TWO HUNDRED AND EIGHTY-FOUR AUTOPSIES AT THE NATIONAL ZOOLOGICAL GARDENS, PRETORIA

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Summary

(1) An outline is presented of disease preventive measures at the National Zoological Gardens, and the duties and problems attached to the part-time veterinary appointment. The necessity for adequate laboratory facilities and the importance of research into morbid conditions of wild animals is emphasized.

(2) An extensive review is presented of South African veterinary literature pertaining to diseases of game.

(3) Two hundred and eighty-four post mortem examinations are individually listed and some are discussed.

(4) An analysis of these autopsies is attempted in four tables.

Introduction

The main purpose of this report is to place on record, in brief form, the experience gained during the performance of routine autopsies at the National Zoological Gardens. As such a large number of species are concerned, it is clear that, with the comparatively small number of post mortems, few, if any, definite conclusions can be drawn from the findings. It is hoped that the material presented here will form a nucleus to be added to from time to time.

General Procedure

The usual procedure is to conduct a post mortem examination on every animal that dies. Very occasionally this is omitted through force of circumstances (advanced decomposition, etc.). Some reptiles are also examined, as are small birds in case of heavy mortality and sometimes individuals of the larger species. Routine necropsies are not performed on birds, because of lack of proper facilities for laboratory investigation and because very little is to be gained from the naked eye examination of the bodies of small birds.

Whenever examinations are carried out, the findings are immediately recorded in a post mortem book made available by the Director of Veterinary Services and of the type used at the Onderstepoort Veterinary Research Institute.

Although the National Zoological Gardens ranks very high in the world amongst institutions of its kind, proper veterinary facilities are non-existent. Even though the great need for a hospital and well equipped laboratory have been felt for many years, sufficient funds for their establishment have not been available. The prospects are brighter at the moment, however.

The unfortunate result has been that valuable scientific material could not be utilized properly. In exceptional cases the author has had the benefit of co-operation with colleagues from Onderstepoort. In view of the great shortage of research personnel and the mounting burdens shouldered by the depleted research staff there, regular demands could not be made on it.

Blood or organ smears could not be examined as a routine procedure. Where there were definite indications for this examination, the work was carried out at the author's hospital, a few miles from the zoo. The same applied to other laboratory procedures, X-ray examination and major operations.

Although autopsies are the main concern of this article, reference to other veterinary measures cannot be considered to be outside its scope.

Handling of a wild animal entails, to the animal itself with few exceptions, great exertion, fear, and grave risk of injury. Proper restraint often presents a problem. Clinical examination is not only made difficult, but the animal is often in such a state of tension as to make it almost impossible to obtain intelligible results clinically. Laboratory procedures would therefore be of more relative value than in the case of most sick domestic animals. From the comparative view point, it is remarkable how soon after showing signs of illness the majority of wild animals die, more particularly the hoofed animals and other herbivora, less so the carnivora and some other orders. Often they appear normal in the afternoon and are found dead the following morning. It is also quite usual to conduct a necropsy and find the organs so moderately altered macroscopically as to leave some uncertainty as to the actual cause of death. In these cases further histopathological, biochemical or bacteriological investigation might be of great assistance. The long drawn out type of illness is not usual. There is some small grain of truth in the statement that they are either healthy or dead.

The following explanation for this is suggested: The animal in the natural state is dependent on good health to obtain food and water with ease and to avoid falling prey to another animal. One condition of survival is, therefore, *to remain healthy*. Once sick, the illness can seldom run its course as the sick animal becomes an easy victim of its enemies. Natural selection thus takes place at the level of absolute resistance to disease, *not* on powers of recovery.

While the author acted on behalf of a colleague now deceased, he found tuberculosis in a buffalo (Syncerus caffer), a nyala (Nyala angasi) and amongst the springbok (Antidorcas marsupialis). He decided to do the tuberculin test on all the herbivora except the pachyderms and the animals in two large camps known as the Lowveld camps. The former were not tested, because of handling difficulties and finding skin suitable for the test, and the latter, because the camps are so big that catching would have resulted in some antelopes being injured or killed. Whenever individuals from these camps are trapped to be moved elsewhere,

they must now first pass a clean test before release. The primates, carnivora, etc., have not been tested, as tuberculosis has never been found amongst them. They have not been in contact with any of the infected animals and effective handling would have been most difficult.

An interesting finding was the remarkable uniformity in thickness of the skin fold amongst the females of the same species. A delicate technique is required to make an effective intradermal injection when the fold is two millimetres thick, sometimes less. As a result of the handling, injuries, even deaths, occurred. Each animal was, therefore, only tested once, unless a positive case was detected in the same or an adjoining enclosure. The tests were repeated at suitable intervals until all the contacts passed a simultaneous negative test. Tuberculous cases were donated by the Director of the Zoological Gardens to Onderstepoort for further study. A tuberculous doe, the only one of a rare species, could not be destroyed, and she and the stag were isolated.

In order to obtain some idea as to the incidence of helminthiasis amongst the mammals, a composite sample from each enclosure or cage was examined, using the Willis flotation technique. There were very few positive samples and each of these indicated a light infestation. It is the usual experience not to find much helminth infestation when animals have been captive for long, but rather when they have been recently caught. Notwithstanding, haemonchosis occurs amongst the thar (Hemitragus jemlahicus), barbary sheep (Ammotragus lervia), mouflon (Ovis musimon) and a mixture of various Lowveld antelopes occupying spacious camps in the newer part of the zoo. Phenothiazine in correct amounts for each camp is mixed with a day's ration of concentrates and fed at intervals throughout the day. Concentrates are withheld the day preceding treatment to ensure the rapid eating of the medicated feed. This treatment is repeated at suitable intervals. Results have been satisfactory.

Vaccines are employed whenever possible. Horsesickness vaccine is used on the draught animals (horses and mules), none of the wild equines in the zoo being susceptible to this disease. The Onderstepoort distemper vaccine ensures immunity to all wild members of the Canidae if injected once only. All Felidae are protected against feline infectious panleukopenia with Burroughs Wellcome vaccine — two injections being given spaced by at least six weeks.

Briefly, the purpose of the part-time veterinary appointment can be described as the institution of preventive measures, the treatment of the sick and the performance of autopsies in order to determine, in the first place, whether death was from a cause which constituted a threat to the health and lives of other animals.

Given suitable conditions and facilities, it is not only feasible, but imperative to make an intensive study of morbid conditions of game. The self-evident advantage is that the knowledge so gained

would be applied to the benefit of the animals in the zoo. Further, it would help to advance knowledge of pathological processes in domestic animals and in man, as the larger the number of species in which a particular disease is studied, the better the disease will be understood. Finally, what is termed civilization is continually encroaching more and more onto areas inhabited solely or mainly by game. The closer association between domestic animals and game favours the transmission of diseases from the latter to the former. It is therefore of cardinal importance to study these problems. Only constant scientific investigation will make it possible for game and domestic animals to co-exist harmoniously. Those, who are indifferent to our natural heritage and who are prepared to sacrifice everything for material gain, will, in time to come, clamour more and more for destruction of game. Those demands may eventually be difficult to resist, unless science has an answer for many of these problems, notably that of communicable disease. It is hoped that, with adequate facilities at their disposal, zoo veterinarians of the future will recognize and accept their responsibilities with regard to disease problems of game in the wild state and will have suitable facilities at their disposal for their study.

South African References to Disease in Wild Animals

Although international literature on wild animal pathology is voluminous, it is still scanty compared to the wideness of the subject. In South Africa the investigations concerned mainly internal and external parasites and infectious diseases. A wide field still lies fallow.

Very little has been published about morbid conditions of individual game animals. Martinaglia (1930) reported tuberculosis in a giraffe (Giraffa camelopardalis) from the Johannesburg Zoo. Curson (1931a) described polydactyly in a pig and a springbok, and (1931b) a foreign body (wire) wound round the os coxae of a jackal (Thos mesomelas). Curson and Quinlan (1931) mention a steenbok (Raphicerus campestris), which, when shot in the veld, was found to have ankylosis of the hock joint.

Martinaglia and Robertson (1933) reported an umbilical herniotomy on a lion cub (Leo leo). Hofmeyr (1952a) recorded placenta praevia in a hanuman monkey (Pithecus entellus) and (1952b) tetanus in a Cape Chacma baboon (Papio ursinus ursinus).

Of external parasites ticks are, generally speaking, not host specific and are to be found on game and domestic stock alike. Those specially interested are referred to the work of Dr. G. Theiler in connection with the tick survey in the Union and published in various Onderstepoort Journals.

The investigations of Bedford into the lice of wild fauna have been too extensive to be referred to in detail here, but will be found under the following references: (1918a, 1918b, 1926-1927, 1928, 1929, 1930, 1931, 1934, 1939a, 1939b).

Numerous articles have been published about helminth parasites. A great deal of the work concerns the description of new species.

Experiments have been made in order to determine the significance of various infestations in game to domestic animals. There is little to indicate the effect on game hosts. Theiler and Robertson (1915) worked on the life-cycle of the wireworm of the ostrich and Baer (1926-27) identified some helminths from various hosts. Mönnig (1926-27, 1929a, 1929b, 1929c, 1931b, 1931c, 1931d, 1932b, 1932c, 1933a), le Roux (1929a, 1929b, 1929c, 1930a, 1930b, 1930c, 1930d), Ortlepp (1932a, 1932b, 1933a, 1933b, 1934, 1935, 1937a, 1937b, 1937c, 1938a, 1938b, 1938c, 1938d, 1939a, 1940), van der Westhuysen (1938), Malan (1939) and Meeser (1952) described many helminth parasites, the first three authors identifying numerous new species. Mönnig (1931a, 1932a, 1933b) investigated the rôle of antelopes as carriers of parasites of domestic ruminants, and Ortlepp (1939) found that hares and rabbits can act as hosts of the trichostrongylids of sheep, but discounts the possibility of this being important economically. Martinaglia and Brandt (1947) refer to cysticercosis of impala (Aepyceros melampus) and wildebeest (Gorgon taurinus taurinus) carcases during meat inspection. They were confronted with the problem as to what to do with lightly infested carcases as it was not known, whether freezing as for beef measles would be sufficient. Lesions produced by Oesophagostomum columbianum in the blesbok (Damalisccus albifrons) were investigated by Fourie (1951).

Very interesting facts have been brought to light by those who worked on microbial infections of game. Walker (1912) noted a Leucocytozoon infection in an ostrich. Neitz (1931) examined blood and gland smears of a large series of animals shot in Zululand. Trypanosoma congolense was found in a zebra (Equus burchellii), a kudu (Strepsiceros strepsiceros) and a bushbuck (Tragelaphus sylvaticus), T. vivax in a bushbuck, and small piroplasms in zebra, bushbuck, duiker (Sylvicapra grimmia), waterbuck (Kobus ellipsiprymnus), kudu, blue wildebeest, reedbuck (Redunca arundinum), mountain reedbuck (Redunca fulvorufula), steenbok, and ant bear (Orycteropus afer) — recording them for the first time in the last six species. Kluge (1945) and R. du Toit (1954) wrote reports on nagana in game in this area, the latter also about the eradication of tsetse flies by chemical means. Neitz (1935a) also showed that Spirochaeta theileri can be transmitted to the blesbok and (1935b) Anaplasma marginale to the black wildebeest (Connochaetes gnu). The cases remained clinically unaffected. These findings are significant with regard to livestock.

Other protozoa found in game were as follows: Neitz (1937a) discovered Piroplasma pitheci in the blood of a vervet monkey (Cereopithecus aethiops cloeti) (1938b), Nuttallia cynicti M. Mayer 1912 in the albino and wild rat after splenectomy and Martinaglia (1930) a babesia in a sable antelope (Ozanna grandicornis).

The following new protozoa were described: Neitz (1938a) Grahamella conchi in the multimammate mouse (Mastomys concha),

Neitz and Thomas (1948) Cytauxzoon sylvicapra from the duiker, P. J. du Toit (1937) Sauroplasma thomasi from a lizard (Zonurus giganteus) and Jansen (1952) Babesia thomasi from the Cape dassie (Procavia capensis).

Neitz and Steyn (1947) transmitted Babesia canis and Rickettsia canis to the black backed jackal (Thos mesomelas mesomelas). A fatal form of theileriosis amongst cattle and named "corridor disease", together with other diseases transmissible by game were mentioned by Bigalke and Neitz (1954). Neitz, Canham and Kluge (1955), who investigated corridor disease, regard buffaloes and perhaps other species of game as reservoirs of infection.

Aspergillosis is a problem in most zoos amongst the birds. In Pretoria, e.g., it usually accounts for the penguins eventually. Walker (1915) referred to this infection in ostrich chicks.

Few bacterial diseases in game have been reported in the Union. Paine and Martinaglia (1928) found tuberculosis in kudu and duiker. Thorburn and Thomas (1940) diagnosed this infection as occurring naturally in the Cape kudu, and Robinson (1944) found the tuberculosis to be of bovine type.

De Villiers (1943) was of the opinion that anthrax, causing mortality in kudus, was transmitted by biting flies.

Neitz (1933) found the blesbok susceptible to both heartwater (Rickettsia ruminantium infection) and bluetongue. He (1937b) later confirmed the findings with regard to heartwater in this species; the animals remained clinically healthy. The same author (1944) transmitted heartwater to springbok. In the intima smears of two which died he found numerous colonies of Rickettsiae.

Neitz and Marais (1932) gave a history of rabies as it occurred from the earliest times in S.A. as well as a survey of wild vectors. Anon (1931) drew up a list of the transmitters of rabies amongst the small carnivora and also referred to the warthog (Phacochoerus aethiopicus) as a carrier of African swine fever. Neitz and Thomas (1934) drew up a summary of cases of rabies and its distribution in S.A. during 1933. Snyman (1937) made a comprehensive survey of the rabies problem in this country, and indicated the wild species in which the disease has been diagnosed. He (1940) wrote a thesis on the study and control of the vectors. Von Maltitz (1950) gave information about rabies in northern S.W. Africa.

P. J. du Toit (1932) described the foot and mouth disease position in S. Rhodesia. Rossiter and Albertyn (1947) discussed, inter alia, the game factor in the spread of this disease.

Mettam (1934), referring to "snotsiekte" in cattle, indicated the rôle played by the black wildebeest in transmitting the sickness, although it remains free from symptoms.

Stevenson-Hamilton (1939) gave a picture of the population fluctuations of some veld species and suggested possible causes of death. He urged the importance of scientific investigation of disease amongst game. Thomas and Neitz (1933) and de Kock (1938) stressed the importance of the spread of disease from game to domestic animals.

Thomas and Kolbe (1942) defined the distribution of wild pigs in S.A. and discussed their rôle in the dissemination of disease, especially African swine fever.

Fourie and Snyman (1942) reported a condition in cattle called "blouwildebeesoog", which occurred in domestic ruminants as an ophthalmic affection of great severity. Circumstances pointed to the blue wildebeest as a subclinical carrier of infection.

Mettam (1936) recorded his experiences with rinderpest, while Thomas and Reid (1944) described their experience of an outbreak of this disease amongst cattle and game in Central Africa and showed what control measures were instituted.

P. J. du Toit (1947), at an international congress, summarized the available knowledge about game in relation to animal diseases in Africa.

POST MORTEM EXAMINATIONS

The following is a list of post mortems performed at the National Zoological Gardens over a period of six years between 1950 and 1956.

Animal		Cause of Death	Refer to comments following table
Chimpanzee	Pan satyrus (Linn.)	Enteritis and fatty degeneration of liver	1
Orang Utan	Pongo pygmaeus (Hoppius)	Obesity and senility	
Hanuman monkey	Pithecus entellus (Dufresne)	Placenta praevia	2
do.		Torsion of colon	
Bengal monkey	Macaca mulatta (Zimmerman)	Trauma	
do.		do.	
Puttynosed monkey	Cercopithecus nictitans (Linn)	Enteritis and fatty degeneration of liver	
Bonnet monkey	Macaca radiata (E. Geoffroy)	Early pneumonia, circulatory collapse	
Yellow baboon	Papiocynocephalus (Linn)	Pulmonary carcinoma	
Ringtailed lemur	Lemur catta (Linn)	Trauma	
Sumatran tiger	Felix tigris (Linn)	Rupture of uterus	3
Puma	Felix concolor (Linn)	Trauma	
do.	do.	do.	
Leopard	Panthera pardus melanotica (Gunther)	Feline infectious panleucopenia	7
Cheetah	Acinonyx jubatus	One died of encephalitis and four from feline infectious panleucopenia	
Cape Hunting Dog	Lycaon pictus	Two died of distember, one distemper with toxoplasmosis and one from trauma	
Australian dingo	Canis familiaris	Babesia canis infection	5
Black backed jackal	Thos melomelas	Pneumonia one, trauma one	
Silver jackal	Cynalopex chama (A. Smith)	Distemper	4
Long eared fox	Otocyon megalotus (Desmarest)	Distemper	4

Animal		Cause of Death	Refer to comments following table
Honey badger	Mellivora capensis (Schreber)	Too decomposed for post mortem	
Cape polecat	Ictonyx striatus (Perry)	Haemorrhagic gastro-enteritis	
Clawless otter	Aonyx capensis (Schinz)	Pneumonia (one) Circulatory collapse (one) Lesions like those of babesiasis (one) Too decomposed (one)	
Black rhinoceros	Diceros bicornis (Linn)	Generalized tuberculosis	6
Brazilian tapir	Tapirus terrestris (Linn)	Sand in coecum, auto-intoxication	
Transvaal zebra	Equus burchellii transvaalensis (Ewart)	Enteritis (one) Trauma (one) Strongylus inf. Treated (one) Pneumonia (one)	
Rock rabbit (Dassie)	Procavia capensis (Pallas)	Babesiasis	8
Hippopotamus	Hippopotamus amphibius (Linn)	Acute gastritis (new born) (one) Trauma (new born) (one) Pneumonia (new born) (one)	
Javan swine	Sus vittatus (Muller and Schlegel)	Pneumonia	
Warthog	Phacochoerus aethiopicus (Pallas)	Heat stroke (effects of journey)	
Wild boar	Sus scrofa (Linn)	Chronic nephritis	
Camel	Camelus dromedarius (Linn)	Fibrosis of myocardium	
Giraffe	Giraffa camelopardalus	Volvulus of colon (one) General parenchymatosis atrophy (one) Cirrhosis of liver (one) Trichuris infestation (one)	
Friesland calf	Bos taurus (Linn)	Snotsiekte	10
Buffalo	Syncerus caffer (Sparrman)	Emaciation and dystokia	
Water buffalo	Bubalus bubalus	Kidney and liver cirrhosis	
Anoa. Dwarf buffalo	Anoa depressicornis (H. Smith)	Encephalitis (one) Uraemia (atrophy of kidney) (one) Stillborn (one) Pneumonia peritonitis and pleuritis (one)	
Gnu Black wildebees	Connochaetes gnu (Zimmermann)	Inanition (new born) (one) Trauma (two) Extensive abscessatiton of neck (one)	
Blue wildebees	Gorgon taurinus taurinus (Burchell)	Starvation (new born) (one) Trauma (new born) (one) Traumatic pericarditis (one)	
Redhartebeest	Alcephalus caama (Cuvier)	Enteritis (two)	
Bontebok	Damaliscus pygargus (Pallas)	Trauma (two) Enteritis (one) Exposure (young) (one) Foreign bodies in rumen (one)	

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Blue wildebees	Gorgon taurinus taurinus (Burchell)	Starvation (new born) (one) Trauma (new born) (one) Traumatic pericarditis (one)	
Redhartebeest	Alcephalus caama (Cuvier)	Enteritis (two)	
Bontebok	Damaliscus pygargus (Pallas)	Trauma (two) Enteritis (one) Exposure (young) (one) Foreign bodies in rumen (one)	

Animal		Cause of Death	Refer to comments following table
Impala	Aepyceros melampus melampus (Lichtenstein)	Trauma (fifteen). Worm infection (six). Enteritis (twelve), four with congestion of lungs and three with pneumonia. Pneumonia (eight). One bad teeth (shot). Feeding etc. (five). Too decomposed (two) dental defects (one). Inanition (young). Fatty liver (one) pregnant. Exposure (young) (one). Multiple abscesses (one) cachexia (one)	
Blue duiker	Guerei caerula (H. Smith)	Trauma (two) Enteritis (three) Pneumonia (two) Enteritis and pneumonia (one) Fatty degeneration of liver (one) Exposure (young) one Multiple abscesses (one) Cachexia (one)	
Gemsbok (Cape Oryx)	Oryx gazella (Linn)	Traumatic pericarditis (one) Trauma (two) Pneumonia (one) Enteritis and pneumonia (one) Hydrocephalus (one) Encephalitis (two) Senility (one) Exposure (new born) (one) Starvation (new born) one	
Sable Antelope	Ozanna grandicarnis (Herman)	Impaction of forestomachs (one) Blindness and general collapse (one)	
Roan antelope	Ozanna equina (Desmarest)	Pneumonia and senility (one)	
Eland	Taurotragus oryx (Pallas)	Trauma (two) Nephrolithiasis (one) Congestion of lungs (one) Pneumonia (one) One no diagnosis Torsion of uterus (one) Heart failure (one) (age) Irregular teeth (one) Cachexia and parenchymatons atrophy (one)	
Kudu	Strepsiceros strepsiceros (Pallas)	Trauma (two) Pneumonia, cirrhosis liver and kidneys (one)	
Nyala	Nyala angasii (Grey)	Enteritis (one) Encephalitis (two)	

Animal		Cause of Death	Refer to comments following table
Bushbuck	Tragelaphus scriptus sylvaticus (Sparrman)	Trauma (two) Senility (one) Abomasitis (two) Pneumonia (two) Undiagnosed (one)	
Thar	Hemitragus jemlahicus (H. Smith)	Trauma (three) Exposure (new born) four Cachexia (one)	
Blackbuck	Antilope cervicapra (Linn)	Trauma (three) Heartwater (one) Enteritis (one)	
Nilgau	Boselaphus tragocamelus (Pallas)	Exposure (new born) one	
Barking deer	Muntracus muntjak (Zimmermann)	Pneumonia (one) Enteritis (one) Exposure (new born) one	
Hog deer	Cervus porcinus (Zimmermann)	Trauma (three) Stillborn (one) Enteritis (one) Pneumonia (one)	
Fallow deer	Dama dama (Linn)	Pneumonia (one)	
Pere David's deer	Elaphurus davidianus (A. Milne Edwards)	Peritonitis (one)	
Spotted paca paka	Cuniculus paca (Linn)	Undiagnosed (one)	
Patagonian cavy	Dolichotis patacochonica (Shaw)	Encephalitis (one)	
Large spotted tailed native cat	Dasyuris maculatus (Kerr)	?	
Tasmanian devil	Sarcophilus harrisii (Boitard)	Pneumonia (one)	
Naked nosed wombat	Phascolomis mitchelli (Owen)	Pneumonia (one)	
Great red kangaroo	Macropus rufus (Desmarest)	Liver degeneration and necrosis Fracture of metatarsus (one) Pneumonia (one)	
Red necked wallaby	Macropus ruficollis (Desmarest)	Pneumonia (one) and paraplegia	
Black faced kangaroo	Macropus melanops (Gould)	Pneumonia (one)	

Here now follow some brief comments on the post mortems as indicated by numbers in the last column above:—

(1) The chimpanzee died as a result of one member of the public giving him 14 icecreams in succession. The animal developed severe enteritis. Treatment was impossible as no way could be found to disguise the medicine successfully and he was too powerful to be dosed by force. When he weakened sufficiently to permit handling, he could no longer swallow. Intravenous glucose saline drip for hours on end with a keeper holding his arm in position, as well as other parenteral therapy proved unavailing.

(2) This case of placenta praevia [described by Hofmeyr (1952a)] unfortunately occurred in the night house during the night. If the condition had been detected in time a caesarean hysterotomy should have been successful.

(3) The Sumatran tigress as well as the lion, which shared her cage, had been reared on dogs. The lion developed into a magnificent specimen, but the tigress remained on the small side. She became in whelp by him and, at full term, developed dystokia, the pelvis being rather small and the "liger" cubs very big. Caesarean section was decided upon, while she was still fairly strong, but she unexpectedly collapsed and died. Autopsy showed rupture of the uterus well forward and a cub with placenta lying free in the abdominal cavity. The sudden demise was apparently due to shock.

(4) The cases of distemper among the Cape hunting dogs and the other members of the Canidae were due to the fact that there was a temporary shortage of vaccine. The Toxoplasma infection was diagnosed by Dr. D. A. Haig of Onderstepoort.

(5) The Babesia canis infection manifested itself in the same way as in the common domestic dog. Other cases recovered after appropriate treatment.

(6) The rhinoceros had not been in contact with any of the diagnosed tuberculosis cases in the zoo. The diagnosis was made ante mortem from sputum by Dr. E. M. Robinson of Onderstepoort, and later confirmed by a biological test. The only animal in contact with the rhinoceros was the elephant, which had a habit of putting its trunk across the space between their enclosures, until measures were taken to prevent it. To date the elephant appears to be in normal health.

(7) Feline infectious panleukopenia runs a rapid and highly fatal course amongst some of the wild Felidae. Particularly amongst the cheetahs a haemorrhagic gastro-enteritis is a constant and ominous symptom. Besides the deaths listed, some pumas were affected, but recovered after treatment.

(8) The whole colony of dassies died out as a result of babesiasis. Unfortunately the keeper, through an oversight, did not submit any cases for autopsy until the last two died. From one of these Jansen (1952) described the new organism Babesia thomasi.

(9) This giraffe had been caught in the veld, but was never robust and was subject to bouts of diarrhoea. Repeated faeces examination showed a few worm ova. Treatment with phenothiazine on two occasions produced no improvement. During the last weeks before death the diarrhoea was uncontrollable.

(10) The Friesland calf developed typical "snotsiekte" soon after a young black wildebest calf was brought in to share its quarters. The latter was not born in captivity and never showed signs of sickness.

(11) The occurrence of pediculosis is interesting. An animal may show depilation and loss of weight. It may be found to have anaemia and lice infestation, the latter usually not as severe as commonly encountered in domestic stock. After delousing, improvement is usually rapid. This seems to indicate that antelopes are much more sensitive to pediculosis than domestic animals.

(12) As the author was on a distant call, Dr. M. M. Greathead was asked to see the sick eland cow. He diagnosed torsion of the uterus and had her prepared for caesarean section, but she died before the operation could be performed.

(13) The three deaths indicated here were representative of the picture as seen in 35 young impala of about 6 months old. All were not recorded as they were identical. Most of these animals were destined for another place. They appeared to do exceedingly well for a week or more. They were confined to a night house. The cases all showed initial diarrhoea, progressive weakness and death, and all succumbed. It was suspected that they, being mainly browsers, could not overcome the period of adaptation of their ruminal flora and fauna. Their hay was then contaminated with ruminal contents of sheep and leaves were brought in to supplement the hay. Intestinal sulphonamides were used as well as the usual anti-diarrhoeals. As Haemonchus and Cooperia hepatica infestation were found, all were treated with phenothiazine even though the infestation was light. All efforts proved unavailing. It has been suggested that salmonellosis played a rôle. Although possible, it appears unlikely. The impala bred in the camp in whose night house the others were kept never showed a similar mass mortality. If the aetiology was infectious, it is difficult to see how spread to the "residents" could have been avoided. In subsequent years it has been found that young impala caught in the veld are very liable to the same disease pattern.

(14) The barbary sheep and the mouflon occupy separate camps high on the hill of what is known as the Extension. It is conceivable that an odd tick infected with heartwater may get into these camps. Although the post mortem picture was typical of this disease, no microscope confirmation could be made.

(15) It had been decided to sell a few redundant males among the fallow deer, black buck and mouflon. As one of each was due to go to a heartwater area, immunization against this disease was attempted. In cattle the procedure is the intravenous injection of blood infected with a known strain of heartwater and then the taking of temperatures twice daily until fever appears, when treatment is carried out. Because of the wildness of the game, no temperatures could be taken, but it was hoped to treat them as soon as they appeared ill. The fallow deer and the mouflon were found dead and unfortunately not submitted for autopsy. The black buck was only seen in extremis and treatment was unsuccessful. Post mortem examination showed typical heartwater.

Table 1

1950

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		3(5)	4(5)	1(2) 11(5)		2(5)		2(5)	2(5)		4(5)

1951

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1(7) 1(5)	2(5)	1(2) 5(5)	4(5)	5(5)	1(3) 2(5)		3(5)	3(5)	1(7) 6(2) 3(5)	2(2) 1(1) 10(5)	3(5)

1952

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2(7) 1(4)		1(7) 4(5)		1(7) 1(3) 2(5)	3(5)	2(5)	3(5)	5(5)	1(2) 1(1) 4(5)	1(2) 1(1) 2(5)	5(5)

1953

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
7(5)	6(5)	1(6) 1(2) 3(5)	7(5)	1(2) 3(5)	7(5)	8(5)	3(5)	1(5)	4(5)	1(5)	

1954

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		1(3) 1(2) 4(5)	5(3)	2(1) 2(5)	8(5)	2(1) 9(5)	1(3) 2(5)	1(3) 4(5)	1(6)		1(1) 4(5)

1955

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4(5)	1(2) 4(5)	1(3) 1(2) 7(5)	1(2) 4(5)	3(5)	8(5)	2(5)	1(2) 2(5)	3(5)	1(6) 1(5)	3(5)	3(5)

1956

Jan.	Feb.	Mar.
1(1)	3(2) 4(5)	3(5)

This table shows the number of post-mortem examinations done per month during the period under consideration. These figures indicate, as set out below, the zoölogical order to which the various cases belonged.

1. Primates, i.e., apes, monkeys and lemurs.
2. Carnivora, i.e., dog and cat family, mongooses, etc.
3. Perissodaytyla, i.e., rhinoceroses and equines.
4. Hyracoidea, i.e., dassies.
5. Artiodactyla, i.e., hippopotami, pigs, bovine, ovine, caprine, antelope and deer family.
6. Rodentia, i.e., rodents.
7. Marsupialia, i.e., all the marsupials.

TABLE 2

Deaths classified according to the system primarily affected

Order	Digestive System	Respiratory System	Circulatory System	Nervous System	Urinary System	Genital System	Trauma
Primates	3	2	1			1	3
Carnivora	1	2	1	1		1	4
Perissodactyla	4	3	1		1		1
Artiodactyla	45	32	9	8	5	1	62
Rodentia				1			
Marsupialia		4		1			

The above list only indicates sporadic and not infectious diseases.

TABLE 3

Years 1951-1955

Deaths amongst the Artiodactyla

Each month shows the total number of deaths during that month over the years indicated above. Only the systems which were the seat of the lesions in a significant number of cases are listed.

Respiratory System

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3	1	3	4	4	1	3	2	3	1		1

Digestive System

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3		5	7		8	4	2	5	2	2	1

TABLE 4

Years 1951-1955

Mortality amongst all species (first column) and Artiodactyla (second column).

Jan. to Mar.		Apr. to Jun.		July to Sept.		Oct. to Dec.	
60	48	78	69	51	48	57	39

Deaths grouped into three monthly records.

Discussions and Conclusions

Table 1 gives the autopsies performed every month over the period under review. No clear pattern emerges, except that the first half of the year generally shows higher mortality than the second half. The orders other than the Artiodactyla are too poorly represented to permit discussion.

The latter statement is confirmed in Table 2. For obvious reasons infectious diseases would have been out of place in this table. It is further patent that the digestive and respiratory systems are, by a long way, the most frequently affected macroscopically. This appears to be true of all orders having had a significant number of deaths. A puzzling feature is the fact that, though pneumonia and enteritis are often diagnosed, severe and advanced lesions are seldom seen. In the domestic animal under similar circumstances one expects, as a rule, to encounter pathological processes much further advanced before the animal succumbs.

For the sake of comparison all deaths due directly or indirectly to trauma have been listed. Injuries are sustained during journeys, fights — the male sometimes attacks the females — but, most often, at night when all animals are instinctively on the alert and stampede easily. Broken necks are then quite common. It is seldom possible to find out what caused a fright, although it has happened during past years that dogs managed to find their way into the zoo at night.

In Table 3 the time of the year is correlated with deaths amongst the Artiodactyla and associated with the main lesions in a particular system. The number of deaths in other orders have been too small to be significant. The pictures with regard to the respiratory and digestive systems are similar, i.e., autumn to spring is the worst time from the point of view of affection of these systems.

Table 4 shows the time of the year when an animal in this zoo is the most likely to meet its death irrespective of species or cause of death. In all species the mortality rate is fairly constant throughout the year, but there is a peak during April to June. This applies to the Artiodactyla by themselves, except that the peak during April to June is more evident. The other orders taken together, are represented by too small a number to give significant results. The apparent higher mortality rate during these months is entirely due to the Artiodactyla.

It is hoped that, by the presentation of additional data from time to time over a period of years, a much clearer picture will emerge.

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