(5) *By giving Sublethal Doses.*

An attempt was made to immunize animals by injecting sublethal doses which were then gradually increased until the lethal dose was exceeded.

(i) *In Cattle.*

Heifer 3932, which had previously been used in determining the minimum lethal dose for cattle [Section C (*a*) 2, see Appendix, page 1160], and which had recovered after receiving 0.0001 c.c. per kg. body-weight (i.e. 1 minimum lethal dose), was again injected with 1 minimum lethal dose toxin. No reaction was noticed this time. Eleven days later 5 minimum lethal doses were injected with no ill effects. After the lapse of another seven days the heifer received 10 minimum lethal doses. Symptoms of lamsiekte appeared four days after the injection and the heifer died six days later.

Conclusion.—Although a slight immunity had undoubtedly been conferred by the small doses of toxin, the animal was unable to withstand 10 minimum lethal doses.

It was thought that in this case the initial dose had perhaps not been small enough, and the increase in the size of the dose too rapid.

(ii) *In Goats.*

Experiment No. 1.—Goat 3 received 0.0001 c.c. toxin per kg. body-weight, contracted lamsiekte, but recovered after an illness lasting about three weeks [see Section C (*d*), and Appendix, page 1166]. After recovery the goat again received 1 minimum lethal dose and showed no reaction. Eleven days later it received 5 minimum lethal doses with no ill effects. After another week it was injected with 10 minimum lethal doses and developed symptoms of lamsiekte about five days later, but had recovered completely eleven days after the injection. The immunity of the goat was thereupon tested with 100 minimum lethal doses. Two days after the test the goat showed signs of the disease and it died five days after the injection.

Conclusion.—The result of this experiment was very similar to that obtained with heifer 3932. After two injections of the minimum lethal dose the animal was able to withstand 5 minimum lethal doses; when 10 minimum lethal doses were injected the goat showed symptoms, but recovered. After 100 minimum lethal doses it died. The immunity obtained in this way was therefore not very considerable.

Experiment No. 2.—In this experiment very small doses were used at the beginning and the increase was very gradual. Unfortunately the experiment was, for various reasons, never completed, so that in some goats the dose was not increased much above the minimum lethal dose. Nevertheless it is considered worth while to record the observations.

To facilitate discussion the details of this experiment are first given in tabular form. The results of the two experiments just described are also included in Table No. 29.

TABLE No. 29.

No. of Animal.	Weight in kg.	Amount of Toxin.	Number of Days after Previous Injection.	Reaction.	
				Incubation.	Result.
Heifer 3932	138	0·0001 c.c. per kg.	—	6 days	Recovered after 13 days.
		0·0001 c.c. per kg.	24 days	No reaction.	
		0·0005 c.c. per kg.	11 days		
		0·001 c.c. per kg.	7 days	4 days	Died after 10 days.
Goat 3	41	0·0001 c.c. per kg.	—	5 days	Recovered after 3 weeks.
		0·0001 c.c. per kg.	26 days	No reaction.	
		0·0005 c.c. per kg.	11 days		
		0·001 c.c. per kg.	7 days	5 days	Recovered after 11 days.
		0·01 c.c. per kg.	19 days	2 days	Died after 5 days.
Goat 75	58	0·000017 c.c. per kg.	—	No reaction.	
		0·000051 c.c. per kg.	7 days	,,	
		0·000088 c.c. per kg.	7 days	,,	
		0·00017 c.c. per kg.	7 days	,,	
		0·00034 c.c. per kg.	7 days	,,	
Goat 76	70	0·000035 c.c. per kg.	—	No reaction.	
		0·0001 c.c. per kg.	7 days	,,	
		0·0002 c.c. per kg.	7 days	,,	
		0·00042 c.c. per kg.	7 days	,,	
		0·00084 c.c. per kg.	7 days	,,	
Goat 77	63	0·000079 c.c. per kg.	—	No reaction.	
		0·0002 c.c. per kg.	7 days	,,	
		0·00047 c.c. per kg.	7 days	,,	
		0·00095 c.c. per kg.	7 days	7 days	Recovered after 11 days.
Goat 79	14	0·000071 c.c. per kg.	—	No reaction.	
		0·0002 c.c. per kg.	6 days	,,	
		0·00045 c.c. per kg.	7 days	,,	
		0·00085 c.c. per kg.	7 days	,,	
		0·0016 c.c. per kg.	7 days	,,	
Goat 81	23	0·00021 c.c. per kg.	—	No reaction.	
		0·0004 c.c. per kg.	6 days	,,	
		0·0008 c.c. per kg.	7 days	,,	
		0·0017 c.c. per kg.	7 days	,,	
		0·0034 c.c. per kg.	7 days	7 days	Died on the 7th day.

It will be noticed that the commencing dose in each of the five goats (75, 76, 77, 79, and 81) was usually very considerably below the accepted minimum lethal dose of 0.0001 c.c. per kg. body-weight. The actual quantities of toxin injected varied between 0.0001 c.c. and 0.001 c.c., the dose per kg. body-weight being given in Table No. 29. Further doses were then given at weekly intervals, the size of the dose gradually increasing as shown in the table.

Goat 75 received five injections, going up to about 3 minimum lethal doses without showing any reaction. Goat 76 also received five injections up to 8 minimum lethal doses without ill effects. Goat 77 received 9 minimum lethal doses at the fourth injection and then showed symptoms of lamsiekte seven days later, but recovered. In the case of goat 79 the fifth injection contained 16 minimum lethal doses, and no symptoms were produced. Goat 81 received 2, 4, 8, 17, and 34 minimum lethal doses. Seven days after the last injection the goat contracted lamsiekte and died the same day (see Appendix, page 1199).

Conclusions.—It would appear from these experiments that some degree of immunity can undoubtedly be conferred on animals by starting with very small doses and increasing the doses gradually, say, at weekly intervals. Some of the goats treated in this way survived the injection of quantities of toxin which would have killed untreated goats in a very few days.

Unfortunately, however, the value of the method seemed to be decidedly limited. Goat 77 contracted the disease when the amount of toxin reached 9 minimum lethal doses, and goat 81, which survived the injection of 17 minimum lethal doses, succumbed when 34 minimum lethal doses were given.

(iii) *In Horses.*

It has been shown in Section C (*b*) that the minimum lethal dose of lamsiekte toxin for horses is round about 0.005 c.c. per kg. body-weight. For a horse weighing, say, 400 kg., the lethal dose is therefore about 2 c.c.

Experiment No. 1.—In this experiment the horses received an initial dose of toxin somewhat below the lethal dose. The dose was then repeated and gradually increased in the hope of being able to produce immunity in this way.

It will be convenient to give the details of this experiment in tabular form and then to discuss the results. (For further details see Appendix, page 1199.)

TABLE No. 30.

Horse No.	Weight in kg.	Number of Days after Previous Injection.	Amount of Toxin Injected.	Result.	Remarks.
13331	349	—	0·5 c.c.	No symptoms	
		10 days	0·5 c.c.	,,	
		8 days	1 c.c.	,,	
		7 days	2 c.c.	,,	
	287	7 days	5 c.c.	Losing condition. Six days after the last injection animal unable to stand. Died on 7th day	10 c.c. heated toxin given with the unheated toxin.
11440	389	—	1 c.c.	No symptoms	
		10 days	1 c.c.	,,	
		8 days	2 c.c.	,,	
		7 days	4 c c.	,,	
	311	7 days	10 c.c.	Nine days after the last injection horse showed signs of distress, and died the next day	20 c.c. heated toxin given with the unheated toxin.
12394	413	—	0·5 c.c.	No symptoms	
		10 days	1 c.c.	,,	
		7 days	2 c.c.	,,	
	410	7 days	5 c.c.	Seven days after the last injection horse got dull and weak. It rapidly lost in condition, and died 3 weeks after the last injection	10 c.c. heated toxin given with the unheated toxin.
11182	381	—	0·5 c.c.	No symptoms	
		10 days	1 c.c.	,,	
		7 days	2 c.c.	,,	Found dead in veld 3 days after last injection.
13530	443	—	0·5 c.c.	No symptoms	
		9 days	1 c.c.	Animal has lost condition and become weak	
		37 days	5 c.c.	Symptoms of lamsiekte, which disappeared	
		5 days	15 c.c.	Gradual emaciation and weakening. Five days after last injection complete paralysis. Death on the following day	

All five horses used in this experiment died. Horse 13331 received three injections which were below the minimum lethal dose.

The fourth injection of 2 c.c. was slightly above the lethal dose, but produced no symptoms. It will be noticed that during the month in which the horse received these four injections it lost 62 kg. in weight. The fifth injection of 5 c.c. (=0.017 c.c. per kg. i.e. about three minimum lethal doses) produced symptoms of lamsiekte in six days, the animal dying on the seventh day.

In the next horse (11440), the course of events was very similar to that just described. This horse lost 78 kg. in weight within one month and died after the fifth injection of 10 c.c. (i.e. 0.032 c.c. per kg. = about 6 minimum lethal doses, killed the horse in ten days).

Horse 12394 also contracted lamsiekte and died after the dose had been increased to 5 c.c. (i.e. 0.012 c.c. per kg. = about 2 minimum lethal doses). Here the loss of weight was not so great as in the two preceding cases.

In the case of horse 11182 no symptoms were actually observed, but the animal was found dead in the veld three days after the injection of only 2 c.c. toxin. The last horse (13530) became very weak and emaciated during the course of the injections. After 5 c.c. toxin (about 2 minimum lethal doses) it showed symptoms of lamsiekte and recovered. When, however, the dose was increased to 15 c.c. the animal became completely paralysed and died (see Appendix, page 1200).

Conclusions.—Even when given in small quantities the toxin seemed to have a deleterious effect, producing marked emaciation.

According to the procedure adopted in this experiment, it was not possible to obtain any marked degree of immunity. Some of the horses withstood the injection of 2 or 3 minimum lethal doses, but when the dose went above this the animals contracted lamsiekte and died.

It was thought that perhaps the rate of increase of the quantity of toxin in these cases had been too rapid and an experiment was accordingly devised in which the initial doses would be much smaller and the increase much more gradual.

Experiment No. 2.—Six horses were used in this experiment which was continued for about 7½ months. Unfortunately the experiment had to be closed then, before final results were obtained.

The following table gives a summary of the details:—

TABLE No. 31.

Horse No.	Weight in kg.	Number of Days after Previous Injection.	Amount of Toxin Injected.	Result.
10213	395	—	0·001 c.c.	No reaction.
		7 days	0·002 c.c.	,,
		8 days	0·004 c.c.	,,
	395	7 days	0·008 c.c.	,,
		8 days	0·016 c.c.	,,
		7 days	0·032 c.c.	,,
	395	7 days	0·07 c.c.	,,
		7 days	0·15 c.c.	,,
		7 days	0·3 c.c.	,,
		7 days	0·6 c.c.	,,
	408	7 days	1 c.c.	,,
		7 days	2 c.c.	,,
		7 days	4 c.c.	Three days after this injection animal seems dull and shows signs of lamsiekte, which persist for about 3 weeks. Weight drops to 378 kg.

Horse No.	Weight in kg.	Number of Days after Previous Injection.	Amount of Toxin Injected.	Result.
10213	387	66 days	2 c.c.	No reaction.
		7 days	2 c.c.	,,
	424	10 days	5 c.c.	,,
		8 days	5 c.c.	,,
		8 days	5 c.c.	,,
	410	9 days	5 c.c.	,,
		18 days	5 c.c.	,,
		21 days	5 c.c.	,,
11074	320	—	0·001 c.c.	No reaction.
		7 days	0·002 c.c.	,,
	320	8 days	0·004 c.c.	,,
		7 days	0·008 c.c.	,,
		8 days	0·016 c.c.	,,
		7 days	0·032 c.c.	,,
	325	7 days	0·07 c.c.	,,
		7 days	0·15 c.c.	,,
		7 days	0·3 c.c.	,,
		7 days	0·6 c.c.	,,
	335	7 days	1 c.c.	,,
		7 days	2 c.c.	,,
		7 days	4 c.c.	Animal loses condition. Weight drops to 295 kg.
	312	66 days	2 c.c.	No reaction.
		7 days	2 c.c.	,,
	332	10 days	5 c.c.	,,
		8 days	5 c.c.	,,
		8 days	5 c.c.	,,
	298	9 days	5 c.c.	,,
		18 days	5 c.c.	,,
		21 days	5 c.c.	,,
11227	370	—	0·001 c.c.	No reaction.
		7 days	0·002 c.c.	,,
		8 days	0·004 c.c.	,,
	370	7 days	0·008 c.c.	,,
		8 days	0·016 c.c.	,,
		7 days	0·032 c.c.	,,
	375	7 days	0·07 c.c.	,,
		7 days	0·15 c.c.	,,
		7 days	0·3 c.c.	,,
		7 days	0·6 c.c.	,,
	403	7 days	1 c.c.	,,
		7 days	2 c.c.	,,
		7 days	4 c.c.	Three days after injection animal shows signs of illness, which persist for about 3 weeks. Weight drops to 349 kg.
	360	66 days	2 c.c.	No reaction.
		7 days	2 c.c.	,,
	380	10 days	5 c.c.	,,
		8 days	5 c.c.	,,
		8 days	5 c.c.	,,
	365	9 days	5 c.c.	,,
		18 days	5 c.c.	,,
		21 days	5 c.c.	,,
11247	400	—	0·001 c.c.	No reaction.
		7 days	0·002 c.c.	,,
		8 days	0·004 c.c.	,,
	400	7 days	0·008 c.c.	,,
		8 days	0·016 c.c.	,,
		7 days	0·032 c.c.	,,
	410	7 days	0·07 c.c.	,,
		7 days	0·15 c.c.	,,
		7 days	0·3 c.c.	,,
		7 days	0·6 c.c.	,,
	413	7 days	1 c.c.	,,
		7 days	2 c.c.	,,
		7 days	4 c.c.	Four days after this injection animal appears ill. Symptoms persist for about 3 weeks. Weight drops to 331 kg.
	374	66 days	2 c.c.	No reaction.
		7 days	2 c.c.	,,
	403	10 days	5 c.c.	,,
		8 days	5 c.c.	,,
		8 days	5 c.c.	Slight symptoms.
	350	9 days	5 c.c.	No reaction.
		18 days	5 c.c.	,,
		21 days	5 c.c.	,,

Horse No.	Weight in kg.	Number of Days after Previous Injection.	Amount of Toxin Injected.	Result.
12919	370	—	0·001 c.c.	No reaction.
		7 days	0·002 c.c.	,,
		8 days	0·004 c.c.	,,
	370	7 days	0·008 c.c.	,,
		8 days	0·016 c.c.	,,
		7 days	0·032 c.c.	,,
	350	7 days	0·07 c.c.	,,
		7 days	0·15 c.c.	,,
		7 days	0·3 c.c.	,,
		7 days	0·6 c.c.	,,
	363	7 days	1 c.c.	,,
		7 days	2 c.c.	,,
		7 days	4 c.c.	Three days after injection animal shows first signs of lamsiekte. It dies 11 days after the injection.
13202	365	—	0·001 c.c.	No reaction.
		7 days	0·002 c.c.	,,
		8 days	0·004 c.c.	,,
	365	7 days	0·008 c.c.	,,
		8 days	0·016 c.c.	,,
		7 days	0·032 c.c.	,,
	360	7 days	0·07 c.c.	,,
		7 days	0·15 c.c.	,,
		7 days	0·3 c.c.	,,
		7 days	0·6 c.c.	,,
	385	7 days	1 c.c.	,,
		7 days	2 c.c.	,,
		7 days	4 c.c.	After 3 days animal appears to be ill. Symptoms remain for about 3 weeks. Weight drops to 335 kg.
	338	66 days	2 c.c.	No reaction.
		7 days	2 c.c.	,,
	380	10 days	5 c.c.	,,
		8 days	5 c.c.	,,
		8 days	5 c.c.	,,
	370	9 days	5 c.c.	,,
		18 days	5 c.c.	,,
		21 days	5 c.c.	,,

It will be noticed that the six horses were treated in almost exactly the same way. The first injection consisted in each case of 0.001 c.c. toxin. This dose was doubled at the next injection a week later, and the same process continued until 2 c.c. toxin was injected. Up to the fifth stage no reaction had been noticed after any of the 12 injections. 2 c.c., it will be remembered, represent just about 1 minimum lethal dose for the size of a horse used in this experiment.

A week after the injection of the 2 c.c. toxin, the dose was again doubled and each of the six horses received 4 c.c. toxin subcutaneously. Three or four days later all the horses appeared dull and refused their food. They developed unmistakable signs of lamsiekte, which persisted for two or three weeks and then disappeared in most of the animals. During this period the horses lost considerably in weight and presented an emaciated appearance.

In the case of horse 12919 this attack of lamsiekte ended in death eleven days after the injection. The other five recovered, horse 11074 having shown only very slight symptoms.

The injections were then resumed after an interval of about two months in the five surviving horses. Each of these horses received two injections of 2 c.c. each and six injections of 5 c.c. each at intervals varying between seven and twenty-one days. Only horse 11247 showed very slight symptoms after the fifth injection, but these disappeared after one day. The other four horses showed no reactions at all during this series of injections.

Conclusions.—As in Experiment No. 1, so it was found here that the sublethal doses did not produce much immunity; practically as soon as the amount of toxin reached the minimum lethal dose, lamsiekte developed. In the present experiment the horses had received eleven injections of toxin below the minimum lethal dose. The twelfth was about equal to 1 minimum lethal dose and the thirteenth to about 2 minimum lethal doses. As soon as this stage was reached all the horses reacted and one died.

After recovery the surviving horses withstood repeated injections of two to three times the minimum lethal dose. This would seem to indicate that by careful adjustment of the size of the dose, it is possible to obtain an immunity against several times the minimum lethal dose. Unfortunately, as stated above, the present experiment was closed at this stage, so that it is impossible to say accurately how strong an immunity could be obtained in this way, but judging by the results obtained with goats and also with horses it would seem that by means of the methods employed it is impossible to obtain a strong immunity.

It is conceivable that by increasing the doses still more gradually better results would have been obtained. Such a method would, however, be far too cumbersome to be of practical value.

On the whole, the method of immunization by giving initial sublethal doses, and gradually increasing these, has given disappointing results and does not seem applicable in practice.

(*b*) Passive Immunization.

A priori there seemed to be very little likelihood of producing any immunity at all against lamsiekte by passive immunization. In the foregoing section numerous instances can be found of animals recovering from a severe attack of lamsiekte and succumbing immediately afterwards to an injection of an increased dose of toxin. The blood therefore did not seem to contain immune bodies in great quantity. Nevertheless it was felt that this avenue also had to be explored.

The serum of the various species of animals was tried. Usually an animal was chosen which had received a large amount of attenuated toxin; various considerations have led us to believe that the serum of such animals was most likely to have immunizing properties. The serum was then either given simultaneously with the toxin or given alone and then followed by toxin.

(1) *With Cattle Serum.*

Cow 229 [see Section D (*a*) 1 (i), page 1120, and Appendix, page 1182], which had received 1,000, then 5,000, and then 10,000 minimum lethal doses toxin heated to 70° C. for twelve hours, was bled and the serum collected.

Experiment No. 1.—Rabbit 318 received 100 minimum lethal doses toxin mixed with 10 c.c. serum of cow 229; the mixture was made half an hour before injection. Two days after the injection the rabbit was ill, and it died the next day.

Rabbit 319 received 50 minimum lethal doses toxin mixed with 5 c.c. serum. Two days later the rabbit was paralysed and after another eighteen hours it was dead.

Conclusion.—In the quantity and proportions used here the serum of cow 229 was not able to counteract the lamsiekte toxin when given simultaneously.

It should be pointed out that the quantity of serum used must be considered large when compared with the quantity of toxin. In the case of rabbit 319, for instance (weighing 1,800 grams), 50 minimum lethal doses=0.09 c.c., i.e. less than one-fifteenth the amount of serum injected.

Experiment No. 2.—Rabbit 320 received 10 c.c. serum subcutaneously and half an hour later 100 minimum lethal doses toxin. It was half paralysed the next day and died two days after the injection.

Rabbit 321 received 5 c.c. serum and half an hour later 50 minimum lethal doses toxin. About one and a half days later it was dead.

Rabbit 325 served as a control to these two experiments. It received 10 c.c. serum of cow 229 and showed no reaction.

Conclusion.—10 and 5 c.c. serum of cow 229 could not protect rabbits against 100 and 50 minimum lethal doses toxin respectively, when the toxin was given half an hour after the serum.

Table No. 32 summarizes these results.

TABLE No. 32.

Experiment No.	Rabbit No.	Weight in grm.	Amount of Serum.	Amount of Toxin.	Given when.	Result.	
						Incubation Period.	Died after.
1	318	1,530	10 c.c.	100 × M.L.D.	Simultaneously	40 hours	2½ days.
	319	1,800	5 c.c.	50 × M.L.D.	,,	2 days	2½ days.
2	320	2,250	10 c.c.	100 × M.L.D.	½ hour later	1 day	2 days.
	321	2,000	5 c.c.	50 × M.L.D.	,,	—	1½ day.
	325	1,550	10 c.c.	—	—	No re	action.

(2) *With Horse Serum.*

Horse 13340 [see Section D (*a*) 1 (i), page 1119, and Appendix, pages 1181 and 1200], which had received 1,000, then 5,000, and then 10,000 minimum lethal doses toxin heated to 70° C. for 12 hours, was bled and its serum collected.

The same experiments, as with cattle serum, were conducted with horse serum. Two rabbits received respectively 100 minimum lethal doses toxin mixed with 10 c.c. serum and 50 minimum lethal doses toxin mixed with 5 c.c. serum. The first died after twenty-one hours and the second after one and a half days.

Two other rabbits received 10 and 5 c.c. serum, followed half an hour later by 100 minimum lethal doses and 50 minimum lethal doses toxin respectively. The first was dead seventeen hours and the second one and a half days after the injection.

A toxin control rabbit received 100 minimum lethal doses and died after one and a half days. A serum control rabbit received 10 c.c. serum of horse 13340 and showed no reaction.

Conclusions.—In the quantities and proportions mentioned the serum of horse 13340 offered no protection when given simultaneously with the toxin nor when given half an hour before the toxin.

A summary of these results is contained in the following table:—

TABLE No. 33.

Experiment No.	Rabbit No.	Weight in grm.	Amount of Serum.	Amount of Toxin.	Given when.	Result.	
						Incubation Period.	Died after.
1	314	2,100	10 c.c.	100 × M.L.D.	Simultaneously	—	21 hours.
	315	1,550	5 c.c.	50 × M.L.D.	,,	17 hours	1½ day.
2	316	2,150	10 c.c.	100 × M.L.D.	½ hour later	—	17 hours.
	317	2,050	5 c.c.	50 × M.L.D.	,,	21 hours	1½ day.
	330	1,620	—	100 × M.L.D.	—	25 hours	1½ day.
	322	2,050	10 c.c.	—	—	No reaction.	

(3) *With Goat Serum.*

Goat 3 [see Section C (*d*), page 1106, and Appendix, page 1166], which had recovered from a very severe attack of lamsiekte, was bled for the purpose of these experiments.

Experiment No. 1.—Three guinea-pigs received 5 minimum lethal doses toxin mixed with 0.1, 1, and 5 c.c. respectively of serum of goat 3. They died after three and a half, three, and four and three-quarter days. A control guinea-pig which received 5 minimum lethal doses toxin and no serum died after a little more than three days, and the serum control guinea-pig, which received only 5 c.c. serum, showed no reaction. Another guinea-pig received 5 minimum lethal doses toxin mixed with 10 c.c. normal goat serum, and died after sixteen days.

Conclusions.—The serum of goat 3 seemed to have no protective value against lamsiekte toxin.

Experiment No. 2.—In order to determine whether the serum of goat 3 would be able to protect against a single minimum lethal dose, guinea-pig 76 received this quantity of toxin mixed with 10 c.c. serum. It was found dead about ten days later. The control guinea-pig which received only 1 minimum lethal dose toxin died after fifteen days.

Conclusion.—Even in a quantity of 10 c.c. the serum of goat 3 could not protect a guinea-pig against a single minimum lethal dose of toxin.

Experiment No. 3.—In this experiment the serum was used of goat 25 [see Section E (*a*) 3 (i), page 1135, and Appendix, page 1194], which had recovered from a slight attack of lamsiekte after the injection of 1,000 minimum lethal doses toxin mixed with two and a half times the amount of Lugol solution.

Four rabbits were injected with 0.1, 0.5, 5, and 10 c.c. respectively of this serum, and after an hour received either 50 or 100 minimum lethal doses toxin. They were all dead within two days. The control rabbit, which received 100 minimum lethal doses toxin only, died at about the same time as the others. The serum control rabbit showed no reaction.

Conclusions.—The serum of goat 25 gave no more immunity than did the serum of goat 3; the conclusion of Experiment No. 1 also applies here.

The details of the above experiments are contained in the following table:—

TABLE No. 34.

Experiment No.	Guinea-pig or Rabbit No.	Weight in grm.	Amount of Serum.	Amount of Toxin.	Given when.	Result.	
						Incubation Period.	Died after.
1	G. 70	680	0·1 c.c.	5 × M.L.D.	Simultaneously	2½ days	3½ days.
	G. 71	630	1 c.c.	5 × M.L.D.	,,	2½ days	3 days.
	G. 75	460	5 c.c.	5 × M.L.D.	,,	4½ days	4¾ days.
	G. 73	670	—	5 × M.L.D.	—	2¼ days	3½ days.
	G. 78	440	10 c.c. (normal serum)	5 × M.L.D.	Simultaneously	—	16 days.
2	G. 76	460	10 c.c.	1 × M.L.D.	Simultaneously	—	10 days.
	G. 77	420	—	1 × M.L.D.	—	—	15 days.
3	R. 36	1,360	0·1 c.c.	100 × M.L.D.	1 hour later	19 hours	1½ day.
	R. 37	1,270	0·5 c.c.	50 × M.L.D.	,,	19 hours	31 hours.
	R. 38	1,640	5 c.c.	50 × M.L.D.	,,	19 hours	31 hours.
	R. 39	1,510	10 c.c.	100 × M.L.D.	,,	19 hours	31 hours.
	R. 35	1,470	—	100 × M.L.D.	—	19 hours	31 hours.
	R. 40	1,350	10 c.c.	—	—	No reaction.	

(4) *With Dog Serum.*

The surum of dog 19 [see Section C (*f*), page 1108, and Appendix, page 1170], which had received 150 c.c. toxin (i.e. 5 c.c. per kg. body-weight), was used in these experiments.

It was thought that since the dog is apparently completely insusceptible to lamsiekte toxin, its serum might naturally possess protective qualities.

Two rabbits (326 and 327) received toxin mixed with the serum of dog 19. Three other rabbits (310, 311, and 312) were injected with toxin mixed with the serum of a normal dog. And another two rabbits (328 and 329) received first the serum of dog 19, followed half an hour later by toxin. All these rabbits died. (For details see Table No. 35).

Conclusions.—Neither normal dog serum nor the serum of a dog previously injected with a large amount of toxin could protect rabbits against the effects of lamsiekte toxin.

Table No. 35 gives a summary of these experiments.

TABLE No. 35.

Experiment No.	Rabbit No.	Weight in grm.	Amount of Serum.	Amount of Toxin.	Given when.	Result	
						Incubation.	Died after.
1	326	1,320	10 c.c.	100 × M.L.D.	Simultaneously	2 days	2½ days.
	327	1,900	5 c.c.	50 × M.L.D.	,,	2 days	2½ days.
2	310	1,700	50 c.c. (normal)	50 × M.L.D.	Simultaneously	—	Less than 2 days.
	311	1,470	5 c.c. (normal)	10 × M.L.D.	,,	—	6 days.
	312	850	2·5 c.c. (normal)	5 × M.L.D.	,,	—	1 day.
3	328	2,150	10 c.c.	100 × M.L.D.	½ hour later	2 days	2½ days.
	329	1,350	5 c.c.	50 × M.L.D.	—	29 hours	1½ day.

(5) *With Pig Serum.*

The pig, like the dog, is insusceptible to lamsiekte, and it was thought, therefore, that its serum might have protective properties.

Pig 345 [see Section C (*g*), page 1108, and Appendix, page 1170], which had received large doses of toxin without showing any reaction, was accordingly bled and the serum collected.

Experiment No. 1.—Rabbit 330 was injected with 100 minimum lethal doses toxin mixed with 6 c.c. serum of pig 345. No reaction followed.

Rabit 324 received 7 c.c. serum and half an hour later 100 minimum lethal doses toxin; and again no symptoms followed.

Conclusion.—This preliminary experiment seemed to indicate that the serum of pig 345 was actually able to protect rabbits against large doses of toxin.

Experiment No. 2.—Two further rabbits were injected with toxin mixed with the serum of pig 345. Rabbit 344 received 100 minimum lethal doses mixed with 10 c.c. serum. Thirteen days later it was paralysed and died the same day.

The control rabbit (346), which received the 100 minimum lethal doses toxin only, died within twenty-four hours.

Rabbit 345 was injected with 10 minimum lethal doses toxin mixed with 1 c.c. serum. After three days it showed signs of lamsiekte and was dead six days after the injection.

Conclusion.—In this experiment the pig serum was unable to protect the rabbits. It is significant, however, that rabbit 344 lived so much longer than the control rabbit 346.

It would appear that the serum of pig 345 has some protective value, but not so much as was indicated by the results of Experiment No. 1.

Experiment No. 3.—Four rabbits received 1 minimum lethal dose toxin mixed with 1 c.c. serum, 5 minimum lethal doses toxin mixed with 5 c.c. serum, 10 minimum lethal doses toxin mixed with 10 c.c. serum, and 100 minimum lethal doses toxin mixed with 10 c.c. serum. Of these rabbits, the first showed no reaction; the other three died

Conclusions.—These results agree more or less with those of Experiment No. 2. A small degree of immunity seemed to be conferred by the serum of pig 345.

Experiment No. 4.—Another series of rabbits were injected with 0.1 c.c., 0.5 c.c., 1 c.c., 2 c.c., 3 c.c., 4 c.c., 5 c.., and 10 c.c. serum, followed half an hour later by the injection of 100 or 50 minimum lethal doses toxin All the rabbits were dead within three days.

Conclusion.—Very little, if any, immunity was conferred on the rabbits used in this experiment by the serum of pig 345.

Experiment No. 5.—Two rabbits were injected with 100 minimum lethal doses toxin and 4½ c.c. normal pig serum each. Both were dead within two days.

Conclusion.—Normal pig serum seems to have no protective value.

Experiment No. 6.—Goat 1172 received 100 minimum lethal doses toxin mixed with 10 c.c. serum of pig 345. Two days later the first signs of lamsiekte appeared. The animal went through a chronic form of the disease and died more than a month after the injection.

Conclusion.—As in previous experiments, the serum of pig 345 seemed to have some immunizing properties. Without the addition of the serum, the 100 minimum lethal doses toxin would probably have killed the goat in less than forty-eight hours.

General Conclusions.—The serum of normal pigs does not seem to afford any protection against lamsiekte toxin. On the other hand, the serum of pigs previously treated with large doses of toxin does contain some immunizing properties, but apparently not enough to be of practical value.

Table No. 36 summarizes these results.

TABLE No. 36.

Experiment No.	Rabbit No.	Weight in grm.	Amount of Serum.	Amount of Toxin.	Given when.	Result.	
						Incubation.	Died after.
1	330	2,450	6 c.c.	100 × M.L.D.	Simultaneously	No reaction.	
	324	1,300	7 c.c.	100 × M.L.D.	After ½ hour	,,	
2	344	1,900	10 c.c.	100 × M.L.D.	Simultaneously	13 days	13½ days.
	345	2,500	1 c.c.	10 × M.L.D.	,,	3 days	6 days.
	346	1,700	—	100 × M.L.D.	—	—	1 day.
3	353	1,400	1 c.c.	1 × M.L.D.	Simultaneously	No reaction.	
	354	1,900	5 c.c.	5 × M.L.D.	,,	7 days	11 days.
	355	1,300	10 c.c.	10 × M.L.D.	,,	1 day	1½ day.
	356	1,700	10 c.c.	100 × M.L.D.	,,	—	1½ day.
4	333	1,420	0·1 c.c.	100 × M.L.D.	After ½ hour	—	1 day.
	334	1,320	0·5 c.c.	100 × M.L.D.	,,	29 hours	1½ day.
	335	1,550	1 c.c.	100 × M.L.D.	,,	29 hours	1½ day.
	336	1,000	2 c.c.	100 × M.L.D.	,,	1½ day	2½ days.
	337	950	3 c.c.	100 × M.L.D.	,,	2 days	3 days.
	338	1,450	4 c.c.	100 × M.L.D.	,,	2 days	Nearly 3 days.
	347	1,800	5 c.c.	50 × M.L.D.	,,	31 hours	2 days.
	348	2,200	10 c.c.	100 × M.L.D.	,,	—	1 day.
5	331	1,750	4·5 c.c. (normal serum)	100 × M.L.D.	Simultaneously	1 day	2 days.
	332	2,600	4·5 c.c. (normal serum)	100 × M.L.D.	After ½ hour	—	Less than 1 day.
6	Goat 1172	18 kg.	10 c.c.	100 × M.L.D.	Simultaneously	2 days	32 days.

APPENDIX.

This Appendix contains the experimental material on which the conclusions arrived at in the various sections are based. The letters and figures at the head of the various sub-sections refer to the corresponding sub-sections in the main text. Thus, Sub-section E (*a*) (1) (ii) of the Appendix contains the experimental records of the *goats* used in the experiment aiming at *the active immunization of this class of animal with heated toxin.* (See page 1131.)

SECTION C (*a*) (1).

BULL 189.

Condition, fairly good; pulse, 60; respiration, 24. Weight, 595 lb.

19.1.20: (3.45 p.m.) Drenched with 20 c.c. culture diluted in 200 c.c. water.

20.1.20: Temperature, 100.6° F.

21.1.20: (6 a.m.) Temperature, 98.4°. (7.30 p.m.) Lying down, is able to get up unaided. Salivating profusely. Tongue can be drawn out easily, and is withdrawn with difficulty. Coughing now and again.

22.1.20: (6 a.m.) Bull is found dead in stable. Tympanitis present (probably post-mortal). Rigor mortis just beginning to disappear. Body still somewhat warm. Large pool of saliva in front of mouth.

POST-MORTEM.

D0B No. 189. Bull. Four-tooth, Black and white.

P.M. No. 14628. Date of death, 21-22.1.20.

Condition fairly good. Abdomen distended. Interim, died during night. Rigor mortis not present. Integument intact. Natural openings: mouth closed, anus slightly open, mucous membrane protruding. Visible mucous membranes, nothing unusual. Blood: fluid, blackened; flesh, nothing unusual; subcutaneous tissue, nothing unusual. Salivary glands, nothing unusual. Lymphatic glands, nothing unusual. Tongue, nothing unusual. Tonsilla palatina, nothing unusual. In mouth some food-rests present. Thymus, nothing unusual. Oesophagus—pharynx, nothing unusual. Peritoneal cavity—situs viscerum, nothing unusual. Diaphragm: convex forward. Pleural cavities, nothing unusual. Respiratory organs, ventral and caudal part of septum nasium strongly injected. In plica-palato-nasopharyngeale ecchymoses size of pin's head and smaller. Larynx and cervical trachea, few punctiform petechiae. Lungs in medium state; pleura pulmonales on heart-lobes pinkish-red in colour; on diaphragmatic lobes, bluish-grey, opaque. Venae pulmonales, nothing unusual. Arteriae pulmonales, nothing unusual. Bronchi and trachea (thoracic), some ingesta; mucous membranes rather dark red, some petechiae present. Pulmonary and mediastinal glands, nothing unusual; parenchyma of diaphragmatic lobes, very moist on section, of blood-red colour. Pericard, sac contains 360 c.c. straw-coloured liquid mixed with flocculi (fibrine); pericard, nothing unusual. Circulatory organs: heart, 21 by 17; epicardium, numerous petechiae and hæmorrhagic patches on both ventricles, especialy on apex; left auricle is entirely infiltrated, black in colour; right ventricle distended and containing large clots of coagulated blood; endocardium contains large hæmorrhagic patches; left ventricle almost empty; endocardium, nothing unusual; vasa-cordis, nothing unusual; parenchyma of light reddish-brown colour; aorta thoracica, nothing unusual; aorta abdominalis in few small patches, intima wrinkled and rough. Periportal glands, nothing unusual. Liver, gall-bladder half-filled with amber-coloured clear bile; mucous membranes contain a few hæmorrhagic patches. Ductus choledochus and ductus cysticus open. Liver, shape and size nothing unusual; capsula, smooth and glistening, colour normal. Vena porta, vena cava-caudalis; vena hepatica, nothing unusual; parenchyma, nothing unusual. Pancreas strongly hyperaemic. Spleen: 50 by 16 by 5; capsula smooth and glistening, light bluish-grey colour; few petechiae present, edges not very sharp; consistency firm; on section, parenchyma dark brown-red; trabeculae and follicles indistinct; consistency firm. Suprarenal glands, nothing unusual. Kidneys: capsula contain a fair amount of yellow fat; strips easily; surface of normal colour and appearance; parenchyma, nothing unusual. Stomach: rumen large, distended with gas; many amphystoma present; ingesta rather dry; distinctly alkaline to litmus; mucous membranes, nothing unusual; abomasum: pyloric portion contains a slimy liquid; reaction neutral; fundus portion, liquid and soft; mucous membranes, nothing unusual; omasum contains semi-solid ingesta of slightly alkaline reaction; mucous membranes slate-coloured; reticulum: amphystoma present; ingesta semi-liquid; small pieces of stones; reaction slightly alkaline; mucous membranes, nothing unusual. Duodenum contains liquid golden-yellow ingesta; mucous membranes slightly swollen. Small intestines, mucous membranes slightly swollen and injected. Large intestines, nothing unusual. Mesenteric glands slightly enlarged. Mesentery, nothing unusual. Sexual organs: testicles and the other parts of sexual organs, nothing unusual. Urine turbid, membranes of bladder slightly swollen and injected. Nervous system, vessels of pia-mater marked and rather filled. Skeleton, nothing unusual. Blood-smear examination, negative.

Pathological Anatomical Diagnosis: Tympanitis (post-mortal). Petechiae on epicardium and endocardium of right ventricle, in larynx, trachea, velum palat, septum nasium, gall-bladder mucosa. Hyperaemia and oedema of lungs, slight jejunitis catarrhalis. Necrosis of media in aorta abdominalis (beginning). Hydropericardium.

Etiological Diagnosis (disease): Lamsiekte.

Heifer 4727.

Condition of animal, poor; pulse, 60; respirations, 20; weight, 412 lb.

19.1.20: (4 p.m.) Drenched with 5 c.c. culture diluted with 100 c.c. water.

20.1.20: (7 a.m.) Ruminating.

23.1.20: (6 a.m.) Heifer lying down, cannot be induced to get up. If head is lifted it falls down again. Salivating rather more than usual. (9 a.m.) Heifer lifted, but unable to stand. (3 p.m.) Treatment with 50 per cent. magnesium sulphate; 500 gr. dissolved in 1 litre normal saline, warmed to blood-temperature and infused into the jugular vein. Almost immediately after the beginning of the infusion, the urine is seen to flow off involuntarily. After about one minute (before completion of the infusion) the animal dies.

Post-mortem.

D0B No. 4727. Heifer. Four teeth. Red and white.

P.M. No. 14629. Date of death, 23.1.20.

Condition poor. Abdomen relaxed. Interim, one hour. Rigor mortis not yet present. Integument intact. Slight necrosis and infiltration on right side at seat of previous injection (31.12.23). Natural openings: mouth half open, anus closed, mucous membranes pale. Blood: in left jugular vein blood completely coagulated, chocolate-brown-reddish mass; blood escaping from vena cava-caudalis is liquid, but shows the same colour; flesh somewhat watery; subcutaneous tissue, almost no fat present, very moist, and gelatinous. Salivary glands, nothing unusual; lymphatic glands, left praescapular glands very much enlarged; other glands, nothing unusual. Tongue, nothing unusual. Oesophagus—cervical portion, nothing unusual; thoracic portion contains long pieces of undigested grass. Peritoneal cavity—situs viscerum, nothing unusual; fairly large quantity of perfectly clear, yellowish liquid present. Diaphragm, convexity forwards. Pleural cavities, nothing unusual. Respiratory organs: left lung, heart, and diaphragmatic lobes attached to the fifth rib by fibrous tissue; costal pleura at this point greatly thickened (callus); rib shows thickening, too (old fracture). Lungs in state of inspiration; pleura pulmonalis smooth; on diaphragmatic lobes the colour is grey; on other lobes, pink to dark red; venae pulmonales and arteriae pulmonales, nothing unusual. Mediastinal glands very moist. Trachea and bronchi filled with white foam; on pressure of lungs more foam escapes; on section some lobules appear pink, others blood-red, very moist. Larynx and trachea (cervical) contain froth. Pericard contains a small quantity of gelatinous fat; pericardial sac, 100 c.c. slightly reddish-yellow-coloured liquid, somewhat opaque, foamy. Circulatory organs: heart, very soft and flabby; epicardium on the left ventricle, few small thickened patches, otherwise smooth and glistening; right ventricle—endocardium, nothing unusual, completely empty; left ventricle, small quantity of liquid blood. Vasa cordis, nothing unusual. Myocardium, normal colour; consistency soft. Aorta (thoracic portions), nothing unusual; aorta abdominalis, nothing unusual. Periportal glands, nothing unusual. Liver: gall-bladder almost full; ductus cysticus and choledochus open; bile, nothing unusual; mucosa of gall-bladder injected; liver, normal size and shape; capsula smooth and glistening, colour bluish-grey; consistency very firm. Vena porta, vena hepatica, and vena cava-caudalis, nothing unusual. Prancreas, nothing unusual. Spleen, 39 by 10½ by 1½; capsula slightly shrivelled; colour normal; consistency of spleen firm; parenchyma, nothing unusual. Suprarenal glands, nothing unusual. Kidneys: capsula, some gelatinous fat; strips fairly easily; hylus very gelatinous; parenchyma—cortex brownish-yellow in colour, especially that of right kidney, surface of right kidney, yellow-brown. Stomach: abomasum contains a large quantity of fluid ingesta; mucous membranes, nothing unusual; omasum filled with semi-dry ingesta; mucous membranes, nothing unusual; reticulum contains very little dry ingesta and a few small stones; mucous membranes, nothing unusual; rumen filled with dry ingesta, amphystoma present; mucous membranes, nothing unusual. Small intestines: duodenum contains bile-coloured liquid mixed with flocculi; on mucous membranes, few petechiae; parts of jejunum injected. Large intestines: rectum distended with rather dry faeces; other parts, nothing unusual. Mesenteric glands, nothing unusual; mesentery: no fat present, very moist, gelatinous. Bladder empty. Sexual organs, nothing unusual. Udder in state of agalactia; glands somewhat enlarged. Nervous system, a fair amount of clear liquid escapes out of the canalis centralis of medulla oblongata. Brain substance, nothing unusual. Skeleton, nothing unusual. Blood-smear, negative.

Pathological Anatomical Diagnosis: Hydraemia. Pleuritis fibroplastica adhaesiva. Oedema pulmonum. Callus costae. Fatty degeneration of kidneys. Gastro-enteritis catarrhalis. Blood coagulum at seat of injection in vena jugularis. Discoloration of blood in all vessels. Agglutination (under microscope) of red corpuscles.

Etiological Diagnosis: Lamsiekte.

Cause of Death: Infusion of magnesium sulphate.

SECTION C (*a*) (2).

BULL 196.

Weight, 565 lb.

22.1.20: (4.45 p.m.) Injected 1 c.c. filtered toxin subcutaneously.

24.1.20: (6 a.m.) Bull is lying down in stable and cannot rise. It kicks and struggles and bellows continually. The tongue is paralysed and hangs out of the mouth. Slightly increased salivation. (7 a.m.) Treatment with 50 per cent. magnesium sulphate (Epsom salts) solution, 500 gr. dissolved in 1 litre normal saline. The solution is filtered and heated to blood-temperature. An infusion is made into the jugular vein. After about 400 c.c. of the solution have flowed into the vein, the animal dies without any struggle. A change of colour in the blood is clearly noticed.

POST-MORTEM.

D0B No. 196. Bull. Two-tooth. Red-brown.

P.M. No. 14630. Date of death, 24.1.20 (7.10 a.m.).

Condition good. Abdomen much distended. Interim, two and a half hours. Rigor mortis not present. Integument intact. Natural openings: mouth and anus closed; visible mucous membranes, nothing unusual. Flesh, nothing unusual; subcutaneous tissue, some fat present. Salivary glands: both parotids, and especially submaxillary glands, enlarged; cervical lymphatic glands distinctly increased in size. Tongue, nothing unusual. Tonsilla palatinae, nothing unusual. Oesophagus—cervical portion and pharynx, nothing unusual; thoracic portion, small quantity of ingesta. Thymus, nothing unusual. Peritoneal cavity—situs viscerum, nothing unusual. Omentum, fat well developed. Diaphragm, convexity forwards, otherwise nothing unusual. Pleural cavities some yellow-coloured liquid mixed with fibrine flocculi. Respiratory organs: larynx and trachea (cervical portion), nothing unusual; lungs in middle state of respiration, surface smooth and glistening, colour varying between steel-grey and pinkish-red; peri-bronchial and mediastinal glands, nothing unusual; venae pulmonales and arteriae pulmonales, nothing unusual; trachea (thoracic portion) and bronchi contain somewhat pinkish froth; parenchyma, on section rather moist. Pericard, some firm fat present; pericardial sac, 50 c.c. sherry-coloured liquid with flocculi. Circulatory organs: heart, epicardium smooth and glistening; right ventricle contains fairly large clot dark red to chocolate-brown in colour; endocardium, nothing unusual; left ventricle and left auricle contain large coagula of the same colour; endocardium of left ventricle shows white thickened patches where surface is uneven; myocardium, nothing unusual; aorta thoracica, nothing unusual; aorta abdominalis, nothing unusual. Periportal glands, nothing unusual. Liver, somewhat swollen, edges rather blunt. Gall-bladder half-full; ductus cysticus and ductus choledochus open; bile yellowish-green, clear; mucous membranes and bile-duct, nothing unusual; Glisson's capsula, smooth and glistening; in left lobe on surface, a small stone-hard lobule in size that of a kaffir corn is present; in right lobe similar nodules are found, but slightly bigger; parenchyma distinctly hyperaemic and chocolate-brown-red in colour; blood escapes on section. Acini fairly distinct, apparently somewhat swollen. Vena porta, vena hepatica, vena cava-caudalis, nothing unusual. Pancreas slightly hyperaemic. Spleen, 43.5 by 13 by 3; capsula smooth, of normal steel-grey colour; consistency elastic; parenchyma on section protrudes over cut surface. Folliculi enlarged, showing a cholocate-brown-red colour. Suprarenal glands, nothing unusual. Kidneys: capsula contains rather soft fat; strips easily; parenchyma somewhat hyperaemic, otherwise nothing unusual. Stomach: abomasum—pyloric portion contains small quantity of fairly hard ingesta; fundus portion filled with semi-liquid ingesta; mucous membranes somewhat swollen; omasum, dry ingesta; mucous membranes, nothing unusual; reticulum contains small quantity rather liquid ingesta; amphystoma present in very large numbers; rumen contains dry ingesta; amphystoma; mucous membranes, nothing

unusual. Small intestines: duodenum, small quantity of semi-liquid yellowish-green ingesta; mucous membranes injected; jejunum slightly swollen, injected all the way through. Large intestines: rectum filled with soft grass-green faeces; mucous membranes, nothing unusual. Mesenteric glands rather large; mensentery, nothing unusual. Bladder: urine clear; mucous membranes slightly injected. Sexual organs, nothing unusual. Nervous system, vessels of pia-mater very markedly injected. Brain substance, nothing unusual. Skeleton, nothing unusual. Bood-smear, negative

Pathological Anatomical Diagnosis: Tympanitis. Oedema pulmonum; slight gastro-enteritis catarrhalis: slight tumour of spleen and liver. Hyperaemia of kidneys and of the other organs. Fibrous patches of endocardium in left ventricle.

Etiological Diagnosis (disease): Lamsiekte.

Cause of Death: Intrajugular injection of magnesium sulphate solution.

BULL 4834.

Weight, 406 lb.

22.1.20: (3.30 p.m.) Injected 0.5 c.c. filtered toxin subcutaneously.

24.1.20: (12 noon) Animal noticed to be somewhat ill. It lies down, gets up again and salivates rather more than usual. (5 p.m.) No change.

25.1.20: (6 a.m.) Found dead in stable, with tongue protruding and a pool of saliva on the ground. The animal had died just before 6 a.m.

POST-MORTEM.

D0B No. 4834. Bull. Milk-teeth. Red.

P.M. No. 14631. Date of death, 25.1.20 (6 a.m.)

Condition fairly good. Abdomen not distended. Interim, four hours. Rigor mortis not present, except in the muscles of masseter. Integument intact. Natural openings: mouth one inch open, tongue protruding; anus closed; visible mucous membranes, nothing unusual. Blood: fluid dark red; in venae jugulares and head-vessels not coagulated, still fluid and foamy; flesh, nothing unusual; subcutaneous tissue, some fat present. Salivary glands larger than usual. Lymphatic glands, nothing unusual. Tongue, nothing unusual. Pharynx, nothing unusual. Oesophagus—thoracic portion, nothing unusual; cervical portion, nothing unusual. Tonsilla palatinae (right side) contains a few small nodules filled with thickened pus. Thymus large, rich in blood. Peritoneal cavity—situs viscerum, nothing unusual; some yellow-coloured clear liquid present. Diaphragm, convexity forwards. Pleural cavities, nothing unusual. Respiratory organs—peritoneal and mediastinal glands, nothing unusual; venae pulmonales and arteriae pulmonales, nothing unusual (the former empty, the latter filled with liquid blood). Lungs in expiration; pleura pulmonalis shrivelled, colour steel-grey to pinkish-red; on section blood escapes; parenchyma, nothing unusual. Larynx and trachea—cervical portion, nothing unusual. Pericard, fat well developed; pericardial sac contains 55 c.c. almost clear amber-coloured liquid mixed with a few flocculi. Circulatory organs: heart, in epicardium a few petechiae present; at apex of left ventricle a slight suffusion of blood; right ventricle empty; endocardium, nothing unusual; left ventricle empty; endocardium, nothing unusual; myocardium, nothing unusual; aorta (thoracic portion), nothing unusual; vasa-cordis, nothing unusual; aorta abdominalis, nothing unusual. Periportal glands, nothing unusual. Liver, from ductus choledochus specimen of stilesia hepatica is projecting into the duodenum. Gall-bladder filled; bile yellowish-green, clear; mucous membranes of gall-bladder slightly injected; numerous yellow spots, about one millimetre in diameter, are visible; where isolated, these are surrounded by red rings. Liver: increased in size; edges on apex of left lobe round; capsula smooth, normal colour. Vena hepatica and vena cava-caudalis, fluid blood; on section blood escapes; acini indistinct. Pancreas slightly hyperaemic and enlarged. Spleen, 41 by 11½ by 2; capsula smooth, opaque, white-grey; vessels of capsula injected; consistency firm; trabeculae, and folliculi distinct; parenchyma colour brick-red. Suprarenal glands, nothing unusual. Kidneys: capsula contains a fair amount of hard fat; strips easily; parenchyma rather hyperaemic, otherwise normal. Stomach: abomasum —pyloric portion contains some semi-liquid ingesta; mucous membranes swollen and injected; fundus portion filled with fairly dry ingesta; mucous membranes highly injected; omasum filled with dry ingesta; mucous membranes, nothing unusual; reticulum, small quantity rather liquid ingesta and a piece of wire; rumen nearly filled with dry ingesta; mucous membranes, nothing

unusual. Duodenum distended with gas; small quantity of slimy substance present; mucous membranes highly injected. Small intestines strongly injected; large intestines, rectum contains a few pieces of hard faeces covered with mucus; colon and caecum strongly injected. Mesenteric glands, nothing unusual; mesentery contains some fat. Bladder filled, urine clear, pale yellow; mucous membranes contain some petechiae: Sexual organs, nothing unusual. Nervous system, vessels of pia-mater strongly marked and injected. Ventricles, a fair amount of liquid. Skeleton, nothing unusual. Blood-smear, negative.

Pathological Anatomical Diagnosis: Petechiae in epicardium; blood not coagulated after four hours post-mortem. Abcesses in right tonsilla palatinae. Hyperaemia of brain, lungs, liver, and kidneys. Cholecystitis hæmorrhagica. Stilesia hepatica. Hyperaemia of liver. Gastro-enteritis catarrhalis, partly hæmorrhagica.

Etiological Diagnosis (disease): Lamsiekte.

BULL 188.

Weight, 417 lb.

26.1.20: (10.40 a.m.) injected 0.1 c.c. Berkefeld Filtrate subcutaneously. (Dosis: .00052 c.c. per kg. live weight.) 29.1.20: (6 a.m.) Animal found in physiological position, unable to ge up, head turned back and supported on the ground. (7 a.m.) Lies flat on left side. There is a complete paralysis of all muscles. When the tongue is pulled out it is not withdrawn. Tail is slack. Head lies flat on ground. Legs cannot be moved. Urine (and later faeces) passed involuntarily. Sensibility is present everywhere (also in tail). Heart beats very slowly (40 per minute). No mydriasis. (9 a.m.) Treatment with 1 kg. magnesium sulphate dissolved in 2 litres physiological saline, injected intraperitoneally. No immediate effect visible. Pulse-rate drops to 32 per minute; after a few minutes it increases to 60. About half an hour after injection the animal dies.

POST-MORTEM.

D0B No. 188. Bull. Two-tooth. Black.

P.M. No. 14632. Date of death, 29.1.20.

Condition rather poor. Abdomen distended. Interim, one hour. Rigor mortis absent. Integument intact. A small wound on right abdominal side in front of tuber coxae (seat of infusion). Natural openings closed; visible mucous membranes, nothing unusual. Blood not coagulated; rather dark with a slight wine-red tinge; flesh dark coloured; subcutaneous tissue fat present. Salivary glands moist. Lymphatic glands, nothing unusual. Thyroid and thymus, nothing unusual. Cavum oris, a large quantity of food present; also in the ventral nose passage. Tongue, nothing unusual. Tonsilla palatina, nothing unusual. Oesophagus—thoracic portion contains some ingesta; in pharynx and entrance of oesophagus, bolus of ingesta. Peritoneal cavity—situs viscerum, nothing unusual; a rather large quantity of clear liquid present (intraperitoneal infusion of 2 litres); on omentum, a few petechiae. Diaphragm, convexity forwards; red patchy discoloration. Pleural cavities, a few drops of clear liquid present. Costal pleura shows a few small petechiae. Respiratory organs: lungs, pleura shrivelled; on right diaphragmatic-lobe, some greyish-white thickenings; colour of pleura, greyish-pink-red. Pulmonary arteries, nothing unusual. Bronchi and trachea (thoracic) contain some liquid, froth mixed with ingesta; mucous membranes, nothing unusual; parenchyma in state of expiration, moist on section; blood, froth, and ingesta escape on pressure; consistence elastic. Apical lobe, emphysema. Mediastinal and peribronchial lymphatic glands, nothing unusual; on epiglottis and in larynx, a bolus of ingesta; in cervical trachea, ditto; mucous membrane, nothing unusual. Pericard, fat well developed; contains 60 c.c. clear, amber-coloured liquid, otherwise nothing unusual. Circulatory organs: heart very flabby, 15 by 12 cm., dilated; epicardium shows a few small petechiae, otherwise nothing unusual; right ventricle empty, except for some froth; endocardium, nothing unusual; left ventricle empty, also froth; endocardium, nothing unusual; vasa-cordis, nothing unusual; myocardium, red-brown with a greyish tinge; consistency friable; thoracic aorta, nothing unusual; aorta abdominalis, nothing unusual. Periportal glands, nothing unusual. Liver, size and shape nothing unusual; capsula smooth and glistening, blue-violet colour. Ductus choledochus open. Gall-bladder filled with dark green, clear bile; mucous membranes highly

injected and thickened; bile-duct, nothing unusual. Vena porta, cava-caudalis, nothing unusual; parenchyma very moist; a large amount of wine-red, viscid blood is oozing off; consistence firm. Pancreas, nothing unusual. Spleen, 40 by 10½ by 2 cm; capsula smooth and glistening; steel-red-grey colour; vessels distinct, small petechiae present; shape, nothing unusual; folliculi, and trabeculae distinct; parenchyma, consistence firm; flesh-like colour with a wine-red tinge. Suprarenal glands, nothing unusual. Kidneys: fat well developed in capsula; fibrosa strips easily; parenchyma moist; blood oozes on section; consistency somewhat friable. Stomach: abomasum, pylorus contents rather soft; mucous membrane, nothing unusual; fundus contents liquid, distended with gas; mucous membrane slightly hyperaemic; omasum, hard ingesta, dry; mucous membrane, nothing unusual; reticulum, a small quantity of ingesta; mucous membranes, nothing unusual; rumen, dirty fluid in dorsal sac, otherwise dry in ventral sac; mucous membranes, nothing unusual. Small intestines: duodenum yellow-coloured, chyle present, and a large amount of froth; mucous membranes, nothing unusual; small intestines somewhat injected. Large intestines: rectum contains soft faeces; mucous membranes, nothing unusual; caecum and colon, nothing unusual. Mesenteric glands, nothing unusual; mesentery, some fat present. Bladder, a little grey-yellow turbid liquid. Sexual organs, nothing unusual. Nervous system, hyperaemia of pia-mater. Skeleton, nothing unusual. Blood-smear, negative.

Pathological Anatomical Diagnosis: Petechiae on omentum, diaphragm, and epicardium. Dilatatio cordis and myodegeneratio cordis. Emphysema of apical lobe. Oedema pulmonum. Pleuritis fibrosa localisata. Blood not coagulated. Hyperaemia of lungs, liver, kidneys, and brain. Food bolus in mouth, ventral nose-passage, larynx and trachea, and bronchi. Choleocystitis hæmorrhagica. Slight gastro-enteritis catarrhalis. Tympanitis, fluid in peritoneal cavity.

Etiological Diagnosis (disease): Lamsiekte.

Cause of Death: Shock (?) after injection of magnesium sulphate.

BULL 190.

Weight, 540 lb.

2.2.20: (2.30 p.m.) Injected 0.098 c.c. Berkefeld Filtrate subcutaneously, i.e. .0004 c.c. per kg. live-weight.

5.2.20: (2 p.m.) Animal is ill. Lying down (in physiological position) and salivating profusely. (3 p.m.) Treatment with 5 gr. potassium permanganate dissolved in 1 litre physiological saline infused into the right jugular vein. Animal kicks once or twice. Heart beats much quicker. After about ten minutes it dies.

POST-MORTEM.

D0B No. 190. Bull. Full mouth. Black and white.

P.M. No. 14642. Date of death, 5.2.20.

Condition fair. Abdomen normal. Interim, one hour. Rigor mortis not present. Integument intact. Natural openings slightly open, tip of tongue protruding; visible mucous membranes, nothing unusual. Blood at seat of infusion (right jugular) coagulated, in other vessels partly fluid; flesh and subcutaneous tissue, nothing unusual; muscle at seat of infusion somewhat injected. Salivary glands: parotid slightly injected and swollen. Submaxillary, nothing unusual. Lymphatic glands, nothing unusual. Tonsilla palatina, nothing unusual. Peri-bronchial and mediastinal slightly swollen. Tongue, nothing unusual. Pharynx, nothing unusual. Oesophagus, nothing unusual. Peritoneal cavity—situs viscerum, nothing unusual. Peritoneum smooth and glistening; a small quantity of liquid present. Omentum, fat well developed. Diaphragm, convexity forwards. Pleural cavities; costal pleura covered with small fibrous thickenings in inter-costal spaces. Respiratory organs: lungs in inspiratory stage; trachea and bronchi, nothing unusual; pleura pulmonaris smooth and glistening; lung parenchyma filled with gas, also in the inter-lobular connective tissue, otherwise nothing unusual. Larynx and trachea, nothing unusual. Pericard, fat present and 35 c.c. pinkish-turbid liquid in sac. Circulatory organs: heart—epicardium, nothing unusual; right ventricle contains small clot; endocardium, nothing unusual; left ventricle, nothing unusual; myocardium somewhat friable; thoracic aorta, nothing unusual; abdominal aorta, nothing unusual. Periportal glands, nothing unusual. Liver: capsula smooth and glistening, steel-grey colour (mottled); edges of liver rather blunt; consistency firm. Gall-bladder filled with amber-coloured, clear bile; mucous membranes injected; bile-duct open. Vena

porta and hepatica contain fluid blood; vena cava-posterior, nothing unusual; parenchyma of liver dark brown-red. Acini distinct; periphery filled with blood. Pancreas, nothing unusual. Spleen, 40 by 12 by 3 cm; capsula smooth and glistening; edges rather blunt; surface uneven; consistence firm; on section trabeculae and folliculi distinct; colour normal. Kidneys: capsula contains some yellow fat; strips easily; surface smooth, brown-red; on section blood escapes; parenchyma, nothing unusual; consistence firm. Stomach: abomasum, pylorus contains fairly firm ingesta; mucous membranes smooth; fundus, some liquid ingesta and a piece of cloth; mucous membranes injected; omasum contents dry; mucous membranes, nothing unusual; reticulum contents dry; mucous membranes, nothing unusual; rumen contents dry; mucous membranes, nothing unusual. Small intestines: duodenum contains some yellowish mucus; mucous membranes slightly swollen and injected; ileum and jejunum slightly injected. Large intestines: rectum contains small quantity of normal faeces; mucous membranes, nothing unusual. Mesenteric glands, nothing unusual; mesentery contains some fat. Bladder filled with pale yellow, very turbid urine; mucous membranes slightly injected. Sexual organs, prostata swollen. Nervous system—brain, nothing unusual. Skeleton, nothing unusual. Blood-smear, negative.

Pathological Anatomical Diagnosis: Emphysema pulmonum. Hyperaemia of liver, spleen, and kidneys. Slight gastro-enteritis. Prostatitis.

Etiological Diagnosis (disease): Lamsiekte.

Cause of Death: Shock, due to infusion of magnesium sulphate.

BULL 194.

Weight, 502 lb.

2.2.20: (2.30 p.m.) Injected 0.034 c.c. Berkefeld Filtrate subcutaneously, i.e. .00015 c.c. per kg. live-weight.

5.2.20: (2 p.m.) Animal salivating profusely. (3.30 p.m.) Treatment with 80 gr. sodium bicarbonate dissolved in 2 litres physiological saline. No effect shown.

6.2.20: (9 a.m.) Another treatment with 80 gr. sodium bicarbonate in 2 litres physiological saline infused into the jugular vein. A few minutes after infusion the animal gets up. Pulse about 90 per minute. The animal is exceedingly thin, having eaten nothing for two days.

7.2.20: (6 a.m.) Lying in physiological position. (9 a.m.) Animal is lifted and is able to walk about. It does not salivate any more. Tongue not paralysed. (5 p.m.) Animal now completely paralysed.

8.2.20: (6 a.m.) Found dead.

POST-MORTEM.

D0B No. 194. Bull. Two-tooth. Red.

P.M. No. 14645. Date of death, 8.2.20.

Condition fair. Abdomen relaxed. Interim, died during night. Rigor mortis not present. Integument intact. Natural openings, mouth closed, numerous fly larvae; visible mucous membranes pale. Blood partly coagulated; at seat of infusion (jugular veins), a hard thrombus present; wall of jugular vein thickened; flesh, nothing unusual; subcutaneous tissue show some fat. Salivary glands enlarged and swollen. Lymphatic glands, on right (side on which animal lay) enlarged and hæmorrhagic. Retropharyngeal glands highly injected; thyroid, ditto. Tongue, nothing unusual. Pharynx injected. Oesophagus—mucous membranes, post-mortem changes. Peritoneal cavity—situs viscerum, nothing unusual. Peritoneum, smooth and glistening. Omentum, fat well developed and a few petechiae present. Diaphragm, convexity forwards. Pleural cavities, pleura smooth and glistening. Lungs in state of inspiration. Trachea and bronchi contain froth; arteries and veins, nothing unusual; pleura pulmonalis smooth and glistening; colour of lungs pinkish-red to bluish-red; consistency spongy and elastic; on section parenchyma pink-red, small air bubbles and blood appear. Larynx and trachea, nothing unusual. Pericard, fat well developed and contains 20 c.c. red liquid. Circulatory organs: heart, epicardium smooth and glistening, under epicardium numerous petechiae and hæmorrhagic patches; right ventricle contains a large clot of blood; endocardium, nothing unusual; left ventricle, a large clot; endocardium covered with hæmorrhagic patches; myocardium somewhat friable; thoracic and abdominal aorta, nothing unusual. Periportal glands, nothing unusual. Liver enlarged, edges somewhat blunt. Bile-ducts open. Gall

bladder filled with dark yellowish-green, clear, viscid bile; mucous membranes, nothing unusual. Portal and hepatic veins, nothing unusual. Vena cava—posterior, nothing unusual. Capsula of liver smooth and glistening; colour normal; consistency very firm on section; parenchyma appears swollen, is rich in blood, bile-ducts distended. Pancreas, nothing unusual. Spleen, 40 by 11 by 15 cm.; capsula shrivelled, glistening; under the normal-coloured capsula, numerous hæmorrhagic patches from 1 to 5 mm. in diameter; consistency normal; parenchyma, nothing unusual; trabeculae and folliculi distinct. Suprarenal glands, nothing unusual. Kidneys: capsula contains rather gelatinous fat; strips easily; surface dark brown-red; parenchyma on section rich in blood; hilus contains some fat. Stomach: abomasum, pylorus contains gelatinous mucus; fundus, some brown, formed ingesta; mucous membranes, nothing unusual; omasum contents dry; mucous membranes, nothing unusual; reticulum contents dry; mucous membranes, nothing unusual; rumen, ingesta dry; mucous membranes, nothing unusual. Small intestines: duodenum contains an ochre-yellow mucoid ingesta; small intestines: mucous membranes swollen and post-mortem changes. Large intestines: rectum contains hard pieces of faeces covered with mucus; mucous membranes slightly injected; large intestines—mucous membranes slightly swollen and post-mortem changes. Mesenteric glands, nothing unusual; mesentery, fat well developed Bladder contains a small amount of opaque, yellowish urine; mucous membranes injected. Sexual organs, nothing unusual. Nervous system—brain, vessels of pia-mater filled. Skeleton, nothing unusual. Blood-smear, negative.

Pathological Anatomical Diagnosis: Thrombophlebitis of both venae jugulares. Emphysema pulmonum. Petechiae in epicardium and in omentum. Hæmorrhagic patches in endocardium of left ventricle and in capsula of spleen. Hyperaemia of liver, kidneys and lungs. Slight gastro-enteritis.

Etiological Diagnosis (disease): Lamsiekte.

HEIFER 3932.

Weight, 305 lb. = 138 kg.

9.2.20: (3.30 p.m.) 0.0138 c.c. Berkefeld Filtrate subcutaneously, i.e. 0.0001 c.c. per kg.

15.2.20: (9 a.m.) Animal appears ill. Salivating slightly.

16.2.20: (6 a.m.) Salivating somewhat more than usual, otherwise normal. (2 p.m.) Looks worse. Tongue slightly protruding. Salivating; no cud in mouth.

17.2.20: (6 a.m.) Salivating, otherwise no symptoms.

18.2.20: (6 a.m.) No change.

19.2.20: (6 a.m.) Still salivating.

20.2.20: (6 a.m.) Still seems to have some difficulty in getting up. The left front leg seems particularly weak.

21.2.20: (6 a.m.) Standing and ruminating with rather more salivation than normal.

22.2.20: (6 a.m.) Recovered.

4.3.20: (5 p.m.) 0.0001 c.c. filtered toxin per kg. body-weight. No reaction.

15.3.20: (4 p.m.) 5 x MLD filtered toxin (immunity test). No reaction.

22.3.20: (3 p.m.) 10 x MLD filtered toxin (immunity test).

26.3.20: (2 p.m.) Lying down unable to rise.

27.3.20: (6 a.m.) Walking about. Later in the morning lying down again, unable to rise. When lifted it can walk.

28.3.20: (9 a.m.) Lying down, stretched out. Unable to rise.

30.3.20: (11 a.m.) Treated with 20 g. borax dissolved in 1 litre normal saline heated to body-temperature, and injected into the jugular vein. The anmial does not seem to react in any way.

31.3.20: (6 a.m.) No change.

1.4.20: (6 a.m.) Dying. (8 a.m.) Dead of lamsiekte.

BULL 4361.

Weight, 378 lb. = 171.5 kg.

26.1.20: (10.40 a.m.) 0.01 Berkefeld Filtrate subcutaneously, i.e. 0.000058 c.c. per kg. No reaction.

9.2.20: (3.30 p.m.) 0.01715 c.c. Berkefeld Filtrate subcutaneously, i.e. 0.0001 c.c. per kg.

14.2.20: (7 a.m.) Animal appears slightly ill. It looks dull and lies down most of the time.