

One pigeon was forcibly fed with putrid material and a second one with pycnosoma pupae. Both died. The feeding was undertaken on two different dates, and both birds took ill the day after the second feeding. One pigeon, when noted ill, showed clonic spasms of head and neck, which were continually shaken. The bird had some difficulty to maintain its balance when walking, and was unable to fly. In the course of the next day, the bird was noted to droop the wings. These conditions remained the same for the next few days. It died after four days' illness. This then would represent a subacute case. The second bird when found ill showed slightly drooping wings and was unable to fly. It died the same afternoon. This would represent an acute case. The third bird sickened seven days after the second feeding of putrid material. The illness was only a short one, lasting one day, and the bird recovered.

#### T.—DISCUSSION OF THE SYMPTOMS NOTED IN BIRDS.

Ostriches, ducks, and pigeons had proved to be susceptible to the toxin found in carcass material. The symptoms in all three species of birds showed themselves in more or less an identical manner, mainly paralysis of the locomotor system. In this respect they could be identified with those noted in ruminants and equines.

Naturally contracted lamsiekte did occur in ostriches and ducks, seeing that both were known to eat carrion as well as bones, in the case of the ostrich. Symptoms resembling those described were recorded, hence we might conclude that these symptoms noted under natural conditions were those of lamsiekte, as noted in cattle.

#### THE PATHOLOGY AND PATHOGENESIS OF LAMSIEKTE.

##### THE PATHOLOGY OF PERACUTE AND ACUTE LAMSIEKTE.

The majority of lamsiekte cases observed by us must be placed under the headings of "peracute and acute lamsiekte." The reason was that most cases were experimentally produced by direct application of the toxic substances, either per os (drenching of putrid material) or parenterally (by subcutaneous injections of cadaver débris, culture, and toxin).

There was, however, also a number of animals that contracted the disease in the natural way by eating putrid bones supplied to them in troughs or scattered on the ground in a paddock, and there were some animals that contracted it naturally without any experimental interference (naturally contracted cases).

The distinction between peracute and acute lamsiekte from a pathological anatomical point of view was of no advantage, both groups showing practically the same lesions. The distinction, although clinically accepted, was an arbitrary one. Even a distinction of subacute cases was not entirely justified, since the lesions in this type were not at all well marked.

The cadavers that formed the subject of the post-mortem examinations belonged to animals of both sexes. Different ages were also represented. For the experimental production of lamsiekte by means of drenching and injections, naturally a cheaper and usually poorer class of tollies and heifers were used, whilst for the bone-feeding experiments the usual farm cattle were selected, mostly cows and

heifers, being cattle that had previously shown craving for bones. These were all in fair and good condition. Amongst the naturally contracted cases there was only one in which the animal was in poor condition. The autopsies were usually carried out within a few hours after death, in many cases immediately or soon after death; the longest interim that elapsed was rarely over fifteen hours, and in cases of animals that died late in the day, too late to be examined the same evening, the examinations were held as early as possible on the following morning. An autopsy was rarely made after a longer interval.

Rigor mortis was present in most cases, but absent in those animals that were submitted to the examination directly after death. It was also absent or not complete in post-mortems made up to two hours after death. It was present after an interim of three to eight hours. In cases of eight hours' interval it was noted to pass off, being only present in the hind legs. In the cases in which the animals died during the night it was found to be present in some, passing or absent in others. There was no difference noted in cadavers of animals that were rendered ill artificially or that had contracted the disease naturally.

*The integument* in most cases was intact. Only in one case were there fresh erosions of the skin that could be considered to be of traumatic origin. They were noted on shoulder and legs. Loss of hair was occasionally recorded, and was the result of lice infestation in the poorer conditioned animals.

*The abdomen* in most cases was found to be relaxed or only slightly distended. In only a few cases that came up for post-mortem examination within the first few hours was it slightly distended. Even in animals that died during the night, and in which the rigor had passed off it was not conspicuously distended. More or less pronounced post-mortem changes were, however, noted in a number of cadavers, and these were usually those in which also the abdomen was more or less distended.

*The visible mucous membranes* (eyes, mouth, anus, and vulva) showed no changes in most cases. Increased pallor was noted in a few; it was connected with the poor condition the animals were in previous to the lamsiekte and which was produced by other causes. In some instances it was a sequel to a previous infection of babesiosis or anaplasmosis, which the animals had contracted before arriving in Armoedsvlakte, and from which they had not yet completely recovered. The mouth was usually found closed. In a number of cases it was open. In some of these the tongue was either between the lips or slightly protruding or hanging out conspicuously.

*The nostrils* in most cases showed no changes. Only in one case (bone-feeding experiment) was escape of ingesta through the nostrils recorded. It occurred in an animal that was examined two hours after death, and in which rigor had not set in. In another case (naturally contracted case) some blood was found in the nostrils. In the cases in which the nasal cavity was examined it was found that the mucosa of the septum and the turbinated bones was deeply injected and bluish. The anus was found to be closed. In a peracute case it was slightly turned out; in this instance the abdomen was distended. In another case of an animal in poor condition it was found open and faeces escaped.

The *oral cavity* in a few cases showed the presence of food, in the shape of a bolus, usually situated at the root of the tongue.

The *blood in the axillary vein* was well coagulated in the majority of cases. The cases in which it was not coagulated were submitted to autopsy soon after death. The blood was not completely coagulated in some cases that were submitted as late as two hours after death, and in one case even four hours after death. The latter case was a peracute one. Generally the blood stained well. In a few instances of poor animals it stained badly. In a case of far advanced decomposition the blood was laked. The *subcutaneous tissue* of a number of animals showed changes that could not be connected with the disease. The principal one was the presence of watery gelatinous infiltration of the fatty tissues; this obviously represented an atrophic condition of the latter, and was found in the animals of poor condition. In some of the animals that had previously, and more so in those that had recently been submitted to subcutaneous injections of putrid substances and cultures, foci of connective tissue formation (granulation tissue, cicatrix) or abscesses and some necrotic foci were observed, sometimes surrounded by oedematous infiltration, hyperaemia, and blood extravasations in the adjacent tissue. In one such case emphysema was also present. In this case the dissolution of the blood was particularly noticeable.

The colour of the *flesh* was found to vary in the different animals. It was described as pale in a number of animals and dark in only a few, showing no changes in the majority. The poor-conditioned animals showed either pale or dark flesh; it was normal in the good-conditioned ones. It was discoloured in some of advanced decomposition, being of a diffuse reddish colouration. The superficial lymph-nodes (the subparotids, retropharyngeal, upper and lower cervicals) were examined in most cases, and various observations were made. There was, however, no regularity in these observations. Frequently the glands were found to be enlarged. Rarely did the enlargement affect all the glands, in most cases only one or more groups being affected. The enlargement was sometimes due to an oedematous infiltration; the glands were unusually moist and soft, so much so that on section liquid escaped. In other cases they were rich in blood, red to dark red, and sometimes embedded in watery connective tissue. In quite a number of cases, and certainly in the majority that showed swollen glands, those of the head, particularly the retropharyngeals, were so affected; they were often described as being hæmorrhagic. The submandibulae rarely showed the changes described. Occasionally, however, they were found to be unusually moist. The lower superficial cervicals were more frequently affected. This was not only noted in some of the animals that had been injected subcutaneously, but also in those that had been drenched. Most frequently the glands of only one side were so affected. In some of the drenched animals the retropharyngeals were occasionally found to be hæmorrhagic. In the poor-conditioned animals the lymph glands were almost invariably found embedded in oedematous tissue that had replaced the adipose tissue, and sometimes the glands were conspicuously small (atrophic) at the same time.

The *peritoneal cavity* in the greater number of animals showed no alterations. In some, however, a clear straw-coloured liquid was present. It usually amounted only to a small quantity, and only

in one case, in a poor-conditioned animal, to half a litre. The liquid was discoloured to a reddish colour in only a few cases; the presence of fibrinous flocculi was also rare. The serosa was generally smooth and glistening. In one instance only ecchymoses reaching in size that of a sixpence were recorded. In a few cases the serosa of the small intestines was red. The situs viscerum was always normal. In a number of instances, however, there were alterations of a chronic nature, such as attachment to the diaphragm by means of fibrous adhesions or ligaments of the rumen and reticulum or the abomassum or omentum. In one case, after severing the fibrous growth, abscesses were opened and a thickish pus escaped.

Occasionally the rumen, and in a number of cases also the intestines, were noted to contain gas. These were the cases which showed a distended abdomen.

*The diaphragm* in all cases was recorded in normal position with forward convexity. It sometimes showed fibrous adhesions connecting it with the neighbouring organs.

*The larynx*, in the greater number of cases, showed no changes; when these were present, they were insignificant, and consisted of the presence of froth and an occasional injection of the mucosa.

*The cervical trachea* was frequently found to contain froth; occasionally the froth was copious. There were also ingesta present in a few instances. Ecchymoses and injection of the mucosa, as well as diffuse reddening, were noted in several instances. Ingesta and froth were sometimes present in the same animal. Ecchymoses were noted in the absence as well as in the presence of ingesta.

*The thyroideae* in all cases in which a description was recorded showed very little alterations. It varied in colour from light-brown to dark-brown.

In the greater number of cases the *pharynx* showed no changes. In some instances the mucosa was purple or bluish. The presence of mucus was also recorded. Food in the form of a bolus was occasionally found. In one instance a small ulcer in the wall of the pharynx was described.

*The oesophagus* was usually normal. In some animals the mucosa of the proximal portion was discoloured to a bluish coloration. The presence of loose ingesta was also recorded, and in one animal a bone was found.

*The salivary glands* generally showed a normal appearance. In some animals, however, the parotid was found to be harder than usual. It was also noted that the gland on one side was harder than that on the opposite side. The increased hardness was particularly noticeable on cutting. No changes concerning submaxillary glands were registered, except that they, as well as the parotid, were found embedded in a gelatinous tissue in some animals.

*The lungs* were usually retracted and in the expiratory stage, and more or less deflated. Sometimes they were found in an inspiratory stage, but it was never well marked. Only in a few cases were the lungs not completely retracted, remaining partially attached to the costal pleura. In these cases the presence of a localized fibrinous pleuritis and pneumonia could be diagnosed. Only in one case was the attachment due to fibrous adhesions. Occasionally a tuft-like, low, granular tissue was found in the inter-costal spaces. The nature of these was not quite clear. It was also found in animals

that had succumbed to other diseases. The consistence of the entire lung was in most cases elastic, except in those that showed pneumonic foci in either the apical or cardiac lobes, and in these cases a pleuritis was also recorded.

The pulmonary pleura, with the exception of the pleuritic changes already mentioned, was smooth, glistening, and transparent. Sometimes blood-spots were found under the pleura. The lung-tissue was generally of a pink colour, which also varied from red to dark red, according to the amount of blood present; this in cases of hypostasis was sometimes quite considerable. Fibrous thickening of the pleura of old standing was also found. On section a certain amount of moisture could be traced in most lungs. When the cut surface was scraped or a slight pressure was exerted on the lung, more or less froth was found in the bronchi; this rarely amounted to a considerable quantity. In such cases froth was also noted in the trachea. The mucosa of the bronchi was usually normal. Ingesta were also seen in some cases. Injection of the vessels, ecchymoses and diffuse red discoloration was seen. This was noticed in bronchi that contained ingesta.

The pulmonary arteries and veins were found to be empty in a number of cases that were examined soon after death; in all cases the intima was found smooth, and in some cases in which post-mortem changes were marked, it was stained diffusely red. In the few cases, in which consolidation of parts of the lungs was found, this was either due to a bronchopneumonia, in which both red and grey hepatisation were present, or to the presence of necrotic foci. Most likely the pneumonia was of traumatic origin, and probably connected with paresis and paralysis of the pharynx and oesophagus.

The *mediastinal and bronchial glands* were sometimes slightly enlarged and moist; they were also found full of blood. Sometimes they were embedded in tissue of jelly-like consistence. This was the case in poor-conditioned animals.

The *thymus* in a few cases was found to be enlarged and studded with numerous ecchymoses.

The *pericardium* showed a certain amount of liquid practically in every case. The quantity was small, amounting from 10 to 100 c.c. In only a few cases more liquid was present. The maximum quantities found in two cases were 300 c.c. and 500 c.c. respectively; both these animals were in good condition. The liquid was usually clear and straw coloured; in some cases where post-mortem changes were present, it was stained reddish. Occasionally a fibrinous flocculus was found.

The parietal serosa was smooth and glistening. It was of a reddish discoloration in cases of post-mortem changes. In only one instance was it attached to the epicardium.

The *heart* showed no changes in size or shape. In all cases the right ventricle was found in partial or complete diastole, the left ventricle in systole. Where the cadaver was submitted to examination soon after death, both ventricles were found empty, the right one more or less dilated. Only rarely a little blood was found in the left ventricle. When the autopsy was made at a later period, and the blood had had time to coagulate, the clots found in the ventricles and atrium were well formed and fairly firm. Blood undergoing dissolution was found in cases of far advanced post-mortem changes.

The *epicardium* in good-conditioned animals showed the presence of normal fat, in greater or lesser amount, at the base and along the coronary grooves. This depended upon the state of nutrition the animal was in at the time. In a number of cases the fat was replaced by jelly-like substances. This was in the case of poor animals

Petechiae and ecchymoses were found in the greater number of animals; they were in and under the epicardium. They were found at the base of the heart, along the circular as well as the longitudinal coronary grooves. They were also found scattered over the sides, sometimes on one side only, sometimes on both sides, either evenly distributed, or more were found on one side than on the other. Sometimes the extravasations formed small red areas. In one instance a whole auricle was involved in such an extravasation in which 300 c.c. and 500 c.c., respectively, of liquid was found in the pericardium. In these cases numerous ecchymoses were present. The colour of the epicardium varied in intensity from light reddish-brown to dark brownish-red. In some cases there was a diffuse reddish discoloration, others showed red patches. These were the cases of late autopsies. Generally it was smooth and glistening. There were two exceptions to this, however, one in which it was partly enveloped by a fibrous membrane and another in which small tufts of a fine granular tissue were noted on the conus arteriosus. In two instances the lymph vessels were conspicuously prominent and filled with clear lymph. Both were poor-conditioned animals. Blood extravasations were also found under the endocardiums. Only a small number of animals were so affected, however. It was practically always the left endocardium that showed either petechiae, ecchymoses, blood-streaks, or more or less diffuse patches. They were in some cases both in the septum and in the walls; in other cases they were only in the septum, or only in the walls, and then preferably in the papillary muscles. Ecchymoses were also found in the conus arteriosus and in the atrioventricular valves. All the cases that showed ecchymoses under the endocardium did not show them under the epicardium, but in many cases both went together.

Diffuse discoloration of the right endocardium was found in some animals that had already undergone post-mortem changes. In one instance a shrivelled condition of the endocardium near the apex of the left ventricle and of the atrium was noted. It was in a poor-conditioned animal. This condition was not clearly understood.

The *myocardium* in the greater number of cases was firm and transparent. Its colour varied from pale reddish brown to dark reddish brown. The consistence was firm. Opacity and muddy discoloration were noted in cases undergoing decomposition; here the presence of moisture and also a somewhat soft consistence were recorded. In a few cases the presence of *cysticercus inermis* was recorded; in one or two cases small white fibrous streaks and patches (*cicatrix*) were seen.

No alterations were found in the *vasa cordis*, except wine-red discoloration in cases of late autopsies.

The *aorta thoracica* was normal in all cases; not so the *aorta abdominalis*. In a number of instances the intima had a pitted appearance, the pits being arranged in patches or more often in streaks. In this portion the wall was thin. Microscopic examination revealed the presence of lime deposition in the media. A roughened

intima of the vena cava was found in one instance. In cases of advanced decomposition the intima was coloured diffusely wine red.

The *periportal lymph glands* generally showed no changes. In some they were enlarged and moist, sometimes containing watery liquid. This was only exceptionally met with in a good-conditioned animal, being present more often in poor ones.

The *liver* hardly ever showed any appreciable changes in size or shape. When it was enlarged, it was so only to a slight extent, the left border being only slightly rounded. The blood-contents were usually normal. There rarely was a marked increase of blood, in which case, however, the organ had a dark colour. In some of the poor-conditioned animals the liver appeared rather small in size and then showed thin borders. The capsule was transparent, smooth, and glistening in most cases. In a few instances white thickening of the parietal serosa and a few fibrous adhesions were noticed. The parenchyma varied in colour from light reddish brown to dark brown in animals that came fresh to the autopsy. On section it was translucent. The consistence was firm. In cases undergoing decomposition, a clay-like to dark purple discoloration, as well as opacity and softness were noted. In such cases yellow points or patches of irregular shape and different sizes were also noted. Gas bubbles were present in some cases, but these also showed other signs of advanced decomposition.

The *gall-bladder* was never found empty. In rare cases it contained but little bile; usually a fair amount was present and in some cases it was distended with it. The consistence of the bile was mostly liquid, frequently more or less viscid; but sometimes the consistence was stringy, the colour being either green, yellow, brown, or a mixture of these, in all possible shades. Transitions from light green to dark green and bright yellow to brownish yellow were also seen.

The mucosa of the gall-bladder was sometimes discoloured and this was the case in yellow, brown, and dark green biles. In some instances it was slightly swollen and showed ramified injections or diffuse reddening.

The *ductus choledochus* was always found open. In a few instances the bile ducts were found to contain an increased amount of bile. The presence of liver flukes and *stilesia hepatica* was also recorded. In these cases the bile ducts were found to be thickened and even standing out prominently on the surface of the liver and in sections through the organ.

The *pancreas* showed practically no changes in colour or consistence in cases that came fresh to the autopsy. It was moist and reddish where post-mortem changes had appeared.

The *spleen* in the greatest number of cases showed the usual dimensions. The length, in only three cases, reached 50 cm. or surpassed it (55 cm. and 70 cm.). It averaged from 36 to 45 cm. Only in one case, that of a small heifer, it reached a minimum of 24 cm. In the cases of the larger dimensions the animal had undergone putrefactive changes and the pulpa was soft; in the case of the largest dimension, it was attached to the diaphragm and mechanically drawn out to this length. The width of the organ averaged about 12 cm. It was very rarely less; 9 cm. in one case was the minimum. The maximum in one case was 30 cm.. The capsule in most cases

showed no changes; occasionally it was found to be slightly shrivelled, in others it was somewhat tense. The pulpa was mostly of normal consistence; sometimes it was described as dry and in some cases as unusually soft. These were the cases that showed advanced putrefaction. The colour varied from light brown to dark brown in most cases and red in a few. The trabeculae were usually distinct; indistinct in some, where the pulpa was soft. The follicles in some cases were not visible, in others they were indistinct, whilst in others again they were quite distinct and even enlarged. In the majority of cases, however, the follicles were distinct. They were indistinct where the pulpa was unusually soft as a result of putrefaction. A distinct tumor splenis was recorded in one animal, that, from its previous history, appeared to have recovered from an attack of redwater or anaplasmosis. In this case the lesions of anisocytosis were still present in the blood.

The *suprarenal glands* generally showed no abnormality in size; in only a few instances they were described as small. The cortex was usually brown, yellow brown, or yellow; it was also found to be yellow streaked. The brown and yellow colours were present in about equal numbers of autopsies. Good condition was not always accompanied by yellow suprarenal glands, although this was so in the greater number of cases. More frequently a brown suprarenal gland was found in poor-conditioned animals.

The adipose capsule of the *kidney* showed no alterations in good-conditioned animals; in these it contained more or less fat, sometimes even a considerable amount. In poor animals fat was absent and replaced by a watery, jelly-like substance. The capsula fibrosa stripped easily in all but one case, in the latter it was removed with a little difficulty. The surface of the kidney was generally smooth. In the case mentioned above it was uneven and the organ small, indicating a chronic inflammatory condition. In one case the presence of an abnormal growth was recorded, slightly protruding over the surface. It apparently was an organized infarct. In a few instances the surface had a finely reticulated appearance produced by a fine linear meshwork that was probably caused by the distribution of the blood in the cortex. The colour generally varied from brownish red to dark brown. In some cases it was dark red, almost black. The zones were distinct almost without exception. They sometimes showed distinct differences in the intensity of coloration. In some cases the intermediary zone and also the medulla were found to be dark. In kidneys that were rich in blood, the cortex was also of a dark colour. It had a striated appearance at the same time, caused by the injections of the interlobular vessels. In poor animals, the hilus was found to show a gelatinous infiltration; it had a jelly-like appearance. The consistence of the kidney was more often firm than soft. The latter condition was noted in cases of advanced post-mortem changes. The transparency of the tissue was generally good. This applied only to the fresh cases; in older ones it was opaque.

The *rumen* in every case contained the usual coarse ingesta, and in normal quantities. Abnormal contents were registered in a few animals, viz., bones in one animal that had been in a bone-feeding experiment, and also in another animal that had contracted the disease naturally in the veld. The submucosa in a number of cases showed ramified injection of the blood vessels or diffuse reddening after the mucosa had been removed. In some cases this discoloration



could be seen through the mucosa. These changes were principally found at and behind the rumeno-reticular fold. They were only found in animals that had been drenched with putrid material. Peeling off of the mucosa was a sign of post-mortem changes. Amphistomas were found in a number of cases, usually on and behind the rumeno-reticular fold and in the walls of the dorsal sac.

The *reticulum* was found to be empty in a few instances. Usually it contained ingesta. The presence of foreign bodies was quite conspicuous in a number of cases. These foreign bodies in the majority of cases were bones; they were found in animals of the different classes treated in various ways, but most often in those that had had access to bones, viz., in the bone-feeding experiments and in the cases that had contracted the disease in the veld. Stones, pieces of coal, china and wire, nails, sand, and pieces of metal were also found. Chronic inflammatory processes, fistulae, and abscesses were recorded in the walls of the reticulum in a few animals, the walls being thickened and attached to the diaphragm. Nails piercing the reticulum were found. A hairball was present in one case.

The *omasum* always contained ingesta. These were either soft, fairly soft, somewhat dry, or very dry. Only rarely were they very hard and caked. They were, however, more often moist and soft. In one instance a bone was also found in the omasum.

The *abomasum* usually showed liquid contents in the fundus region and ingesta of more solid consistence in the pyloric region. Sometimes they were liquid in both portions, sometimes they were more pultaceous. Liquid ingesta mixed with blood were noted in one case after drenching. Two hairballs and a piece of rag were found in one animal, and pieces of coal in another. The mucosa of the abomasum was frequently recorded to show no changes; this occurred in cases in which the animals were drenched, as well as in cases in which animals contracted the disease by feeding on bones that had been supplied or were found in the veld. Frequently the mucosa was pink, sometimes uniformly throughout the whole abomasum, but more often diffusely in the fundus. Occasionally the fundus showed a dirty discoloration; in other cases, again, it showed a yellowish deposit and red surface after removal. Sometimes the mucosa had a grey or a brown colour, and occasionally white patches were present. Black pigmentation was also seen; it was in an animal that had been drenched. The folds were swollen in a few cases. There was a scar surrounded by hæmorrhages in one case. The pylorus was injected in a number of instances; it was usually of lighter colour than the fundus. In most cases it showed no changes. In one instance a scar measuring about 6 cm. was present. In the same animal pieces of wire and coal were found in the reticulum. The changes in the mucosa of the abomasum were more often found to be present in the animals that had been drenched than in the animals that had contracted the disease in other ways. It might be mentioned that in the cases that received subcutaneous injections of toxin, pink staining of the fundus was also noted, whilst in naturally contracted cases no marked changes were encountered.

The *small intestines* were in all cases the seat of changes; rarely were they present throughout their whole length, in most cases one particular portion only being affected. Moreover, the intensity of the lesions varied very much in the different animals and also in the

different parts of one and the same animal. These changes were recorded as slight redness of the mucosa, either in patches or streaks, or affecting long stretches, or, in some cases, the whole length of the intestines. In other cases the redness was well marked, amounting sometimes to diffuse hæmorrhagic infiltrations. Slight redness and marked redness could be found in the same intestine in different parts. Sometimes the redness was present in the form of cross-stripes along some parts of the intestines and in some instances throughout a smaller or larger portion. Next to the red portions there were others that were simply injected; the injected vessels in some cases only showed faintly, in others they were distinct, and had a ramified distribution. Smaller and larger areas and short and long portions were so altered in some cases. In some animals the mucous membranes showed a slatey-grey discoloration in similar distribution as described above, and particularly noticeable as zebra markings. Ecchymoses were also occasionally found. In other cases redness or injection of the mucous membranes were absent; the mucosa then usually appeared greyish, sometimes also yellowish. The mucosa was frequently found swollen, sometimes markedly so, and a viscid mucus was found adhering to it, the mucous deposition sometimes being well marked. In some cases it contained greyish mucus, whilst in other cases the contents had a brownish colour. In some instances the mucosa had a glossy appearance. In a few cases parts of the serosa were injected and diffusely reddened. A taenia was found in one animal.

The *large intestines* showed changes as often as the small ones, and to the same extent. Their colour varied from light to dark red and hæmorrhagic infiltration in various distributions was described in the small intestines. The mucosa was also frequently found swollen and parts were wrinkled. The contents of the caecum and colon were liquid in some cases, semi-solid in others. In the ampulla recti the faeces were sometimes dry and hard, and had the shape of balls; they were covered with mucus.

The *mesentery* showed no changes in the animals that were in good condition, it contained more or less fat. In poor animals it was devoid of fat and usually infiltrated with liquid to a lesser or greater extent. The mesenteric lymph glands were found to be either larger in size than usual, and to contain liquid, or they were sometimes smaller. In some instances the presence of black pigment was unusually conspicuous.

The *urinary bladder* was either empty, or it contained urine which was always found to be clear. Injection of the blood vessels of the mucosa and ecchymoses were also recorded.

In the *sexual organs* no changes were seen.

The *meninges* in a few cases showed injection of the blood vessels, particularly in the pia mater. In a few instances the brain was recorded to be moist.

#### THE PATHOLOGY OF SUBACUTE LAMSIEKTE.

Equal numbers of artificially produced cases of lamsiekte (drenched or injected) and of normally contracted lamsiekte (bone-eating and naturally contracted) were examined. It might be repeated here that the pathology of subacute cases hardly differed from that of peracute cases already described.

In regard to the condition of the animals, the notes given in the previous description apply here throughout. The same applied to the rigor mortis, the integument, the appearance of the visible mucous membranes, and the position of the tongue. In some cases this organ was hanging from the mouth; the presence of a bolus in the oral cavity was also recorded. The same remarks applied to the blood and the flesh. In regard to the condition of the subcutaneous tissue, it was found that oedematous infiltrations of traumatic origin were found in some animals. These resulted from prolonged lying in sterno-costal or lateral position, and were found on side of thorax and shoulder. Animals injected with cultures showed abscesses and necrotic foci at the seat of the injection. The lymphatic glands showed similar conditions to those already described. The changes in the peritoneal cavities were also similar. Adhesion of rumen, reticulum, and omentum to the diaphragm was recorded. No different observations were made concerning the pharynx, oesophagus, and salivary glands. In one instance a stone was found in the thoracic portion of the oesophagus. Larynx and trachea were found to contain froth in many cases, and sometimes also ingesta. In one instance mucous deposit on the mucosa of the trachea was observed, and after its removal a hæmorrhagic surface was noted. The pleural cavity and the lungs showed conditions as described before. In one case the left lobe was found attached to the costal pleura, and in another case adhesion of the cardiac lobe was recorded. Emphysema in the inter-lobular tissue was seen in one case. The pericardium showed no other changes than those mentioned. The same remarks applied to the heart and the vessels. Nothing more had to be added to or abstracted from the description of the liver, the gall-bladder, the bile itself, and the pancreas.

Similar notes were made in the description of the spleen, the suprarenal glands, and the kidneys.

The contents of the rumen, reticulum, and omasum were the same as those already described. The presence of foreign bodies was also registered. The omasum showed the same changes, perhaps to a lesser extent than in the acute cases. Ecchymoses and hæmorrhages were mentioned. In one case small superficial erosions of the mucosa between the folds were seen. Foreign bodies were also found in the lumen of the abomasum. In connexion with the small intestines the same remarks should be repeated as made before; the lesions were perhaps less extensive. The same held good for the large intestines.

Nothing could be added to the description of the mesentery, the bladder, and the brain.

#### PATHOLOGICAL ANATOMY OF CHRONIC LAMSIEKTE.

The number of animals that died of chronic lamsiekte or were killed is smaller than that described in any of the other two groups (acute and subacute).

The majority of the animals had contracted the disease by feeding bones supplied in troughs or scattered in a paddock. There were also a few cases in which the animals contracted the disease naturally or after drenching. There was no chronic fatal case in which the animal contracted the disease from subcutaneous injection of culture or toxin. The conditions recorded in these cases varied from poor to good. With the exception of the drenched animals the others were in good condition when submitted to the

experiments. The integuments of some of these animals showed decubitus on fetlocks, hocks, elbows, and knees. But this was the case only in animals after a long duration of the disease. In animals that died earlier the integument was intact. The rigor mortis was complete in animals that had died during the night or it was found to be passing off. It was not complete in animals that came to the autopsy within the first few hours of death. In all cases, except one, in which the autopsy was made three hours after death, was the abdomen found to be relaxed. In the case mentioned it was slightly distended.

The visible mucous membranes and the appearance of the flesh and blood were in the majority of cases found to be normal. In some the blood was recorded not to stain well and the flesh to have a dry appearance. The subcutaneous tissue showed some alterations that were connected either with the poor condition the animal was in or they were the result of traumatic influences, caused by lying down. Accordingly the adipose tissue was deficient or absent in some animals; in some traces of fat were present that had an ochre yellow colour. In others the subcutaneous tissue was moist or jelly-like. The superficial lymph nodes were in several cases found enlarged and moist. Some were embedded in jelly-like tissue. The retropharyngeals in one instance and the superficial cervicals in another were found to be red or hæmorrhagic. The abdomen presented no lesions of recent origin. Attachments of the reticulum to the diaphragm were recorded in two cases. The pleural cavity, with the exception of one instance, showed but little transparent liquid. In the one exception it was turbid, the animal showing the lesions of a pleuritis and pneumonia of traumatic origin. The pleura was smooth and glistening, except in two cases, the one just mentioned and a second one in which the lesions of a pleuritis fibrinosa were present. In a third case a tufted low granular tissue was found in the pleura costalis between the ribs. The tongue, pharynx, and oesophagus offered little occasion for remarks, except that in one case a yellow substance was present in the tonsillae and in one case a bolus of food was found in the thoracic portion of the oesophagus. Larynx and trachea in some cases contained froth. In one animal that was submitted late to post-mortem the mucosa was of a bluish discoloration. In the animal that was suffering from traumatic pneumonia, small superficial ulcers were found on the epiglottis and the ligamenta vocalia. The lungs showed recent lesion in one case. In the one already referred to, the eparterial lobe, as well as the right cardiac lobe, were the seat of a broncho-pneumonia traumatica. There were foci present containing necrotic tissue and atelectasis in the adjacent tissue. In the case in which a fibrous pleuritis was described, the presence of atelectasis of the eparterial lobe was also recorded, and atelectasis of the main lobe was also noted in the third case. In all other instances the lung tissue was elastic, sometimes rich in blood and moist on section; froth was usually present in the bronchi and trachea. In some animals the mucosa of the bronchi and the thoracic trachea was found to be injected and ecchymoses were present. This was probably due to ingesta in one instance. The blood-vessels showed no changes. The bronchial glands were markedly swollen in the case of pneumonia. The pericardium in one case only had a slightly increased amount of liquid. The parietal serosa was smooth and glistening. The right

ventricle was found to be in diastole, the left in systole. Blood, when present, was well clotted. The epicardial fat in some instances was jelly-like. Ecchymoses were found in the epicardium of most animals, but not so often in the endocardium. In the animal that showed the pneumonia, the endocardium was studded with numerous white points. The myocardium was described in most cases as pale, as red-brown in some; it was opaque in several. This was also the case in animals that had been examined within the first few hours after death.

In one case, that of an old cow, media necrosis of the aorta abdominalis was recorded. The periportal glands were in all cases found to be normal. Only in two cases was the liver recorded to be enlarged and to be rich in blood. In other cases it was found to be of normal size or even smaller. The colour was described as dark red-brown. In one case only it was yellow. It was an animal that had died during the night after a lengthy disease. The consistence in this case was soft; in all others it was firm. The capsula was generally found smooth and glistening; in one case a white thickening was recorded. The gall-bladder in all cases contained bile; this was liquid in all but two cases, in which it was thick. The colour was green, yellow, or brown. It was found to be transparent in some and turbid in other instances. The quantity was occasionally increased, the bladder being distended. The mucosa of the gall-bladder was sometimes found to be injected. The ductus choledochus was always open. The bile ducts in one instance contained a fair amount of bile, in another the walls of the ducts were thickened (*Stilesia hepatica*). The pancreas showed changes in the poor animals only; it was moist and embedded in jelly-like tissue. The dimensions of the spleen were recorded to vary in length from 30 cm. as the minimum to 50 c.c. as the maximum, and in width from 11 and 16 cm. The largest dimensions were found in two animals, one that died during the night and in which the pulpa was soft, due to decomposition, and in another that had succumbed after a long period of illness, the pulpa also being soft. In cases that came fresh to the autopsy the pulpa was soft in most cases; only in two cases was it recorded to be firm and dry. The follicles were enlarged in the case that was complicated with pneumonia. In all other cases they were visible, badly visible, or not visible at all, particularly in the cases in which the pulpa was soft, when also the trabeculae were indistinct or invisible. The cortex of the suprarenal glands were yellow in all cases but one, in which it was red brown. The adipose capsule was poor in fat and gelatinous in some animals. In most animals it still contained fat, and in a few cases was even described as rich in fat. The fibrosa stripped easily in all cases. The colour of the surface of the kidney was described as pale brown in some cases, and red-brown or even as dark red in others. The zones were distinct in all cases: the intermediary zone was also found to be dark red. The consistence was usually firm; in the cases that came late to the autopsy it was soft. The rumen contained the usual ingesta. They were found to be dry in some animals. The reticulum in two cases was found to be empty; in all other cases it contained soft or liquid ingesta. With the exception of the animals that had been drenched with putrid material, all showed bones in the reticulum or rumen. Two also showed the presence of wire. In one

case, that of a cow that had continued to eat bones for some time during her illness, before she actually went down paralysed, the submucosa of the rumeno-reticular fold was streaky and patchy red. The omasum was found almost empty in one case, otherwise soft ingesta were present in the majority of cases. They were dry in one instance. The abomasum showed liquid contents in all cases; they were mixed with particles of coal in one animal. The mucosa was found without changes in some cases; in two it was patchy red, in one the vessels of the fundus were injected, and in another ecchymoses and cicatrices were found in the ridges of the folds. The mucosa of the small intestines showed red patches in some animals, black ones in others; some showed red cross stripes, some zebra markings; in some the vessels in parts were injected. Generally these changes were not of an intensive nature, and were not found in all parts of the intestines. In one case only were they found more or less throughout the whole length; in another case they were seen mainly in the ileum, which was diffusely reddened. The large intestines more often showed no changes in the mucosa. Red and black discolorations were noted in some. Faeces found in the rectum were soft in the cases that were recorded. The mesentery showed no fat in most cases. The lymph glands were swollen in one case only; in most other cases they were of usual size, although normally small in several animals. In one instance cysts containing a dry substance (larvae of pentastomum) were noted in the glands. The bladder was found to be empty or to contain clear urine. The sexual organs were normal. No changes were recorded in the brain and the meninges.

#### PATHOGENESIS OF LAMSIEKTE.

The pathological anatomical changes noted did not reveal any characteristics that could be considered to be specific or pathognomonic for lamsiekte. Generally speaking, the negative findings were the most typical features. The frequent presence of foreign substances, particularly bones in the proventriculi, especially in the reticulum, might in the absence of other lesions be taken into consideration for the purpose of the diagnosis. As the most constant alterations might be considered the muco-catarrhal and sometimes hæmorrhagic changes in the digestive tract, particularly in the intestines. These were most pronounced in cases of the acute disease caused by drenching. Sometimes these changes occurred also in the rumen, where they were caused by the direct influence of the putrid material that, together with the specific toxins, contained other locally acting substances. The presence of these lesions, however, could, in all cases, hardly be put down to the direct influence of the toxin, certainly not in chronic cases, particularly those of long standing, where they were also found. Here they had to be considered to have been of a secondary nature, and were probably connected indirectly with the disease, the organs in the recumbent animals not properly functioning, and so giving rise to complications. To explain the pathogenesis of the disease we therefore had to rely mainly on the symptoms noted during life, the first to take into consideration being the absence of fever in all cases that were not complicated by infection such as might result from traumatic pneumonia. Thus the absence of fever even in the most acute cases excluded from the very beginning the disease to be a simple bacterial infection, and this all microscopic and bacterioscopic examinations indeed proved.

That the disease was the result of pure intoxication had amply been proved by the injections of toxins, although this toxin was not obtained by pure cultures. It might be assumed that toxin apparently affected in the first instance the motor centres of the spinal chord and the medulla oblongata. But that these centres were not primarily affected was shown by the fact that reflexes were noted for a considerable time after the animal had been paralysed, and only ceased entirely when collapse was approaching. It may therefore be concluded that the nerves were more likely affected in their terminal branches. The nerves most affected were those originating in the caudal portion of the chord, the massive nerves of the hindquarters, and subsequently those of the cranial portion. The deduction is based on the appearance of the paralysis that was often first pronounced in the hindquarters, subsequently in the forequarters, and only finally in the neck and head. It may also be assumed that the toxin had a specific affinity to the motoric centres of the digestive organs under voluntary control viz., mastication and deglutition, viz., the centres of the trigeminus, glossopharyngus, and hypoglossus, but also in their cases the terminal portion of the nerves may have been affected. The fact that not all animals showed an identical set of symptoms, paresis, and paralysis of the nerves mentioned, frequently being absent, could be explained by differences of susceptibility and differences in toxicity.

Comparing lamsiekte with allied diseases, we have to bring it into relation with the botulismus in man with which it is, however, not identical. The term "parabotulismus" in cattle may be appropriately proposed.