:—Several hæmorrhagic ulcers, about the size of a pea, distributed over cæcum. Mucosa of small intestines swollen and congested.

Glands:—Lymphatic glands slightly enlarged.

“*E*,” *Ox* 391.—A Cape Colony animal; aged.

Infested on the 23rd April, 1907, with male and female brown imagines, 108 days old.

After an incubation time of 11 days the temperature of this animal rose, and the disease lasted eight days.

Piroplasma parvum noted daily from the 3rd day after reaction, the animal dying of East Coast fever on the 12th May, 1907.

Post-mortem Examination.

Condition:—Very poor; rigor mortis not set in; beef pale; gelatinous infiltration of mediastinal glands.

Lungs:—Slight œdema; one echymose on left side of costal pleura; pleural cavity contained blood-stained liquid; fibrous adhesions on sternalis.

Heart:—Diastole; blood well coagulated; gelatinous infiltration of left endocard; imbibition in right endocard; pericard full of liquid; epicard injected.

Spleen:—Normal.

Liver:—Slightly enlarged; commencement of decomposition.

Kidneys:—Pale; gelatinous infiltration of calix.

Bladders:—Urinary bladder filled with normal urine. Gall bladder distended; contained thick bile.

Stomach:—Mucosa of abomasus partially slate and red coloured; omasus normal.

Intestines:—Cæcum contained reddened patches, with injection of blood vessels. Bluish colour on outside of small intestines; mesentery slightly infiltrated; mucosa diffusely reddened with superficial erosions; colon normal.

EXPERIMENT No. 2.

With larvæ of blue ticks which were collected at the same time and from the same animals as the ticks used for the previous experiments.

In the previous experiments with imagines of *rh. appendiculatus* absolute proof was given that these brown ticks from the Natal cattle were capable of communicating East Coast fever. If the blue tick is a host of *piroplasma parvum* it must be granted that blue ticks originating from the same animals which supplied us with the pathogenic brown ticks must also transmit the disease, especially if they were placed on animals in large numbers.

N.B.—The larvæ utilised for the infestation of the following animals, hatched from the 23rd March, 1907, onwards.

“A,” *Heifer* 421.—A two-year-old, from Aliwal North. Heavily infested with blue tick larvæ, about 12 days old, on the 4th April, 1907. From the 29th April the dropping engorged females were collected in great numbers. This heifer did not sicken, and is still alive.

“B,” *Heifer* 426.—Two years old, from Aliwal North. Infested with blue larval ticks, about 12 days old, on 4th April, 1907.

No result; the animal is still alive.

“C,” *Heifer* 400.—Aliwal North, two years old. Infested with larval blue ticks on the 24th May, 1907, two months after they had hatched. The repleted females dropped from the 19th June, 1907, in large numbers. No disease ensued; the animal is still amongst our herd.

“D,” *Calf* 440.—Born on the station, about six months old. Infested with blue larval ticks, about 60 days old, on 24th May, 1907. No result; the animal was utilised on the 1st August, 1907, for experiments in connection with pleuro-pneumonia, and died as a result of the inoculation on the 26th August, 1907.

EXPERIMENT No. 3.

With blue tick larvæ originating from an ox immune against East Coast fever.

“A,” *Ox* 377.—An animal from Sjamboks Kraal, Pretoria District, and one of a survivor of a herd consisting of about 200 which were all destroyed by East Coast fever. The diagnosis in this animal was made by proving the presence of *piroplasma parvum* during the disease. On the 9th March, 1907, ox 377 was

purchased and brought to the station, and is still here at the present time. At repeated intervals 377 was infested with blue ticks, and the brood of larval ticks of the last lot collected were utilised for the succeeding experiments.

In order to prove that this ox was immune to East Coast fever it was infested with brown imagines on the 4th April, 1906. These brown imagines belong to the same collection as those which produced the disease on animals 416, 327 and 391. No signs of illness were noted, and hence further proof is given of the immunity of this ox.

N.B.—The larvæ used for the infestation of the following animals hatched on the 5th November, 1906.

“B,” *Heifer* 413.—Two years old, from Pretoria, infested on the 5th December, 1906, with blue tick larvæ 31 days old. Seven days after infestation a rise of temperature was noted for seven days, followed by a second rise running for a longer period, during which spirillum were noticed for several days. The repleted females dropped from the animal on the 23rd December, 1906, and were collected in great numbers. In order to make sure whether the reaction had any connection with East Coast fever, it was decided to test this animal on its immunity. Accordingly 413 was infested on the 16th April, 1907, with nymphal brown ticks which had repleted themselves on animal 387 during the time it was suffering from East Coast fever. From the 22nd April, 1907, onwards, the dropping nymphæ were collected. On the 27th April, 1907, fever appeared in animal 413; *piroplasma parvum* was noticed from the 2nd to the 9th May, on which latter date *piroplasma bigeminum* was seen, and the animal died on the 11th May.

Post-mortem Examination.

Condition:—Fair; rigor mortis not completely set in; lymphatic glands of the groin and serous membranes pale and swollen; blood not coagulated, but of a brownish hue.

Lungs:—Rather pale.

Heart:—Diastole; right endocard normal; left endocard echymosed.

Spleen:—Slightly enlarged.

Liver:—Swollen; section of a peculiarly glossy appearance.

Gall Bladder:—Contracted and containing liquid bile.

Kidneys:—Contained a few infarcts; slight gelatinous infiltration of calix. Urinary bladder contracted.

Stomach:—Normal.

Intestines:—Mucosa of small intestines slightly swollen. Cæcum normal.

“C,” *Ox* 359.—Two years old, from Aliwal North. Infested on the 5th December, 1906, with blue larval ticks, about 31 days old. In this animal a slight reaction was noticed, the nature of which was recognised. 359 was an animal used in a former experiment in connection with *piroplasma mutans*, and had been injected on the 24th August, 1906, frequently showing *piroplasma mutans* at repeated intervals from the 25th September, 1906, so that the reappearance of these parasites during the time of the tick infection must be considered as a coincidence, but the very fact that Professor Koch identified these ring-shaped parasites with *piroplasma parvum* induced me to test this animal on its

immunity to East Coast fever. Four brown females originating from Durban were placed on 359 on 13th February, 1907, and ten days later a rise of temperature was noticed. On the 2nd March, 1907, piroplasma parvum was seen, increasing rapidly until seven days later, when the animal died of East Coast fever.

Post-mortem Examination.

Condition:—Rather poor; rigor mortis not completely set in.

Beef pale; mediastinal lymphatic glands greatly enlarged.

Lungs:—Normal.

Heart:—Normal.

Spleen:—Enlarged; pulpa softened.

Liver:—Abnormal and of a bluish brown colour, with numerous white spots.

Kidneys:—Full of red and white infarcts.

Bladder:—Dark brown bile in gall bladder.

Stomach:—Third stomach normal.

Intestines:—Diffuse hæmorrhagic infiltration of small intestines, and containing a few hæmorrhagic small ulcers.

Hæmorrhagic infiltration of cæcum.

EXPERIMENT No. 4.

To transmit East Coast fever with red ticks (Rhhipicephalus evertsi).

As already stated, my previous experiment with red ticks was negative. This was carried out by placing numerous red ticks on one and the same animal without the disease being noticed, but, as only one animal was utilised, the objection may be raised that, by a coincidence, the animal was immune.

“A,” Ox 357.—Two-year-old animal, from Aliwal North. Infested on the 23rd April, 1906, with red imagines which were collected from animals suffering from East Coast fever at Sjambok’s kraal. A further infestation took place on 25th and 26th April, and, commencing on 5th May, the repleted females dropped, and a rise of temperature began five days later. On 15th May piroplasma parvum was noticed for the first time, increasing rapidly until 29th May, on which day the animal died.

Post-mortem Examination.

Condition:—Fair; some foam in nostrils; subcutaneous tissue œdematous.

Lungs:—Some petechiæ on pleura in region of heart; mediastinum œdematous; some clear fluid in pleural cavity; mediastinal gland congested; foam in trachea.

Heart:—Punctiform hæmorrhages on pericardium, which also contained some blood-tinged liquid; myocardium normal; epicardium shows some blood-staining (probably post-mortem).

Spleen:—Normal.

Liver:—Slightly icteric; hepatic glands congested; gall bladder normal; bile rather thick and yellow.

Kidneys:—Peri-renal fat hæmorrhagically infiltrated; the whole of the cortices covered with hæmorrhages, which also extended into medulla boundary layer and calix.

Bladder:—Urine quite clear.

Stomach:—Fourth stomach slightly congested; contained a few petechiæ.

Intestines:—General congestion, varying from slight to intense.

“B,” Cow 455.—Originating from Pretoria. Infested on 23rd May, 1907, with red imagines, 67 days old, which, in their larval and nymphal stage, had been feeding on ox 358 whilst it was suffering from East Coast fever, and which had moulted on 17th March. After an incubation time of 14 days fever appeared. The reaction lasted 13 days, and the animal died on the 19th June, 1907.

Piroplasma parvum noted four days after the beginning of the reaction, and increased daily.

Post-mortem Examination.

Condition:—Fair; abscess between liver and right kidney.

Lungs:—Normal; right lobe swollen; fibrous induration adjoining abscess capsula.

Heart:—Pericard normal; sugillations in left ventricle and white patches in right ventricle.

Spleen:—Very slightly enlarged.

Liver:—Swollen; friable; yellow patchy discolouration.

Kidneys:—Capsula of right kidney enlarged and containing cheesy matter. White infarcts.

Stomach:—Abomasus congested, and containing a few small ulcers the size of a pea.

Intestines:—Cæcum disseminated with ulcers the size of a pea, and which had a red circumference. Colon also contained similar ulcers; mucosa swollen with red patches. Mucosa of small intestines swollen, and covered with ulcers similar to those in cæcum.

“C,” Heifer 45.—Infested in London by Stockman on the 25th June, 1906, with the same brood of ticks utilised in the first experiment, a number of which were sent to Mr. Stockman, Principal Veterinary Surgeon of England, in order to control the appearance or otherwise of *piroplasma parvum* in cattle outside South Africa, and especially to show whether *piroplasma parvum* would develop in cattle that never have been in contact with South African animals. Commencing on the 8th July, 1906, the animal showed a typical reaction, and died on the 10th July, 1906, on which date *piroplasma parvum* was noticed in almost every blood corpuscle. Stockman was good enough to forward me blood preparations for examination, and the correctness of the diagnosis was indisputable.

EXPERIMENT No. 5.

With amblyomma hebraeum (the bont tick).

These ticks were also collected from cattle on the coast of Natal. It is known that this specie belongs to the ticks with three hosts. Hitherto we have found that (a) ticks with three hosts are capable of transmitting the disease as nymphæ after having fed as larvæ on sick animals; (b) as imagines after having fed as nymphæ on sick cattle; and (c) it has naturally to be expected that the infection passes through the egg.

(A) *Imagines of amblyomma hebraeum.*

“A,” Ox 391.—A full-grown ox, from Klipplaats, Cape Colony. Infested on the 4th March, 1907, with imagines, about 78 days old, collected on the 16th December, 1906, from sick cattle on the Durban coast. Reinfested on the 5th March, 1907, and the

following day male and female ticks were found fast. The engorged females dropped on the 30th March, 1907; no reaction was noted. Ox 391 was tested later on its immunity against East Coast fever, and died (compare Experiment 1, "E").

"B," Ox 389.—Full grown, from Klipplaats, Cape Colony. Infested on the 26th March with imagines, about 100 days old, from the same collection as the previous case. The repleted females were collected from the 7th April, 1907. No reaction ensued. This ox was tested on its immunity on the 6th May, 1907, with nymphæ which as larvæ had fed on ox 387 during its illness. A rise of temperature was noted on the 18th May, and a typical fever reaction followed. *Piroplasma parvum* was noted on the 25th May, 1907, and was very frequent five days later. In order to obtain blood for the purpose of hyperimmunisation this animal was bled to death on the 30th May, 1907.

Post-mortem Examination.

Condition:—Poor; flesh pale; fasciæ and omentum yellow.

Lungs:—In inspirium; slight œdema; some yellow liquid in peritoneum.

Heart:—Endocard normal.

Spleen:—Very slight congestion.

Liver:—Enlarged; brown.

Kidneys:—Slight gelatinous infiltration of calix; a few white areas the size of a pin's head.

Stomach:—Abomasus pale.

Intestines:—Cæcum and small intestines normal.

(B) *Larvæ of amblyomma hebraeum.*

These originated from female ticks which were collected on the 18th December, 1906, in Durban. The eggs had been laid on the 27th December, 1906, and had hatched on the 18th April, 1907.

"C," Heifer 418.—A two-year-old, from Aliwal North. Infested on the 24th and 25th May, 1907, with the above larvæ, which on this day were 36 days old. No reaction noted, and the animal is still alive.

"D," Heifer 419.—A two-year-old, from Aliwal North. Infested on the same date, and with the same brood of larvæ, about 36 days old. No reaction; the animal is still alive.

EXPERIMENT No. 6.

With rhipicephalus capensis.

As already stated, Mr. Lounsbury proved that these ticks, which are especially frequent in the south-eastern parts of Cape Colony, are capable of transmitting East Coast fever. This is also a tick with three hosts. Lounsbury sent me infected imagines which were utilised to verify his results.

"A," Heifer 379.—Originating from Capetown. Infested on the 15th June, 1906, with the above imagines. After an incubation period of 30 days the disease was noticed. The animal died on the 43rd day after infestation, *i.e.*, 28th July, 1906. *Piroplasma parvum* was noticed on the 20th July for the first time, and increased daily. On the day previous to death *piroplasma bigeminum* was also seen.

Post-mortem Examination.

Condition:—Very poor; evidence of diarrhœa; foam in nostrils.

Lungs:—Right lung adherent to chest wall (of old standing).

Heart:—Normal.

Spleen:—Normal.

Liver:—Normal.

Kidneys:—One infarct in right kidney.

Stomach:—Abomasum slightly congested.

Intestines:—Slight general congestion.

“*B*,” *Heifer* 383.—Originated from Capetown. Was kept in the same stable as the previous animal, but not infected with imagnes, notwithstanding which East Coast fever appeared. The disease could only have been transmitted by the ticks from heifer 379, inasmuch as at that time no experiments were carried out with any other species of ticks; this is the sole accidental infection that has occurred on our station. The animal died on the 30th July, 1906.

Post-mortem Examination.

Condition:—Poor.

Lungs:—Normal.

Heart:—Normal.

Spleen: Enlarged; pulp dark.

Liver:—Ochre coloured.

Kidneys:—Numerous infarcts in both kidneys.

Bladder:—Urinary bladder distended with clear blood-coloured urine.

Stomach:—Folds of abomasum œdematous.

Intestines:—Moderate general congestion.

EXPERIMENT No. 7.

Transmission of East Coast fever with progeny of infected brown ticks which as imagnes were collected on sick animals in Natal.

I have already proved that *rhhipicephalus appendiculatus* is the principal host of *piroplasma parvum*, and that the transmission in no case takes place via the egg, but in the nymphal or imago stages. However, should a transmission through the larval stage be possible, it has to be expected that this species would in the first instance be capable of so doing. The following experiments were accordingly made:—

“*A*,” *Heifer* 386.—From Capetown; two years old. Infested on the 13th February, 1907, with brown larvæ whose mothers had been collected on the 16th December, 1906, in Durban. The females had started to lay eggs on the 20th December, 1906, which hatched on the 23rd January, 1907, thus at the date of the infestation the larvæ were 21 days old. On the 15th February, 1907, they were fast; they commenced to replete on the following day, and on the 22nd February, 1907, the first dropping engorged larvæ were collected. Subsequently several infestations were made with the same brood of larvæ up to the 20th February, 1907. The dropping larvæ were collected until the 10th March, 1907, in great numbers. No reaction was noted; this animal died later from inflammation of the intestines.

- “*B*,” *Heifer* 395.—Two and a half years old, from Aliwal North. Infested at the same time and with the same brood of ticks as in the former case. No reaction noted, and the animal is still alive.
- “*C*,” *Heifer* 398.—Two years old, from Aliwal North. Infested in the same way as above. No reaction.
- “*D*,” *Heifer* 402.—Two years old, from Aliwal North. Infested as above. No reaction.
- “*E*,” *Heifer* 408.—Two years old, from Aliwal North. Infested on the 12th March, 1907, with larval ticks from the brood used in the above experiments, which had hatched since the 23rd January, 1907; thus on the date of infestation were 48 days old. On the 15th March, 1907, brown engorged larvæ dropped, and on the same date the animal was infested with a fresh brood of brown larvæ whose mothers were collected on the 18th December in Durban, and which had hatched since 23rd January, 1907—thus were 49 days old. Engorged larvæ from 408 were collected in great numbers. No reaction.
- “*F*,” *Heifer* 409.—Two-and-a-half-year-old animal; infested for the first time on the 12th March, 1907, with larval ticks of the same brood as in the former experiment, and on the 22nd March, 1907, was infested for the second time with brood of larvæ which had hatched on the 25th January, 1907, and accordingly were 56 days old. Engorged larvæ were collected from the 26th March, 1907, onwards. No reaction. The animal met with an accident on the 8th July at Onderstepoort, and had to be killed.
- “*G*,” *Heifer* 412.—Two years old, from Aliwal North. Infested on the 12th March, 1907, with brown tick larvæ which had hatched on the 23rd January, 1907, and the engorged larvæ were collected from the 16th March, 1907. Reinfested on the same date with larvæ hatched on 25th January, 1907—50 days old. Engorged larvæ collected from the 19th March onwards. A third infestation with larvæ of the same origin took place on the 22nd March, 1907, and the collection of the engorged larvæ commenced three days later. No reaction, and the animal is still alive.
- “*H*,” *Heifer* 420.—Two years old, from Aliwal North. Infested on the 12th March, 1907, with brown larvæ which had hatched on 23rd January, 1907. A second infestation on the 16th March with larvæ hatched on the 25th January, 1907. A third infestation with larvæ of the same origin on the 22nd March, 1907. No reaction.
- “*H*,” *Heifer* 422.—Two years old, from Aliwal North. Infested on the 12th March with brown larvæ originating from mother ticks collected on the 16th December, 1906, in Durban, and which hatched since 23rd January, 1907—accordingly were 48 days old. On the 16th March, 1907, a second infestation with larvæ which had hatched on the 25th January. No reaction, and the animal is still alive.
- “*J*,” *Heifer* 401.—Two-year-old, from Aliwal North. Infested on the 13th, 16th and 19th March, 1907, with larvæ whose mothers

had been collected on the 18th December in Durban, and which had hatched since 23rd January, 1907. No reaction, and the animal is still alive.

- “K,” *Heifer* 404.—Two years old, from Aliwal North. Infested on the 13th, 19th and 22nd March, 1907, with larvae of the same brood as utilised above. No reaction, and the animal is still alive.
- “L,” *Heifer* 407.—Two years old, from Aliwal North. Infested on the 19th and 22nd March with the same larvae as before. No reaction, and the animal is still alive.
- “M,” *Heifer* 453.—From Klipplaats, Cape Colony. Infested on the 10th April, 1907, with brown larval ticks originating from mothers collected on the 14th February, 1907, in Durban, and which had hatched since the 23rd March, 1907. No reaction. The animal is still alive.
- “N,” *Heifer* 454.—A two-year-old animal, from Aliwal North. Infested on the 19th April, 1907, with brown larval ticks whose mothers were collected on the 29th January, 1907, in Durban, and which had hatched on the 24th February, 1907—accordingly were 54 days old. No reaction. A subsequent inoculation with blood from an animal immune against redwater caused 454 to contract this disease, and it died on the 20th July, 1907.
- “O,” *Heifer* 419.—From Aliwal North, and about two years old. Infested on the 2nd April, 1907, with the same brood of ticks as used above, the larvae accordingly being 65 days old. No reaction.
- “P,” *Heifer* 449.—A two-year-old, from Aliwal North. Infested on the 2nd April, 1907, as above. No reaction.
- “Q,” *Heifer* 418.—About two years old, and imported from Aliwal North. Infested on the 2nd April, 1907, with larvae of the same brood as above, and which were 71 days old. No reaction.
- “R,” *Heifer* 445.—About two years old, and imported from Aliwal North. Infested as above. No reaction.
- “S,” *Heifer* 452.—About two years old, from Klipplaats, Cape Colony. Infested on the 10th April, 1907, with brown larvae originating from mother ticks collected on the 23rd January, 1907, in Durban. Larvae hatched from the 24th February, and, at date of infestation, were accordingly 45 days old. Reinfested with larvae of the same origin on the 19th April. No reaction; the animal is still alive.

EXPERIMENT No. 8.

With nymphæ of the brown ticks whose mothers had been collected in Durban and which, as larvae, had been utilised in the previous experiments.

The origin of the following animals is:—Heifers 435 and 439 came from England. 440 was born on the station. 449, 450 and 451 came from Klipplaats, and the remainder from Aliwal North.

On the 25th March, 1907, heifers 408, 409 and 422 were infested with brown nymphæ.

On the 27th March, 1907, 409 was reinfested.

On the 28th March, 1907, 422 was reinfested and 404, 407, 412 and 420 infested.

On the 30th March, 1907, full engorged nymphæ dropped from heifers 408 and 409 and 422, and on the 2nd April, 1907, from animals 404, 407, 412 and 420.

On the 4th April, 1907, heifers 450 and 451 were infested with brown nymphæ, and reinfested two days later.

On the same date 440 was infested, and was reinfested on the 9th April, 1907.

On the 10th April, 1907, heifers 394, 398 and 435 were infested.

On the 12th April, 1907, and with the same brood, 439 was reinfested.

On the 13th April, 1907, reinfested 450, 451, 394, 398 and 435, and freshly infested 395, 402 and 405.

On the 15th April, 1907, reinfested 440.

On the 17th April, 1907, reinfested 435 and 439.

On the 18th April, 1907, reinfested 450.

On the 20th April, 1907, reinfested 451.

On the 22nd April, 1907, reinfested 440.

On the 23rd April, 1907, reinfested 435, 439, 450, 451, and on the 26th April, 1907, 435 and 439.

On the 16th May, 1907, reinfested 418, 419 and 449.

None of these 18 animals showed a reaction consequent to the tick infestation, and, with the exception of 409 (*vide* Experiment 7, "F," killed on account of an accident) and 440 (*vide* Experiment 1, "D," died of pleuro-pneumonia) are all still alive.

EXPERIMENT No. 9.

With imagines, which, as larvæ and nymphæ, have been feeding on healthy animals; the mothers of these imagines originated from sick animals.

N.B.—The mothers were collected in Durban on the 16th December, 1906, from animals suffering from East Coast fever. The larvæ had been feeding on animals Nos. 386, 395, 398, 402, 408, 409, 412, 420, 422, 401, 404, 407 and the nymphæ on the animals Nos. 394, 395, 398, 402, 404, 405, 407, 408, 409, 412, 420 and 422, and were collected from the 23rd March, 1907, up to the 22nd April, 1907, from these animals. The engorged nymphæ moulted from the 5th to the 30th May, 1907, and on the 27th May, 1907, the imagines were placed on animals Nos. 446, 447, 450, 451, 452 and 454. On the 3rd June, 1907, all these heifers were reinfested with the same brood of imagines.

Heifer 446.—An irregular temperature reaction noted in this animal, and on the 7th June, 1907, piroplasma bigeminum was seen. The animal is still alive.

Heifer 447.—Nothing noted in this animal. On the 8th July, 1907, infested with brown nymphæ which as larvæ had fed on sick ox 387. From the 25th July, 1907, fever was noticed, and on the 10th August, 1907, this animal died of East Coast fever.

Post-mortem Examination. Made $\frac{1}{2}$ hour after death.

Condition:—Fair; rigor mortis not yet set in; flesh somewhat pale.

Lungs:—In state of inspirium; œdematous; foam in trachea.

Heart:—Pericard normal; extensive hæmorrhages in left and right ventricles.

Spleen:—Normal.

Liver:—Swollen, hyperæmic and of a peculiar glossy appearance.

Kidneys:—Oedematous.

Bladder:—Gall bladder slightly contracted; contained yellow viscid bile.

Stomach:—A few superficial hæmorrhagic ulcers on mucosa of fourth stomach.

Intestines:—Several superficial hæmorrhagic ulcers and hæmorrhages in cæcum; mucosa of colon normal; small intestines presented a swollen appearance all through, with yellow contents adherent to mucosa; mucosa swollen, cross-striped and red.

Heifer 450.—Nothing particular noticed in this animal, which is still alive.

Heifer 451.—Irregular reaction on the 6th July, 1907. Piroplasma bigeminum noted. The animal is still alive.

Heifer 452.—Nothing particular noted in this animal. Still alive.

Heifer 454.—Nothing particular noted in this animal. Still alive.

Résumé.

1. The larvæ of the blue tick (*Rhipicephalus decoloratus*) which originated from females feeding on (a) animals suffering from East Coast fever, and (b) from animals immune to East Coast fever, did not transmit the disease.

2. The larvæ of *Amblyomma hebraeum*, originating from mothers removed from sick cattle and of the imagines originating as nymphæ from sick cattle, did not transmit the disease.

3. All experiments to transmit the disease by means of the progeny (larvæ, nymphæ, and imagines) of brown ticks whose mothers had been feeding on sick animals had no results, notwithstanding the fact that the young ticks were kept for a considerable length of time before they were used for the experiments.

4. East Coast fever was transmitted (a) by the nymphæ of *Rhipicephalus appendiculatus* which as larvæ had been feeding on

animals suffering from East Coast fever, (*b*) by imagines of *Rhipicephalus appendiculatus*, *evertsi*, and *capensis*, all of which had infected themselves as nymphæ.

Conclusions.

Rhipicephalus decoloratus and *amblyomma hebræum* must not be considered as hosts of *Piroplasma parvum*.

Rhipicephalus appendiculatus, *evertsi*, *capensis*, *simus*, and, according to Lounsbury, also *nitens*, must be considered to be hosts of *Piroplasma parvum*. It may safely be concluded that *Piroplasma parvum* in its life cycle of development does not pass through the egg, and finally it is evident that immune animals do not carry the infection.

“D.”—RESULTS OF HORSE-SICKNESS INOCULATION IN PRACTICE DURING 1906-1907.

The inoculation of mules against horse-sickness was recommenced from July, 1906, by the respective Government Veterinary Surgeons of the following districts:—Barberton, Lydenburg, Pretoria, Johannesburg, Krugersdorp, Potchefstroom, Wakkerstroom (Piet Retief and Volksrust), Zoutpansberg, Marico, Rustenburg, Waterberg, Ermelo, Standerton and Heidelberg. The immunisation was also performed in Rhodesia, Natal, Orange River Colony and Bechuanaland Protectorate.

Up to June, 1906, the virus and serum utilised was known as the “Ordinary” strain, but in experimenting I found that a virus from Tzaneen was able to break the immunity conferred by the Ordinary strain, and accordingly it was introduced into practice, as I considered it would afford a better protection. This Tzaneen strain gave good results until December, when from reports which came to hand, it was evident that in some cases it had become avirulent. Further inoculations with Tzaneen virus were accordingly discontinued, and I reverted back to the Ordinary strain. As this avirulency was contrary to previous experience, a thorough investigation was undertaken, but so far I am unable to adduce any reasons for it. Some 230 mules had been inoculated with this inert virus before any steps could be taken, and about 17 had died. The remainder were reinoculated with the Ordinary strain, and the chances of further mortality reduced to a minimum, also the owners of mules which had died owing to the inoculation with inert virus received compensation.

These inoculations and deaths from inert virus have not been included in any of the following tables, but all reinoculations have been taken into consideration.