

The observation that only cattle suffering from "pica" or "abnormal appetite" ever picked up material containing toxin, and the subsequent proof that this pica was specifically due to phosphorus deficiency of the natural pasture, allowed all the earlier observations to be brought into line. It is interesting to note that all the earlier theories of causation held *part* of the truth, but not one the *whole* truth. Hutcheon was right in predicting phosphorus deficiency as causally connected with the disease, but wrong in considering it the direct cause. It is only of etiological significance in so far as it induces an abnormal craving in the cattle, making them ingest toxic carcass débris which they would otherwise shun. Hutcheon and Borthwick were right in maintaining that the feeding of bonemeal prevented the disease; if fed in *sufficient amounts* (very large in some cases) it prevented and cured pica, and so prevented ingestion of toxin. The same result, in so far as prevention of disease is concerned, would have been achieved by burying or burning all carcass débris capable of serving as substrate for toxin production. The opponents of the idea of prevention by bonemeal feeding were also right since certain cattle develop habitual pica incurable by phosphorus feeding, while some others require amounts so high that they never came into practical consideration.

The various exponents of the "infection theory" were right in predicating a bacterium, but wrong in predicating a pathogenic one; the organism being a saprophyte which does not infect the living animal, but does infect the dead one. The believers in the various "intoxication theories" were right in so far as they explained the symptoms of lamsiekte as due to poisoning, but wrong in predicating toxins of vegetable origin, the toxin being of bacterial and the substrate generally of animal origin.

The credit of grasping the truth as a coherent whole in 1919 belongs to Theiler, and of establishing it in all its bearings, to him and the co-workers of his staff over the ensuing few years.

---

## SECTION 2.—CAUSE OF THE DISEASE AND EXPERIMENTS UPON ITS PRODUCTION IN THE LAMSIKTE AREA.

---

### PLAN OF CONTENTS.

#### SUB-SECTION A.—DRENCHING EXPERIMENTS.

	PAGE
Introduction.....	858
<i>Experiment No. 1.</i> —Drenching of cattle with pupae of a blow-fly ( <i>Pycnosoma</i> sp.), reared on carcasses of cattle that had died of naturally contracted lamsiekte..	859
(a) Heifer 3653.	
(b) Heifer 3470.	
(c) Heifer 3722.	
(d) Heifer 3642.	
(e) Heifer 3654.	
(f) Heifer 4261.	
(g) Cow 3611.	
(h) Cow 3318.	

	PAGE
<i>Experiment No. 2.</i> —Drenching of cattle with <i>Pycnosoma</i> pupae reared on the carcasses of animals that had died (a) of diseases other than naturally contracted lamsiekte and (b) of experimentally produced toxæmia.....	863
(a) Heifer 3640.	
(b) Heifer 3470.	
(c) Heifer 3909.	
(d) Heifer 4100.	
<i>Experiment No. 3.</i> —Drenching of cattle with <i>Pycnosoma</i> pupae reared on carcasses of healthy cattle and goats that were killed.....	865
(a) Heifer 3708.	
(b) Cow 2894.	
(c) Heifer 4316.	
(d) Cow 2571.	
<i>Experiment No. 4.</i> —Drenching of cattle with empty shells of <i>Pycnosoma</i> pupae that had been reared on carcasses of cattle that had died of lamsiekte. The object was to ascertain whether toxæmia could be produced by the ingestion of shells alone.....	866
(a) Heifer 3640.	
(b) Heifer 3397.	
<i>Experiment No. 5.</i> —Drenching cattle with empty shells of <i>Pycnosoma</i> pupae reared on carcasses of (a) a goat that had died of cachexia and (b) a heifer that had died of experimentally produced toxæmia.....	867
(a) Heifer 4170.	
(b) Heifer 4298.	
<i>Experiment No. 6.</i> —Drenching of cattle with pupae of the house-fly reared on carcasses of animals that had died of (a) a disease other than naturally contracted lamsiekte and (b) of experimentally produced toxæmia.....	867
(a) Cow 2361.	
(b) Heifer 4229.	
(c) Heifer 4528.	
<i>Experiment No. 7.</i> —Drenching of cattle with larvae of <i>Pycnosoma</i> reared on carcasses of animals that had died (a) of a disease other than naturally contracted lamsiekte and (b) experimentally produced toxæmia.....	868
(a) Tollie 3827.	
(b) Tollie 3846.	
(c) Heifer 3995.	
(d) Tollie 3997.	
(e) Heifer 3996.	
(f) Heifer 4094.	
(g) Cow 4182.	
<i>Experiment No. 8.</i> —Drenching of cattle with <i>Pycnosoma</i> larvae reared on carcasses of healthy animals.....	871
(a) Red heifer 4217.	
(b) Heifer 4297.	
(c) Heifer 3929.	
(d) Heifer 4352.	
(e) Heifer 4053.	
(f) Tollie 3934.	
(g) Tollie 3992.	
(h) Heifer 4148.	
(i) Heifer 127.	
(j) Heifer 144.	
<i>Experiment No. 9.</i> —Drenching of cattle with larvae of the house-fly reared on carcasses of slaughtered healthy cattle.....	877
Heifer 3717.	

	PAGE
<i>Experiment No. 10.</i> —Drenching with <i>Pycnosoma</i> larvae from the carcass of a healthy ox that had shortly before been introduced on to lamsiekte veld.....	877
Cow 3868.	
<i>Experiment No. 11.</i> —Drenching of cattle with putrid flesh.....	878
(a) Tollie 4091.	
(b) Tollie 4003.	
<i>Experiment No. 12.</i> —Drenching of cattle with crushed putrid bones of bovine carcasses.....	879
(a) Heifer 3869.	
(b) Cow 3330.	
(c) Heifer 4137.	
(d) Heifer 4532.	
(e) Heifer 4540.	
(f) Heifer 4546.	
(g) Heifer 4547.	
(h) Heifer 4527.	
(i) Heifer 3805.	
(j) Cow 4178.	
(k) Tollie 4095.	
(l) Heifer 181.	
(m) Cow 3516.	
(n) Cow 2165.	
(o) Bull 187.	
<i>Experiment No. 13.</i> —Drenching of cattle with crushed bones from which all flesh had been removed at the time of the post-mortem. The bones had been exposed to atmospheric conditions for about two months and were kept in an enclosure where carcasses were exposed to putrefaction.....	884
(a) Tollie 3448.	
(b) Heifer 3867.	
<i>Experiment No. 14.</i> —Drenching experiments with ingesta and contents of stomachs of cattle that had died of lamsiekte and toxæmia or which had been slaughtered for the purpose of ascertaining whether such ingesta would cause lamsiekte....	885
(a) Heifer 3880.	
(b) Cow 3563.	
(c) Heifer 3770.	
(d) Heifer 3993.	
(e) Heifer 4537.	
(f) Heifer 4541.	
(g) Heifer 4548.	
(h) Heifer 4542.	
(i) Cow 3153.	
(j) Tollie 3809.	
(k) Heifer 4266.	
(l) Cow 3659.	
(m) Heifer 4006.	
(n) Heifer 4174.	
(o) Cow 2846.	
(p) Heifer 4529.	
<i>Experiment No. 15.</i> —Drenching of cattle with the spleen from the carcass of a cow that showed pronounced signs of decomposition, putrefactive bacteria being present in the pulp.....	890
(a) Tollie 4330.	
(b) Tollie 4372.	
<i>Experiment No. 16.</i> —Drenching of cattle with crushed bones or dry putrid flesh from carcass of a dog.....	892
(a) Tollie 4108.	
(b) Ox 3448.	
(c) Tollie 4099.	
(d) Tollie 4050.	
(e) Tollie 4087.	

	PAGE
<i>Experiment No. 17.</i> —Drenching of cattle with rotten material taken from the carcasses of lambs.....	895
(a) Cow 2756.	
(b) Bull 192.	
<i>Experiment No. 18.</i> —Drenching of a heifer with material obtained from a dead ostrich undergoing putrefaction.....	895
Heifer 121.	
<i>Experiment No. 19.</i> —Drenching of a heifer with bones and flesh from the carcass of a steenbok found on the veld.....	896
Heifer 4528.	
<i>Experiment No. 20.</i> —Drenching of cattle with bones and flesh from the carcass of a mierkat found on the veld.....	897
(a) Heifer 3507.	
(b) Tollie 4328.	
<i>Experiment No. 21.</i> —Drenching of cattle with rotten bones from the carcass of a horse.....	897
(a) Bull 188.	
(b) Heifer 4763.	
<i>Experiment No. 22.</i> —Drenching of a cow with the carrion collected from the carcass of a fowl.....	898
Cow 3659.	
<i>Experiment No. 23.</i> —Drenching experiments to test the toxicity of bones that to judge by sight and smell could not be considered to be putrid in the strict sense of the word.....	899
(a) Heifer 4550.	
(b) Heifer 4539.	
(c) Heifer 4523.	
(d) Heifer 4526.	
(e) Cow 2315.	
(f) Heifer 4028.	
<i>Experiment No. 24.</i> —Drenching experiments with sterilized putrid bones to note whether toxic bones boiled for one hour will still produce the disease.....	901
(a) Bull 195.	
(b) Tollie 191.	
(c) Tollie 209.	
<i>Experiment No. 25.</i> —Experiments to ascertain whether the toxicity of bones and semi-dry putrid flesh can be destroyed by boiling for half an hour.....	901
(a) Heifer 178.	
(b) Heifer 183.	
(c) Cow 2886.	
(d) Cow 3379.	
<i>Experiment No. 26.</i> —Experiments to determine whether a disease could be produced in sheep and goats by drenching them with pupae and larvae collected from carcasses of cattle that had died (1) of naturally contracted lamsiekte, (2) that had been killed for the purpose of experiments, (3) that had died of toxaemia (lamsiekte produced by drenching), and (4) by drenching them with pupae of the housefly from carcasses of animals that had died of disease or were killed—	
(1) Drenching with pupae collected from the carcasses of animals that had died of naturally contracted lamsiekte.....	903
(a) Sheep 9486.	
(b) Sheep 7470.	
(c) Sheep 9618.	
(d) Sheep 9980.	
(e) Sheep 9867.	
(f) Sheep 9850.	
(g) Sheep 7201.	
(h) Sheep 9875.	
(i) Sheep 9643.	
(j) Goat 12278.	
(k) Goat 12280.	

	PAGE
(2a) Drenching with <i>Pycnosoma</i> pupae from the carcasses of healthy animals (goats and cattle) killed for the purpose of experiments.....	936
(l) Sheep 7139.	
(m) Goat 12309.	
(n) Goat 12320.	
(o) Sheep 9874.	
(p) Goat 12304.	
(2b) Drenching sheep and goats with <i>Pycnosoma</i> larvae from the carcasses of healthy cattle that were killed for the purpose of the experiments.....	930
(q) Sheep 7129.	
(r) Sheep 8030.	
(s) Goat 12304.	
(3) Drenching with larvae from the carcasses of cattle that had died of toxaemia (lamsiekte produced by drenching).....	937
(t) Goat 12307.	
(u) Goat 12313.	
(v) Sheep 9092.	
(4) Drenching sheep and goats with pupae of the house-fly from carcasses of animals that had died of disease or were killed.....	903
(w) Sheep 8457.	
(x) Goat 12314.	
(y) Goat 12284.	
(z) Sheep 9878.	
(aa) Goat 12303.	
(bb) Sheep 9871.	

#### SUB-SECTION A.—APPENDIX.

Post-mortem reports of animals that died as a result of drenching.....	919
(1) Cow 3659.	
(2) Tollie 4087.	
(3) Tollie 4050.	
(4) Tollie 4093.	
(5) Tollie 4330.	
(6) Ox 3448.	
(7) Tollie 4108.	
(8) Heifer 3805.	
(9) Cow 3379.	
(10) Heifer 183.	
(11) Heifer 178.	
(12) Heifer 4527.	
(13) Heifer 4547.	
(14) Cow 3868.	
(15) Heifer 127.	
(16) Heifer 3507.	
(17) Heifer 121.	
(18) Heifer 144.	
(19) Cow 2756.	

#### SUB-SECTION B.—FEEDING OF CATTLE WITH PUTRID BONES.

	PAGE
(a) Preliminary observations.....	926
<i>Experiment</i> I.—To study the influence of the sun on the incidence of lamsiekte	926
A. Sun-kraaled lot.	
B. Shade-kraaled lot.	
<i>Experiment</i> II.—To test the influence of a lick on the incidence of the disease. The lick consisted of loogas, rooibrak, and salt, to which cattle had free access..	926
<i>Experiment</i> III.—Grazing (grass toxin tests).....	927

	PAGE
<i>Experiment</i> IV.—Alternate feeding and grazing lot "B.".....	927
<i>Experiment</i> V.—Bonemeal feeding.....	928
<i>Experiment</i> VI.—Bare paddock.....	928
<i>Experiment</i> VII.—Surplus cattle running as controls in the veld.....	929
<i>Experiment</i> VIII.—Available cattle kept in the kraals.....	929
(b) Circumstances leading to the rotten-bone feeding (carcass-feeding) experiments.....	929
(c) The selection of bone-eaters amongst cattle that were grazing.....	930
<i>First Test.</i> —Testing for craving with dry rotten bones.....	930
<i>Second Test.</i> —Testing for craving with old bleached bones.....	931
<i>Third Test.</i> —Testing for craving with rotten bones.....	932
<i>Fourth Test.</i> —Testing of cattle with bleached bones.....	932
(d) Testing of surplus cattle running as controls in the veld.....	932
(e) Testing of cattle for craving in the grazing down paddocks.....	933
(f) Testing of cattle which had been dosed individually with 8 oz. of bone meal per head since 17/12/17 daily.....	933
(g) Testing of cattle for craving (the alternate grazing and kraaling lot). Lot "B" that were not grazing at the time.....	933
(h) Testing of the available lot of cattle.....	934
(i) Testing cattle kept in a paddock from which all grass had been removed for the craving of bones.....	934
(j) Experiment to note whether cattle that had been selected on account of their craving for bleached bones could eat rotten bones and whether they would contract lamsiekte.....	935
First case of lamsiekte.....	Cow 4183.
Second case of lamsiekte.....	Heifer 4181.
Third case of lamsiekte.....	Cow 2790.
Fourth case of lamsiekte.....	Cow 2650.
Fifth case of lamsiekte.....	Cow 2181.
Sixth case of lamsiekte.....	Heifer 3898.
Seventh case of lamsiekte.....	Cow 3000.
Eighth case of lamsiekte.....	Tollie 3826.
Ninth case of lamsiekte.....	Cow 3004.
Tenth case of lamsiekte.....	Heifer 4005.
Eleventh case of lamsiekte.....	Ox 3854.
Twelfth case of lamsiekte.....	Tollie 3821.
Thirteenth case of lamsiekte.....	Heifer 148.
Fourteenth case of lamsiekte.....	Heifer 101.
Fifteenth case of lamsiekte.....	Heifer 3853.
Sixteenth case of lamsiekte.....	Heifer 142.
Tabulated Summary of Lot No. 1, Rotten-bone feeding tests.....	946
Tabulated Summary of Lots Nos. 2 and 3, Rotten-bone feeding tests.....	948

### SUB-SECTION B.—APPENDIX.

Casuistics and post-mortem reports of animals that contracted lamsiekte as a result of feeding on rotten bones..... 950

- (1) Cow 4183.
- (2) Heifer 4181.
- (3) Cow 2790.
- (4) Cow 2650.
- (5) Cow 2181.
- (6) Heifer 3898.
- (7) Cow 3000.
- (8) Tollie 3826.
- (9) Cow 3004.
- (10) Heifer 4005.
- (11) Tollie 3854.
- (12) Tollie 3821.
- (13) Heifer 148.
- (14) Heifer 101.
- (15) Heifer 3853.
- (16) Heifer 142.

SUB-SECTION C.—EXPOSURE OF CATTLE IN A Paddock INTO WHICH  
CARCASSES AND BONES HAD BEEN DEPOSITED.

---

	PAGE
Interpretation of earlier experiments (1916).....	981
Repetition of the experiments in 1918.....	983
Experiments to note whether craving cattle with no access to old bleached bones would eat rotten bones.....	988
Experiments to ascertain whether cattle would pick old rotten bones that were known to produce lamsiekte if no palatable bones could be obtained.....	993
First case of lamsiekte.....	Heifer 3910.
Second case of lamsiekte.....	Cow 3583.
Third case of lamsiekte.....	Bull 2600.
Case of prolapsus reticuli into pleural cavity due to over-feeding with bones..	Cow 3146.
Fourth case of lamsiekte.....	Tollie 3903.
Fifth case of lamsiekte.....	Tollie 3930.
Sixth case of lamsiekte.....	Heifer 3856.
Seventh case of lamsiekte.....	Cow 2968.
Eighth case of lamsiekte.....	Heifer 3905.
Ninth case of lamsiekte.....	Heifer 169.
Tenth case of lamsiekte.....	Heifer 172.

SUB-SECTION C.—APPENDIX.

Casuistics and post-mortem reports of cattle that contracted lamsiekte in the "carcass camp experiment".....	1015
(1) Cow 3146.	
(2) Bull 2600.	
(3) Heifer 169.	
(4) Heifer 172.	

---

SUB-SECTION D.—THE PRODUCTION OF LAMSIEKTE BY MEANS OF MIXED  
CULTURES PREPARED FROM TOXIC MATERIAL.

	PAGE
(1) Selection of seed material.....	1021
Cow 4191.	
(2) Production of the disease by means of toxin obtained in anaerobic culture, using as seed material the black debris off a bone of a carcass having undergone putrefaction.....	1022
Heifer 3659.	
(3) Production of the disease with toxin from a culture which was obtained using intestinal contents of a Pycnosoma larva as seed material.....	1022
Guinea-pig 1.	
Guinea-pig 2.	
Guinea-pig 3.	
Guinea-pig 4.	
Guinea-pig 5.	
Guinea-pig 6.	
Heifer 120.	
Heifer 149.	
(4) Culture injection of the fourth generation.....	1025
Tollie 181.	
Cow 3708.	

(5) Cultures made by using crushed Pycnosoma larvae collected from a carcass undergoing putrefaction.....	1026
Heifer 128.	
Cow 2886.	
Heifer 3507.	
Cow 2315.	
Heifer 4152.	
(6) Cultures made with putrid bones.....	1030
Tollie 150 (Subcutaneous injection).	
Tollie 156 (Drenching).	
General Conclusions.....	1031

#### SUB-SECTION D.—APPENDIX.

POST MORTEM REPORTS.....	1031
(1) Cow 4191.	
(2) Heifer 149.	
(3) Heifer 120.	
(4) Tollie 181.	
(5) Cow 3708.	
(6) Heifer 128	
(7) Cow 2886.	
(8) Cow 2315.	
(9) Heifer 4152.	
(10) Heifer 150.	

#### SUB-SECTION E.—CASES OF NATURALLY CONTRACTED LAMSIEKTE.

Occurring on the pasture during the period in which the experiments were carried out (natural controls).....	PAGE 1039
(1) Heifer 3908.	
(2) Ox 3660.	
(3) Tollie 4341.	
(4) Ox 2267.	
(5) Ox 2641.	
(6) Heifer 115.	
(7) Heifer 3870.	
(8) Cow 2598.	
(9) Heifer 122.	

### SECTION 2.—CAUSE OF THE DISEASE AND EXPERIMENTS UPON ITS PRODUCTION IN THE LAMSIEKTE AREA.

#### SUB-SECTION A.—DRENCHING EXPERIMENTS.

In the course of time a number of theories had been formed by different investigators, and these gave the basis for some of our researches, viz., the Avitaminosis or Deficiency theory, the Sarcosporidiosis theory, the Grass Toxin theory. They have been fully dealt with in the various reports of the Director of Veterinary Research and for a time occupied the attention of the Division. The first two theories were disposed of as untenable, both as a result of experimental work based on more detailed investigations and as not being in conformity with the epizootology of the disease. The



Grass Toxin theory was given extensive consideration, but, although it appeared to explain the occurrence of the disease and circumstances connected with it, it could not be supported by experiments and the weight of prolonged experimental evidence began to tell against it. The results with pycnosoma pupae, the several experiments with ingesta and bones, interpreted by the various investigators as toxæmia and the evidence obtained from farmers, who connected the cause of the disease with a lamsiekte carcass or with the ingesta of such a carcass (pensmist), directed the attention to the study of the toxicity of the carcass itself as a possible source for the solution of the problem.

EXPERIMENT NO. 1.—DRENCHING OF CATTLE WITH PUPAE OF A BLOW-FLY (PYCNOSOMA SPEC.) REARED ON CARCASSES OF CATTLE THAT HAD DIED OF NATURALLY CONTRACTED LAMSIEKTE.

\* Life-cycles of *Chrysomya (Pycnosoma) marginale*, Wied., *C. (P.) chloropyga*, Wied, and *C. (P.) albiceps*, Wied.

The above species are common and widely distributed throughout the Union, but *C. chloropyga* does not, so far as we are aware, occur in the Vryburg District. They are also found in other parts of Africa.

The female flies lay their eggs in masses—the eggs being stuck together with a salivary fluid—on carcasses and occasionally on faecal and other matter.

All flies that have been kept in captivity have produced eggs, but we have reason to believe that they are sometimes viviparous, since we have found young larvae but no empty egg-shells on perfectly fresh carcasses within an hour or so of the death of the animals on several occasions.

The eggs, which are usually deposited in shady places, always hatch within twenty-four hours. Eggs exposed to the sun usually shrivel up within a few hours. The larvae commence feeding as soon as they have hatched, and take from four to twelve days to mature, the time varying according to the temperature and the food supply. When the larvae are mature, they either migrate from the carcass and burrow into the soil to pupate, or else they pupate underneath a carcass.

The pupal stage lasts from five to fifteen days. The life-cycle from the egg to the adult stage occupies therefore from ten to twenty-eight days.

(a) RED HEIFER 3653.—Arrived at Armoedsvlakte from Bestersput on 31.12.16. She was stabled on 29.9.17 and fed on Pretoria bushveld hay.

*Treatment*: 13.11.18: The heifer was drenched with 4 oz. of whole pycnosoma pupae collected from the carcasses of cattle that had died of lamsiekte and had been exposed for putrefaction in a camp set apart for this purpose (carcass camp).

*Result*: 17.11.18: The heifer was lying down in the morning and unable to rise. She died in the afternoon. The temperature during this period of observation was normal. Microscopical examination on 17.11.18 of blood and spleen proved these to be negative. The disease and cause of death was diagnosed as toxæmia (acute lamsiekte).

CONCLUSION.—The disease appeared four days after drenching, lasted for less than 24 hours, and corresponded to acute lamsiekte.

(b) RED HEIFER 3470.—Arrived from Pretoria on 25.8.16. She was stabled on 29.9.17. She was subsequently used in a transfusion experiment of blood (11.11.17) from an animal suffering from lamsiekte with negative results.

*First Treatment*: On the 13.11.18 the heifer was drenched with 7 oz. crushed pupae collected from carcasses of cattle that had died of lamsiekte.

*Result*: Negative.

*Second Treatment*: On 29.11.18 the heifer was drenched with 4½ oz. whole pupae from the carcass of heifer 3653 [which had received 4 oz. pupae from the carcass of an animal that had died of toxaemia (lamsiekte) after drenching with pupae]. [See Expt. 2 (b).]

CONCLUSION.—The drenching of pupae collected from a carcass of an animal that had died of lamsiekte did not produce the disease in the first instance, but the heifer succumbed to toxaemia (lamsiekte) in a subsequent experiment.

(c) BLACK AND WHITE HEIFER 3722.—At Armoedsvlakte since the 8.3.17, stabled on 29.9.17 and fed on Pretoria bushveld hay during this time.

*First Treatment*: On 20.11.18 drenched with 3½ oz. of crushed Pycnosoma pupae from the carcass of a bovine that had died of naturally contracted lamsiekte.

*Result*: Negative.

*Second Treatment*: On 7.12.18 drenched with 3 oz. of whole pycnosoma pupae from carcass of heifer 3804 that had died the previous day showing symptoms of tympanitis (peracute lamsiekte).

*Third Treatment*: On 10.12.18 she was drenched with 4 oz. of whole pycnosoma pupae from carcass of cow 2587, killed *in extremis* on 22.11.18 while suffering from acute naturally contracted lamsiekte.

*Result*: 13.12.18: The heifer was noted to lie down frequently and in the afternoon she rose with difficulty. During the whole period she was in experiment the temperature had a normal course, with one exception, viz., on the third day of December. This was probably of an accidental nature. The microscopical examination of blood taken on 15.12.18 gave negative results. Death occurred the same day. The diagnosis of toxaemia (lamsiekte) was made.

CONCLUSION.—The first drenching with 3½ oz. pupae failed to produce the disease. The disease appeared three days after the third dosing, lasted for two days, and was characterized at its onset by frequently lying down and subsequent difficulty in rising. These are the symptoms of lamsiekte. It thus appears that not all pycnosoma pupae are toxic.

(d) RED HEIFER 3642.—Arrived at Armoedsvlakte on 31.12.16; she was stabled since 29.9.17 and fed on Pretoria bushveld hay. She was used in a lamsiekte blood infusion experiment on 13.12.17 with negative results.

*Treatment*: On 20.11.18 the heifer was drenched with 3½ oz. whole pycnosoma pupae from carcasses of bovines that had died of naturally contracted lamsiekte. These carcasses were exposed to putrefaction in the carcass camp.

*Result*: 29.11.18: The heifer was not feeding well; she had a rather tucked-up appearance and a staring coat. No muscular weakness was observed on this day. 2.12.18: Much the same condition was noted. 3.12.18: Muscular weakness became noticeable. 4.12.18: Muscular weakness was very marked. The heifer went down in the evening and was unable to rise thereafter. During the observation the temperature was normal. Microscopical examination of a blood-smear gave negative results. 7.12.18: The heifer was killed, and the cause of disease was diagnosed as toxaemia (lamsiekte).

**CONCLUSION.**—The heifer sickened nine days after drenching, and the disease lasted for eight days. It commenced with loss of appetite. Muscular weakness appeared three days later and gradually developed into a paresis of the locomotor system, the heifer finally being unable to rise. These were the symptoms of lamsiekte.  $3\frac{1}{2}$  oz. pycnosoma pupae were sufficient to cause the disease.

(e) **RED HEIFER 3654.**—Arrived from Bestersput on 31.12.16. She was stabled since 29.7.17 and fed on Pretoria hay. On 12.2.18 she was used in a lamsiekte blood transfusion experiment with negative results.

*First Treatment.*—On 20.11.18 drenched with  $3\frac{1}{2}$  oz. of pycnosoma pupae collected from a carcass of a bovine that had died of naturally contracted lamsiekte.

*Result:* 2.12.18: The heifer was noted to lie down very frequently. On 10.12.18 she appeared to have regained normal health.

*Second Treatment:* On 10.12.18 drenched with 4 oz. of pycnosoma pupae collected around the carcass of cow 2587 that was killed on the 22.11.18 when *in extremis* and suffering from acute lamsiekte naturally contracted.

*Result:* 13.12.18: In the afternoon marked weakness was noted; the heifer was very stiff in the front quarters; she was lying down most of the time and had some difficulty in rising. During the period of observation the temperature of the heifer was normal. Microscopical examination of the blood-smears gave negative results. She died on the 15.12.18. The disease and cause of death was diagnosed as toxæmia.

**CONCLUSION.**—This heifer showed a slight illness twelve days after the first drenching. This must be diagnosed as a mild attack of lamsiekte. The illness after the second drenching appeared on the third day and lasted for two days. It showed itself in a stiff gait of the forelegs, difficulty to stand, and in lying down most of the time. These symptoms could be interpreted as those of a paresis of the muscular system and hence as lamsiekte. This heifer apparently had two attacks of the disease, the first one being very mild.

(f) **BLACK AND WHITE HEIFER 4261.**—Arrived from Pretoria on 5.12.18 and was stabled since that date.

*Treatment:* On 10.12.18 she was drenched with 4 oz. of whole pycnosoma pupae from carcass of cow 2587 (an animal that was killed *in extremis* on the 22.11.18 while suffering from lamsiekte naturally contracted.

*Result:* Negative.

**CONCLUSION.**—4 oz. of pycnosoma pupae did not cause the disease.

(g) **RED COW 3611.**—Arrived from Pretoria on 1.7.16 and was stabled since 25.2.18. She was used on 22.11.18 in a lamsiekte blood transfusion experiment with negative results.

*Treatment:* 9.1.19: Drenched with an emulsion of 3 oz. pycnosoma pupae at the time of moulting (flies were already escaping). The pupae had been collected from the carcass of heifer 2439 which had died of acute lamsiekte naturally contracted on the 21.12.18.

*Result:* Negative.

**CONCLUSION.**—The drenching with moulting pupae did not produce the disease.

(h) RED COW 3318.—Arrived at Armoedsvlakte from Bestersput on 1.3.17 and was stabled since 25.2.18. She had been used in a lamsiekte blood transfusion experiment on 23.11.18 with negative results.

*Treatment*: 9.1.19: Drenched with  $\frac{1}{2}$  oz. mature pycnosoma pupae collected from carcass of heifer 2439 (an animal that had died of acute lamsiekte naturally contracted on 21.12.18).

*Result*: 26.1.19: The cow was noticed to be ill and walking with a rather stiff gait, she was not feeding properly and the coat was slightly staring. 27.1.19: The cow was frequently lying down, but had no difficulty in rising. 28.1.19: Distinct salivation was noted and diarrhoea was present. 30.1.19: When masticating, frothing at the mouth was very marked. Slight diarrhoea was still present, the back was slightly arched. The gait was normal. The cow was attentive. She was frequently lying down. The eyes appeared to be sunken. 3.2.19: The cow was lying down most of the time, but rose when disturbed, the gait was normal, the back slightly arched, purging was still noted. She was losing condition. 4.2.19: The cow was standing most of the time, she was not feeding well, and whilst masticating, slight salivation was noted. 6.2.19: The cow was feeding well and was attentive. No symptoms of illness were noted after this date. During the whole time of observation no disturbance of temperature was noted.

**CONCLUSION.**—The illness appeared 17 days after drenching and lasted for 11 days. It was characterized by loss of appetite, salivation, muscular weakness, and diarrhoea. No definite diagnosis was made at the time. Some of the symptoms could be interpreted as those of lamsiekte. The presence of diarrhoea complicated the case, but the muscular weakness and the salivation spoke in favour of the diagnosis toxæmia (lamsiekte). Half an ounce of pycnosoma pupae would thus be able to produce the disease.

**RÉSUMÉ OF EXPERIMENTS.**—Eight bovines were drenched with pycnosoma pupae collected from carcasses of cattle that had died of naturally contracted lamsiekte. One heifer was drenched twice and another one three times. Five of the drenched animals contracted a disease; and three of these died, one was killed *in extremis*, and one recovered. The disease appeared some days after drenching. In the cases that ended fatally, the disease appeared 3, 4, 6, and 9 days after drenching respectively. In the case of the cow that recovered, the incubation period lasted 17 days (3318). The course of the disease was very rapid in the case of heifer 3653, viz., less than 24 hours; in the case of two heifers it lasted for about two days (3722 and 3654); in one heifer it lasted for eight days (3642); and in a cow for eleven days (3318). The latter animal recovered. One heifer (3654) which was drenched twice had an attack after each drenching; she succumbed to the second.

It is interesting to note that the two animals that showed the longest incubation periods also showed the longest course of the disease. The symptoms noted were those of a paresis of the locomotor system, and as such can be placed on a par with the symptoms observed in naturally contracted cases of lamsiekte. It would appear that not all pycnosoma pupae were toxic or that not all cattle were susceptible to the toxin. Probably both interpretations hold. As little as  $\frac{1}{2}$  oz. of pupae did prove to be toxic. In one

instance 7 oz. given to a heifer did not prove to be toxic, but later she (3470) succumbed to 4½ oz. of pupae of different origin. Out of five animals that had received 3-4 oz. of pupae, four contracted the disease. The disease produced by drenching of pupae was similar in symptoms to that known as lamsiekte; hence the conclusion that toxæmia (tentatively used for the purpose of diagnosis) is identical to lamsiekte.

**EXPERIMENT NO. 2.—DRENCHING OF CATTLE WITH PYCNOSOMA PUPAE REARED ON THE CARCASSES OF ANIMALS THAT HAD DIED (a) OF DISEASES OTHER THAN NATURALLY CONTRACTED LAMSIEKTE AND (b) OF EXPERIMENTALLY PRODUCED TOXAEMIA.**

(a) HEIFER 3640.—Arrived from Bestersput on 20.4.17 and was stabled since 29.9.17. She had been used in a drenching experiment with empty pupae shells on 17.11.18 with negative results.

*Treatment:* On 29.11.18 she was drenched with 4½ oz. crushed pupae collected from the carcass of heifer 3653 (an animal that had died of toxæmia on 17.11.18 after drenching with pupae).

*Result:* 1.12.18: The heifer was found in recumbent position and unable to rise, showing profuse salivation. She was killed at noon. During the period of observation the temperature was normal. Two days before dosing (27.11.18) it reached 103.6° F. During the last two days before death it had a tendency to subnormal. The microscopic examination of the blood-smears made on 1.12.18 gave negative results. Diagnosis of disease: Toxæmia (lamsiekte).

**CONCLUSION.**—The disease appeared two days after drenching. It was characterized by a paralysis of the locomotor system. The profuse salivation could be interpreted as a paresis or paralysis of the pharynx. These symptoms, considered together with the absence of fever and the negative result of blood-smear examination, might be identified with those of lamsiekte.

(b) RED HEIFER 3470.—Arrived from Pretoria on 25.8.17 and was stabled since 29.9.17. She had been used in lamsiekte blood transfusion experiments with negative results (11.11.17).

*Previous History:* 13.11.18: Drenched with 7 oz. crushed pupae collected from the carcass of a bovine that had succumbed to naturally contracted lamsiekte.

*Result:* Negative.

*Treatment:* 29.11.18: Drenched with 4½ oz. whole pupae collected from carcass of heifer 3653 that had died of toxæmia on 17.11.18 after drenching with whole pupae.

*Result:* 2.12.18: The heifer lay down frequently and was disinclined to rise. She showed a stiff walk in front. 3.12.18: The heifer was down in the afternoon and unable to rise. 5.12.18: She died during the night. During the period of observation the temperature was normal, with a tendency to subnormal during the last few days. Microscopical examination of blood showed that the blood was negative on 5.12.18. Diagnosis: Toxæmia (lamsiekte).

**CONCLUSION.**—This animal had resisted the dosing of pupae from the carcass of an animal that had died of naturally contracted lamsiekte. Three days after the dosing with pupae from a carcass of an animal that had died of toxæmia, the disease appeared. The animal lay down frequently during the initial stages of the disease, but finally

was unable to rise (paralysis). The disease lasted for three days. These symptoms, including the absence of fever and the negative blood examination, are noted in acute lamsiekte.

(c) **WHITE AND BLACK HEIFER 3909.**—Born at Armoedsvlakte on 26.12.16 and stabled since 23.11.18. She was used in an experiment for blood transfusion (from an animal suffering from naturally contracted lamsiekte) on 2.12.18, with negative results.

*Treatment:* 15.1.19: Drenched with 1 oz. pycnosoma pupae from carcass of heifer 4232 (an animal that had died on 31.12.18 of malignant oedema).

*Result:* Negative.

The temperature was normal during the time of observation.

**CONCLUSION.**—One oz. of pupae collected from the carcass of an animal that had died of a disease other than lamsiekte did not produce the disease.

(d) **RED HEIFER 4100.**—Born at Armoedsvlakte on 6.12.17. Kraaled since 8.1.19.

*Treatment:* 15.1.19: Drenched with  $\frac{1}{2}$  oz. pycnosoma pupae from carcass of heifer 2894 (an animal that had died on 1.1.19 of toxæmia after drenching with pupae).

*Result:* 19.1.19: The heifer went down suddenly in the afternoon and was unable to rise. She made frequent attempts to do so and even when assisted on to her feet she was unable to remain in the standing position. 20.1.19: The heifer was much weaker to-day and was unable to maintain herself in the sternal position without support. Salivation was profuse and paralysis of the jaw and tongue was marked. The heifer groaned a good deal in the afternoon. She was killed. Microscopical examination of blood on 20.1.19 proved that the blood was negative. The temperature was normal during the period of observation and on the last day was subnormal.

*Diagnosis:* Toxæmia (lamsiekte).

**CONCLUSION.**—The disease appeared four days after drenching and was characterized by paralysis of the locomotor muscles and subsequently of the tongue and jaw. The animal was killed after an illness of one day. The symptoms described, including a normal and subnormal temperature and the negative blood examination, are those of an acute case of lamsiekte.

**RÉSUMÉ OF CONCLUSIONS.**—Three bovines were drenched with pupae collected from carcasses of two different animals that had died of toxæmia subsequent to drenching with pupae collected from carcasses of animals dead from experimental toxæmia. The minimal quantity given which proved fatal was half an ounce. The disease appeared after two days in the animals that had received the large dose ( $4\frac{1}{2}$  oz.), and after four days in the animal that had been dosed with half an ounce. Two of the sick animals were killed *in extremis*. The disease lasted for three days in the animal in which it was allowed to take its course. The symptoms were those of acute lamsiekte. In the case of one bovine drenched with pupae from a carcass of an animal that had died of malignant oedema, the material did not prove to be toxic. In this experiment only the carcass of animals that had died of toxæmia proved to be toxic. This must be considered to be a mere coincidence, since negative results were also

noted in the previous experiments. This fact has already been interpreted that not all carcasses were toxic or that not all the animals drenched were susceptible to the quantity given. One of the animals (3470) that in a former experiment had resisted a large quantity of pupae (7 oz.) succumbed to  $4\frac{1}{2}$  oz. in this experiment. This one observation speaks for a difference in the toxicity of different carcasses.

**EXPERIMENT NO. 3.—DRENCHING OF CATTLE WITH PYCNOSOMA PUPAE REARED ON CARCASSES OF HEALTHY CATTLE AND GOATS THAT WERE KILLED.**

This experiment should settle the question as to whether the toxicity of the pupae is connected with the carcasses of animals that died of lamsiekte or whether pupae collected from other carcasses have the same effect.

(a) **WHITE AND RED HEIFER 3708.**—At Armoedsvlakte since 15.6.16 and kraaled since 25.1.18.

*Treatment:* 20.12.18: Drenched with 5 oz. whole pycnosoma pupae from carcass of heifer 3627 that had been killed on 6.12.18 on account of an abdominal hernia. The temperature during the time of observation (5 weeks) was somewhat irregular, but rarely exceeded  $103^{\circ}$  F.

*Result:* Negative.

(b) **BLACK AND WHITE COW 2894.**—Since 21.2.17 at Armoedsvlakte and stabled since 24.4.18. She had been used in a previous experiment (27.11.18, muscle injection) with negative result.

*Treatment:* 20.12.18: Drenched with 5 oz. pupae of carcass of heifer 3627 killed on 6.12.18 on account of an abdominal hernia.

*Result:* 28.12.18: At 5 p.m. when taken out of the stable the heifer was noticed to walk slowly. 29.12.18, 7 a.m.: She was unable to rise. 30.12.18, 7 a.m.: The heifer was found lying on ground stretched out. 1.1.19: The heifer died. Microscopical examination showed that the blood was negative on 1.1.19.

*Diagnosis of Disease:* Toxaemia (lamsiekte).

**CONCLUSION.**—The disease commenced eight days after drenching and was characterized by a paralysis of the locomotor system lasting for four days, symptoms which corresponded with those of lamsiekte.

(c) **RED HEIFER 4316.**—Arrived from Pretoria on the 5.12.18 and was stabled immediately.

*Treatment:* On 20.12.18, drenched with 5 oz. fresh pycnosoma pupae from carcass of heifer 3627 (an animal that had been killed on 6.12.18 on account of an abdominal hernia).

*Result:* 25.12.18 at 5 p.m.: The heifer was unable to rise; at 9 p.m. she was found stretched out on one side. The respiration was somewhat laboured. Profuse salivation was noted. 26.12.18: The heifer died. The temperature during the time of observation was normal with one exacerbation to  $104^{\circ}$  F. on the second day after drenching. Microscopical examination showed that the blood was negative on the 26.12.18.

*Diagnosis of Disease:* Toxaemia (lamsiekte).

**CONCLUSION.**—The disease appeared five days after drenching and had a very rapid course, lasting for about 24 hours with paralysis of the locomotor system and of the pharynx, symptoms that are found in acute lamsiekte.

(d) RED AND WHITE COW 2571.—Arrived at Armoedsvlakte from Pretoria on 25.8.16 and was stabled since 27.11.18. She had been used in a previous experiment on 27.11.18 with negative results.

*Treatment:* 23.12.18: Drenched with 5 oz. whole pycnosoma pupae from the carcass of a goat, 12274 (an animal that had died on the 10.12.18 from cachexia). The temperature, although somewhat irregular in its curve, kept within normal limits during the time of observation (five weeks).

*Result:* Negative.

RÉSUMÉ OF RESULTS.—Three bovines were drenched with pupae collected from the carcass of a heifer that had been slaughtered. Two of the bovines contracted toxæmia (lamsiekte) and died. Since the larvae were toxic for two animals and not toxic for one, it must be concluded that the latter animal most likely had a tolerance for the toxin. The pupae collected from the goat did not produce disease. The pupae that gave rise to the disease originated from the carcass of an animal that had no previous history of lamsiekte. The disease lamsiekte as a determining factor for the toxicity of a carcass has therefore to be ruled out. It is of interest to note that toxæmia appeared after the lapse of five and eight days after drenching and lasted for from one to four days respectively. The longer incubation period was followed by a longer duration of the disease.

EXPERIMENT NO. 4.—DRENCHING OF CATTLE WITH EMPTY SHELLS OF PYCNOSOMA PUPAE THAT HAD BEEN REARED ON CARCASSES OF CATTLE THAT HAD DIED OF LAMSIEKTE. THE OBJECT WAS TO ASCERTAIN WHETHER TOXAEMIA COULD BE PRODUCED BY THE INGESTION OF SHELLS ALONE.

(a) RED HEIFER 3640.—Arrived from Bestersput on the 20.4.17 and had been stabled since 29.9.17.

*Treatment:* On 17.11.18: Drenched with 7 oz. empty shells of pycnosoma pupae, collected from carcasses of cattle that died of naturally contracted lamsiekte.

*Result:* Negative.

NOTE.—The heifer was subsequently used and died in an experiment with pupae collected from a carcass of an animal that had died of toxæmia (*vide* Experiment No. 2a).

(b) RED HEIFER (WITH SMALL STAR) 3397.—Arrived from Pretoria on the 5.9.15 and had been stabled since 25.2.18. She had been used on the 22.11.18 in a transfusion experiment of lamsiekte blood, with negative results.

*Treatment:* 9.1.19: Drenched with  $\frac{1}{2}$  oz. empty shells of pycnosoma pupae collected from the carcass of heifer 2439 (an animal that had died of naturally contracted acute lamsiekte on 21.12.18).

*Result:* Negative.

CONCLUSION.—The empty shells of moulted pycnosoma pupae collected from the carcasses of animals that had died of lamsiekte did not produce toxæmia. It would thus appear that toxic substance is contained in the body of the pupae within the shell.



**EXPERIMENT NO. 5.—DRENCHING CATTLE WITH EMPTY SHELLS OF PYCNOSOMA PUPAE REARED ON CARCASSES OF (a) A GOAT THAT HAD DIED OF CACHEXIA AND (b) A HEIFER THAT HAD DIED OF EXPERIMENTALLY PRODUCED TOXAEMIA.**

(a) **RED HEIFER 4170.**—Arrived from Pretoria on 10.1.19 and was stabled on the same day.

*Treatment:* Drenched on 12.1.19 with 1 oz. empty dry shells of pycnosoma pupae, collected from the carcass of goat 12274 (an animal that had died on 10.12.18 of cachexia). The temperature was normal and regular during the time of observation (five weeks).

*Result:* Negative.

(b) **RED AND WHITE HEIFER 4298.**—Arrived from Pretoria on the 5.12.18 and kraaled since 9.1.19. On 5.12.18 she had been used in an infusion experiment of lamsiekte blood with negative results.

*Treatment:* 14.1.19: Drenched with 9 oz. empty crushed shells of dry and old pycnosoma pupae from the carcass of heifer 3348. The temperature was normal during the time of observation.

*Result:* Negative.

**CONCLUSION.**—Empty and dry pycnosoma pupae shells from the carcass of a goat and of a heifer did not produce toxaemia after drenching. The toxic substance therefore must be contained in the body of the pupae within the shell.

**EXPERIMENT NO. 6.—DRENCHING OF CATTLE WITH PUPAE OF THE HOUSE-FLY REARED ON CARCASSES OF ANIMALS THAT HAD DIED OF (a) A DISEASE OTHER THAN NATURALLY CONTRACTED LAMSIEKTE AND (b) OF EXPERIMENTALLY PRODUCED TOXAEMIA.**

The object was to note whether the pupae of flies other than pycnosoma would prove to be toxic, house-fly pupae being sometimes found fairly frequently about the carcass, particularly in the ruminal contents.

(a) **BLACK COW 2361.**—Arrived at Armoedsvlakte on the 21.3.17 and stabled since 3.4.18. She had previously been used on the 1.12.18 and 7.12.18 in muscle injection experiments with negative results.

*Treatment:* 13.1.19: Drenched with 5 oz. house-fly pupae from carcass of heifer 2894 (an animal that had died of toxaemia on 1.1.19 after having been drenched with pycnosoma pupae). The temperature during the time of observation remained normal.

*Result:* Negative.

(b) **RED HEIFER 4229.**—Arrived from Pretoria on 5.12.18 and stabled since that date.

*Treatment:* 13.1.19: Drenched with 3 oz. house-fly pupae collected from carcass of heifer 4232 (an animal that had died on 31.12.18 from malignant oedema after injection of muscle emulsion). The temperature during the time of observation had been normal.

*Result:* Negative.

(c) **RED HEIFER 4528.**—Arrived from Armoedsvlakte from Pretoria on 23.1.19 and kraaled since that date.

*Treatment:* 12.3.19: Drenched with 8 oz. of house-fly pupae found in the stomach contents of carcass of cow 3003 (an animal that died of naturally contracted lamsiekte on 19.2.19). The pupae were washed before drenching.

*Result:* Negative.

CONCLUSION.—In three instances pupae of the house-fly collected from the carcasses of cattle did not cause toxæmia.

GENERAL CONCLUSIONS FROM THE DRENCHING EXPERIMENTS WITH DIPTERA PUPAE COLLECTED FROM THE CARCASSES OF CATTLE.

*Pycnosoma* pupae collected from the carcasses of cattle that had died of lamsiekte or had been killed on account of abdominal hernia, or from carcasses of animals that had died of experimental toxæmia, when given to healthy cattle produced a disease which in the first instance was diagnosed as toxæmia, and subsequently proved to be identical to naturally contracted lamsiekte. Eighteen head of cattle had been used for drenching with *pycnosoma* pupae; of these, nine died or were killed *in extremis* and one recovered. The minimal toxic quantity proved to be  $\frac{1}{2}$  oz., but quantities up to 7 oz. did not in all instances prove toxic, hence it was concluded that the carcass material varied in toxicity. On the other hand, two animals dosed with an equal quantity of identical material that had proved to be toxic did not contract the disease, hence it was concluded that different cattle may have different susceptibility to the toxin. The shortest incubation period of the disease was two days, the longest seventeen days, the average six days. In six animals it was shorter; in one, exactly six days; and in four, longer than six days. The duration of the disease in the shortest instance was twelve hours (peracute case); in the longest, eleven days (chronic case). The average was three and a half days. In seven animals it was shorter and in four it was longer. It would appear that the longer the incubation period the longer the disease will last.

The pupae taken from the carcass of an ox that died of malignant oedema did not prove toxic in the quantity of 1 oz., hence it was concluded that not all pupae of carcasses were toxic. The fact that the pupae that were collected from the carcass of an animal that had been killed produced toxæmia shows clearly that lamsiekte is not a specific factor in the production of toxæmia (lamsiekte). The empty shells of *pycnosoma* pupae did not prove toxic. Pupae of the horse-fly collected from three carcasses gave no results in quantities of 3 to 8 oz. This may be explained by the fact that the larvae of horse-fly pupae do not feed on putrid flesh, and hence the pupae do not become toxic.

EXPERIMENT NO. 7.—DRENCHING OF CATTLE WITH LARVAE OF *PYCNOSOMA* REARED ON CARCASSES OF ANIMALS THAT HAD DIED (a) OF A DISEASE OTHER THAN NATURALLY CONTRACTED LAMSIEKTE AND (b) EXPERIMENTALLY PRODUCED TOXAEMIA.

Since the substance that produced toxæmia was present in the pupae it had to be concluded that it would also be found in the larvae.

(a) ROAN TOLLIE (WITH STAR) 3827.—At Armoedsvlakte since 25.1.17, kraaled since 14.12.18, and stabled since 9.1.19.

*Treatment*: 9.1.19: Drenched with 3 oz. active full-grown larvae (unwashed) from carcass of a black cow 2894 (an animal which had died on 1.1.19 of toxæmia after drenching with pupae obtained from the carcass of a healthy animal).

*Result*: 13.1.19: At midday the tollie was noticed to be uneasy, moving the jaws, and salivating. In the afternoon muscular weakness set in, the animal being unable to rise without assistance.

When helped on to its feet, it could walk for some distance, the gait, however, was rather wobbly and stiff in front. After remaining on its feet for a few minutes, the tollie again went down and was then unable to rise. Paralysis of the tongue and jaw muscles was marked. Towards the evening the weakness increased, and the animal died during the night. The temperature during the period of observation was normal.

*Diagnosis of Disease:* Toxaemia (lamsiekte).

CONCLUSION.—The tollie sickened four days after drenching. The disease was of a peracute nature, lasting for less than twenty-four hours. Paralysis of the locomotor system, of the tongue, and of the jaw was present. These symptoms could be interpreted as being those of an acute case of lamsiekte. It was possible that the unwashed larvae still contained toxic substances from the carcass adhering to their surface.

(b) DARK RED TOLLIE (BLAZE) 3846.—At Armoedsvlakte since 6.12.17 and kraaled since 14.12.18.

*Treatment:* 9.1.19: Drenched with 3 oz. of active fully-grown larvae (washed) from carcass of cow 2894 (an animal which had died on the 1.1.19 of toxaemia after drenching with pupae collected from the carcass of a healthy animal).

*Result:* 13.1.19: The tollie was found dead in the morning. Nothing abnormal was noted the day before. The microscopical examination showed that the blood was negative on 13.1.19.

*Diagnosis:* Toxaemia (lamsiekte).

CONCLUSION.—Death occurred without the tollie showing any previous symptoms (peracute lamsiekte). Such sudden deaths, in which the blood shows no abnormalities, are known in cases of naturally contracted peracute lamsiekte.

(c) RED HEIFER 3995.—Born at Armoedsvlakte on the 28.3.17, and kraaled since 14.12.18.

*Treatment:* 9.1.19: Drenched with 3 oz. of active full-grown larvae from carcass of heifer 4232 (an animal that had died on the 31.12.18 of malignant oedema).

*Result:* Negative.

(d) BLACK AND WHITE TOLLIE 3997.—Born at Armoedsvlakte on the 9.5.17, and kraaled since 14.12.18.

*Treatment:* 15.1.19: Drenched with 10 oz. of larvae from the carcass of heifer 3869 [an animal that had died of toxaemia on the 12.1.19 caused by drenching with putrid bones taken from an animal that had died of naturally contracted lamsiekte (*vide* Expt. 12a)].

*Result:* 17.1.19: Noticed ill in the morning, salivating, and lying down frequently. At 9 a.m. the animal was assisted on to its feet, when it could walk a short distance. Muscular weakness became very marked subsequently, and the animal died in the afternoon. The temperature on the day of drenching was 104.4° F., but it was normal for the rest of the observation. Microscopical examination of the blood-smear showed that the blood was negative on 17.1.19.

*Diagnosis of the Disease:* Toxaemia (lamsiekte).

**CONCLUSION.**—The disease appeared two days after drenching, was very rapid in its course, characterized by great muscular weakness, and salivation. These symptoms are found in peracute cases of lamsiekte naturally contracted.

(e) **WHITE AND RED HEIFER 3996.**—Born at Armoedsvlakte on the 27.4.17. She had been used on the 4.1.19 in the experiment called alternate grazing and feeding experiment Lot "A."

*Treatment:* 18.1.19: Drenched with 1 oz. pycnosoma larvae from carcass of heifer 4217 (an animal that had died on the 16.1.19 of toxæmia after drenching with larvae from the carcass of the slaughtered healthy ox 2458).

*Result:* 22.1.19: The previous night the heifer appeared to be slightly uneasy, the coat was staring. This morning she was found down most of the time. When walking, the gait was stiff, resembling that of lamsiekte. The heifer again went down in the afternoon, and was subsequently unable to rise. Dribbling of saliva became quite marked. 23.1.19: The heifer was unable to rise. She was weak and had to be supported in the sternal position. Slight foaming at the mouth was noted. 24.1.19: She died at 5 p.m. The temperature during the time of observation was normal. The microscopical examination of the blood gave negative results.

*Diagnosis of Disease:* Toxæmia.

**CONCLUSION.**—The disease appeared three days after drenching and lasted for two days. The gait resembled that of an animal suffering from lamsiekte. The course of the disease and the symptoms were typical of naturally contracted lamsiekte.

(f) **RED HEIFER 4094.**—Born at Armoedsvlakte on the 27.11.17. Kraaled since 14.12.18.

*Treatment:* 24.1.19: Drenched  $\frac{1}{2}$  oz. full-grown blow-fly larvae (unwashed) from carcass of heifer 4217 (an animal that died on 16.1.19 of toxæmia after drenching three days previously with blow-fly larvae from a carcass of slaughtered healthy ox 2458).

*Result:* 26.1.19: The heifer was noted to be ill this afternoon, with a stiff gait. She was down most of the time and had some difficulty in rising. At 4 p.m. she was unable to rise and lying in sternal position. The temperature during the period of observation was normal. The microscopical examination of the blood gave negative results. The heifer died on 27.1.19.

*Diagnosis of the Disease:* Toxæmia (lamsiekte).

**CONCLUSION.**—The disease appeared two days after drenching, and showed itself in a stiff gait and subsequent paralysis of the locomotor organs, lasting for about one day. These symptoms were interpreted as those of acute lamsiekte.

(g) **RED COW 4182.**—Arrived from Grahamstown on the 10.5.18, and had been running in the veld since arrival.

*Treatment:* 23.4.19: Drenched with 8 oz. crushed mature blow-fly larvae from carcass of ox 2519 (an animal that had died on 9.4.19 of internal hæmorrhage).

*Result:* 26.4.19: The cow was down and apparently unable to rise this morning. She looked very ill. The ears were slightly drooping. There was a slight dribbling of saliva from the mouth and a collection of it was on the ground. The cow did not feed, she had already refused to feed the previous evening. She remained

in sternocostal position all day long, and in the afternoon was found with the head doubled back on one side. 27.4.19: The cow was found dead in the morning.

*Diagnosis of the Disease:* Toxaemia (lamsiekte).

**CONCLUSION.**—The cow developed the disease three days after drenching. It lasted for one day. The symptoms were those of acute lamsiekte.

**RÉSUMÉ OF OBSERVATIONS.**—Of the seven bovines that were drenched with pycnosoma larvae, six died of toxaemia (lamsiekte). The quantities given were  $\frac{1}{2}$  oz. in one case, 1 oz. in another, 3 oz. in three cases, 8 oz. in one, and 10 oz. in one case. The heifer (3995) which did not contract the disease had been drenched with larvae from the carcass of an ox that had died of malignant oedema (4232). The pupae collected from the same ox and used in the previous experiment also gave negative results, but muscle material from the same ox (*vide* Expt. 11a) given on the same date proved toxic, hence indicating that pupae and larvae from a toxic carcass need not of necessity prove to be toxic. Of the six positive results the larvae had been collected in one instance (3997) from the carcass of an animal that died of toxaemia subsequent to drenching with putrid bones of an animal that had died of naturally contracted lamsiekte. In two cases (3996, 4094) the larvae originated from the carcasses of animals that had died from toxaemia after drenching with larvae from a carcass of a slaughtered healthy ox. In two cases the larvae were collected from the carcass of an ox that had been killed on account of an abdominal hernia and of a carcass of an ox that had died of internal hæmorrhage, respectively. In these five cases the factor of naturally contracted lamsiekte was thus entirely excluded, and the experiment proved that the toxicity of a carcass is not connected with the disease lamsiekte. The experimentally produced toxaemia appeared after a lapse of two to four days and was very rapid in its course, ending in one instance (in 3846) almost with sudden death (peracute case); in other instances it lasted for from half to one day (peracute and acute), and only in one instance for two days (3996) (acute). This heifer had received only 1 oz. In another instance larvae of the same origin in the quantity of  $\frac{1}{2}$  oz. produced fatal results after about twenty-four hours duration of disease. It would thus appear that the severity of the disease is not always connected with the quantity of toxic substance supplied, but with the degree of toxicity of the carcass material. The symptoms that were observed in the toxaemia were interpreted as those of lamsiekte and corresponded with the acute and peracute cases of this disease.

#### EXPERIMENT NO. 8.—DRENCHING OF CATTLE WITH PYCNOSOMA LARVAE REARED ON CARCASSES OF HEALTHY ANIMALS.

The object was the same as in the previous experiment.

(a) **RED HEIFER 4217.**—Arrived from Pretoria 5.12.18 and was stabled on the same date. She had been used in a previous (muscle injection) experiment on the 5.12.18, with negative results.

*Treatment:* 13.1.19: Drenched with 8 oz. larvae (96 hours old) from the carcass of ox 2458 (a healthy animal that was slaughtered on the 9.1.19).

*Result:* 16.1.19: The heifer was found lying down and unable to rise, she was already *in extremis* and died soon after. The