REPORT ON VETERINARY MATTERS, BIRTHS AND DEATHS AT THE AMSTERDAM ZOO 1959-1966

by

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INTRODUCTION

Extensive reports on losses in zoo animals are very rare. As fas as we know only London, Paris, Philadelphia and Washington give yearly reports. Of these London and Paris give very complete information. One of the reasons that so few zoos publish their results may be that it is always more pleasant to give information about successes than about failures.

In our opinion, however, it is no use to disguise the truth and for other zoos it can be very useful to have the opportunity to compare results. The period described in this paper is part of an important era in the history of our zoo, a period of reconstruction, rebuilding and, consequently, of increasing the collection. This period will last another 10-15 years or so as at that time the really old and worn-out buildings will have been replaced and appropriate facilities for the veterinarian will have been achieved. At the same time this period has seen great advances in veterinary care. The Cap-Chur pistol in use in our zoo since 1960 made injection possible of any animal at any time. The increasing arsenal of therapeutics and the international contacts by way of the international symposia on diseases of zoo animals have contributed largely to a better medical care of zoo animals. Thus prevention of diseases is becoming more and more important. In our opinion the effective disinfectant halamid (Chloraminum) plays an important rôle in this respect.

ORGANISATION OF VETERINARY CARE

We have a part-time veterinarian who attends the zoo every day for several hours. The fact that his private practice consists of small animals and horses keeps him in touch with many problems outside the zoo. Moreover this private practice gives him the opportunity to maintain an acceptable level of surgical skill.

Parasitological control of stool samples is done by the department of tropical hygiene of the Royal Institute for the Tropics in Amsterdam. Post-mortems on small animals and birds are done at Utrecht University by the special department for zoo animals of the veterinary pathological institute. The veterinary pathologist of the cancer institute "Antoni van Leeuwenhoek Huis" in Amsterdam performs post-mortems on the bigger animals. The head of the first mentioned department visits the zoo for half a day every two weeks together with our veterinarian. A number of Amsterdam human medical specialists is available for consultation and advice if necessary.

As a good condition of the animals is the base for good health we have appointed a special curator for all problems concerning food and feeding. Every new animal or bird, without any exception, goes into quarantine for some weeks. The standard rule is to control the animals on behaviour, general appearance, feeding habits, control of parasites, if necesary bacteriological investigation, all of which may be followed by treatment of disorders. If the veterinarian declares the animal to be as free as possible from diseases or parasitism it will enter the collection.

THE COLLECTION

When comparing mortality rates it must be considered that our zoo has a rather large collection. This means that there are a great many small mammals with a short span of life and many delicate animals and birds. The death rate will always be higher than at a smaller zoo with more hardy residents.

NUMBER AND PERCENTAGE OF DEATHS

It must be pointed out that no figure given below

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Table 1. *Mammals and birds in collection December 31.*

Year		1959	1960	1961	1962	1963	1964	1965	1966
Mammals	species & subspecies	175	175	181	182	195	201	204	207
	number	579	646	651	714	738	823	817	830
Birds	species & subspecies	252	385	380	397	417	455	469	486
	number	934	1462	1294	1482	1427	1474	1543	1664

can be trusted as completely exact. All figures should be considered as estimates, as exact as possible. The number of deaths is arrived at by adding up the post-mortems of residents. As a resident is considered any animal and bird after quarantine or any animal born and bird hatched in the zoo older than 3 months. Not included are deaths during quarantine nor any new bird that is injured by its fellows the first day of introducing it into a cage or enclosure. Included may be young mammals that within three months after birth are difficult to distinguish from adults. Excluded are also animals that have died in a hidden place and are found already decayed. Some tests at random proved that these are only minor errors of one or two per cent at most. The starting-point when calculating the mortality rate has been that the total number in the collection at December 31st added to the number of deaths is 100. Disregarded are animals and birds bought, sold, born and dead under about three months of age (see tables 8-11).

MAMMALS

The high death rate in 1963 can be partly attributed to the rather severe winter 1962-'63 (respiratory causes are high, see Table 4).

1966, with a high percentage generally, shows a very high rate of infectious diseases and a high percentage of alimentary disorders. The basic reasons for these facts remain unknown. Comparison with death rates of other zoos either calculated in a different way or calculated in our way from the figures procured by these zoos reveal the following:

Philadelphia: number of mammals 426-540 (years 1959-1965), mortality between 7.2 and 12.1% (average 9.1%). Paris collection: 460-537 mammals (1960-1963), mortality between 13 and 15% (average 14% for 4 years). London collection: between 722 and 798 (1959-1962), mortality 18-21.3% (average for four years 19.8). Washington D.C.: number of mammals in collection between 625 and 666 (1960-1965), mortality 13-18.5% (average during 6 years 15.3%).

Table 2. *Number and percentage of deaths of resident mammals*

Year	1959	1960	1961	1962	1963	1964	1965	1966
Deaths	104	191')	112	92	150	100	85	130
Per cent mortality	18	23')	15	11.4	17	10.8	9.4	13.5

') in this figure part of the zoo-born mammals that died young is included

Table 3. *Number and percentage of deaths of resident birds*

Year	1959	1960	1961	1962	1963	1964	1965	1966
Deaths	245	669")	407	305	303	289	373	295
Per cent mortality	26	31")	24	17	17	16	19.4	15

") See also page 8: Stocking a new birdhouse.

BIRDS

After the difficult years 1959-1961 (see page 8 Stocking a new bird house) there are no striking ups and downs. Comparison along the lines stated above and over the same years shows:

Philadelphia collection: 1207-1472,
death rate 11.3 - 15.2 (average 13.2%)
Paris collection: 553-950,
death rate 7 - 14 (average 9.8%)
London collection: 1352-1496,
death rate 17 - 20 (average 18.5%)
Washington collection: 921-1196,
death rate 10.5 - 24.5 (average 15%)

CAUSES OF DEATH (Tables 4 and 5)

When a pathogenic micro organism is cultured or parasites are found the death is listed under this head. If not so the affected organs are listed. This means e.g. that there will be more *Salmonella* than listed as often, after a treatment with antibiotics, no pathogenic organism is to be found. On the other hand, if there is clearly a general infection in a group and in the majority of cases the same strain of *Salmonella* is cultured, all deaths are listed under *Salmonella*. If more than one organ system is involved one is chosen. "Not identified" in most cases means that only slight signs of disease could be found not allowing a firm conclusion. Sometimes there are no signs of any abnormality at all (included are advanced decomposition, no post mortem done). Often the victims of stress also will be listed under this head. Statistics without at least some of these cases cannot be complete.

EPIZOOTICS

Really serious epizootics are exceptional. It is our opinion that this is largely due to the fact that postmortems are done as completely as possible. As a consequence we are able to take preventive measures, as there are treatment of animals not yet sick with antibiotics e.g., and disinfecting the pens with halamid or natronlye if indicated. This is standing rule if *Salmonella* or *Pasteurella* are cultured.

Animals in the same cage or/and, eventually, those in adjacent cages are treated with chloromycetin-palmitate or, because of the inpalatability of chloromycetin, with oxytetracyclin, both mixed in the food and, especially with birds, sometimes also in the drinking water. Rather often the pathogenic organism of an apparent infection remains unknown. In these cases we also make use of the above mentioned antibiotics.

Table 4. *Causes of death — Mammals*

Causes of death	Number								Percentage							
	1959	1960	1961	1962	1963	1964	1965	1966	1959	1960	1961	1962	1963	1964	1965	1966
Infection	18	51	15	22	33	24	24	42	17	27	13	24	22	24	28	32.5
Salmonella	4	—	—	4	8	3	8	15								
Pasteurella	3	—	—	3	5	4	6	13								
Erysipelas	3	—	—	—	4	—	2	2								
Coccidiosis	8	4	—	—	—	—	—	—								
Tuberculosis	—	—	1	1	—	1	—	—								
Toxoplasmosis	—	—	—	—	—	—	3	1								
Alimentary	8	21	11	8	17	8	10	17	8	11	10	9	11	8	12	13
Respiratory	6	17	12	9	18	4	4	8	6	9	11	10	12	4	5	6
Liver	3	3	11	13	6	4	8	12	3	1.5	10	14	4	4	9	9
Injury	—	10	6	10	15	11	9	7	—	5	5	11	10	11	11	5
Parasitic worms	7	13	3	1	4	9	6	5	7	7	3	1	3	9	7	4
Neoplasms	—	3	—	—	2	3	—	1								
Overfeeding	9	—	—	—	—	—	—	—	39	13.5	19	16	14	15	20	18.5
Other causes	32	23	21	15	19	12	17	23								
Not identified	21	50	33	14	36	25	7	15	20	26	29	15	24	25	8	12
Total	104	191	112	92	150	100	85	130	100	100	100	100	100	100	100	100

— means zero or not counted separately

Table 5. *Causes of death — Birds*

Causes of death	Number								Percentage							
	1959	1960[1])	1961	1962	1963	1964	1965	1966	1959	1960	1961	1962	1963	1964	1965	1966
Infection	60	170	113	48	58	82	103	50	24.5	25	28	16	19	28	28	17
Salmonella	11	68	36	8	12	21	18	6								
Pasteurella	3	—	20	23	3	2	4	10								
Mycosis	13	33	9	7	15	12	9	5								
Tuberculosis	9	3	4	4	6	26	10	3								
Coccidiosis	11	11	9	—	8	—	11	6								
Erysipelas	5	—	—	—	3	5	2	4								
Virus	5	—	2	—	—	—	31	—								
Alimentary	50	90	57	56	86	27	66	50	20.5	13.5	14	18	28	9	18	17
Respiratory	26	98	36	20	21	13	28	23	11	15	9	6.5	7	4.5	7.5	8
Injury	15	33	54	68")	36	38	28	33	6	5	13	22.5	12	13.5	7.5	11
Parasitic (often Capillaria)	23	15	16	18	23	21	11	14	9	2	4	6	7.5	7	3	5
Urinary	6	23	26	16	17	19	17	16	2.5	3.5	6.5	5	6.5	7	4	5
Liver	—	4	4	5	3	12	19	16								
Circulatory	8	3	2	—	2	—	8	12	3	2	2.5	2	1.5	6	8	10.5
Neoplasms (Leucosis)	—	4	4	2	—	5	2	3								
Other causes	23	67	13	27	20	25	20	25	9.5	10	3	9	6.5	9	5	8.5
Not identified	34	162	82	45	36	47	71	53	14	24	20	15	12	16	19	18
Total	245	669	407	305	302		373	295	100	100	100	100	100	100	100	100

[1]) Birds hatched included

") 14 Birds killed by an invasion of black rats in the birdhouse

When few animals are involved that easily can be injected either by hand or with the Cap-Chur pistol this way of treatment has preference.

SALMONELLA

Although *Salmonella*'s of different types are cultured rather frequently as well in mammals as in birds it is only seldom that these infections give rise to an epizootic.

As generally accepted the infection can be acquired by several means, most of which it is impossible to prevent. Even infection by the food is not entirely avoidable.

On January 11, 1960 in the Carnivora building a Bengal Tiger (*Panthera tigris tigris*) fell ill under symptoms of an infectious disease. Bacteriological examination of a stool sample revealed a *Salmonella* infection. The animal was treated with daily injections of chloromycetin and twice weekly injections with B-vitamins and liver extract. During the following weeks the infection spread through the building and gradually several other individuals got infected among which 1.1 Jaguar (*Panthera onca*), two juvenile Jaguars, 1.1 Puma (*Felis concolor*), three juvenile Pumas and some Leopards (*Panthera pardus*). These animals were treated in the same way as the Bengal Tiger. All adult animals recovered with exception of the female Jaguar which had been in the collection for 6 years. Moreover we lost three Puma cubs aged ½ year and one of the two Jaguar cubs aged 9 months.

In the autumn of the same year the infection started again. This time with a juvenile Puma aged 5 months. After three days a juvenile Bengal Tiger of 6 months joined. Both were treated as described before; the Puma died, the Tiger recovered. One month later the Bengal Tiger suffered a relapse and died, after oral medication with chloromycetin tablets.

In January 1961 two juvenile Lions (*Panthera leo*) and a juvenile Leopard fell ill with the same symptoms. One juvenile Lion died as well as the Leopard cub (aged 5 months).

At the end of January 1961 we started treating every single animal in the building – whether showing symptoms or not – with oxytetracyclin soluble powder mixed in the food (dosage: 55 mg oxytetra-

cyclin HCl per kg estimated bodyweight). After this radical four day treatment of all the animals we did not have any suspect case for several years.

Moreover we removed the Guinea pigs (*Cavia porcellus*) housed in the same building, as they might be a possible source of infection. Whether the disappearance of the disease was due to the treatment or to the removal of the Guinea pigs or to both is, of course, very difficult to decide.

A remarkable fact was that, although all the animals had been vaccinated against cat distemper and during lifetime from the stools of many animals *Salmonella* was cultured, at the post-mortems of several of the animals cat distemper was diagnosed. We suppose that in spite of the vaccination the virus normally stays extant and superposes any infection which evokes a state of exceptional stress. Moreover the antibiotic treatment of the animals made culture of *Salmonella* after death difficult if not impossible.

In 1965 the infection started anew and this time again it turned out to be very difficult to put an end to it. Treatment this time consisted of oral dosing with chloromycetin palmitate (50 mg per kg bodyweight) and furazolidone (50 mg per kg bodyweight). This time typing of the cultured *Salmonella* occurred. The types *oranienburg* and *bareilly* were found.

TUBERCULOSIS

This is a rare disease among our mammals. Only occasionally it occurred during the years under discussion. In birds about the same situation exists. Only in 1963 we had some cases in a small number of lesser fish-eating birds (herons etc.) and pheasants. which are housed close to each other.

In 1964 there was an outbreak among the same groups of birds during which we lost 26 birds to this disease. The only *practical* way of discovering (possibly) infected birds before their death we found to be selection after careful examination on general condition. Tuberculin testing proved to be useless. Serological examination is not practicable under normal zoo conditions. The selected birds were isolated and if their condition did not improve within two or three weeks of heavy feeding (which it nearly never did) they were killed. Post-mortems proved that practically all these birds were infected with tuberculosis.

Through this radical elimination of possible sources of infection together with a thorough disinfection of the feeding trays we reduced the number of affected animals from 26 in 1964 via 10 in 1965 to 3 in 1966. In a comparable way we got rid of a tuberculosis infection in the small mammals' house before 1959. The daily disinfecting of the feeding trays (with halamid) and the weekly disinfecting of the pens has been continued as a general preventive measure.

VIRUS INFECTIONS

In 1963 an outbreak of feline influenza occurred among the small cats. A Caracal (*Felis caracal*) and a Bengal Tigercat (*Felis bengalensis*) had died without having shown any symptoms. Post-mortems showed indications for feline influenza. Immediately afterwards all cats in the small mammals' house were injected daily with chloromycetin for seven days (20-25 mg per kg bodyweight i.m.). Only one other Tigercat died, all the others survived.

A not identified virus infected some young Chimpanzees (*Pan troglodytes*) in September, 1963; presumably it was a virus pneumonia. All four of the animals were treated with a chloromycetin palmitate oral suspension. Three of them recovered rather quickly, the fourth died of pneumonia.

A serious outbreak of a virus infection (presumably psittacosis, although it could not be identified) occurred in the parrot collection in 1965. During two months and a half all birds received daily high doses of oxytetracyclin soluble powder in the food and the drinking water. 31 Birds died. Two deaths about a month later, in 1966, were possibly related to the same infection.

In 1962 an unknown agent that could not be identified in any known way killed within a short span of time all porcupines in the collection. Three Oursons (*Erethizon dorsatum*), two of which had shortly before been introduced into the collection after their quarantine period, one Brazilian Tree Porcupine (*Coendou prehensilis*), two Brushtail Porcupines (*Atherurus macrourus*) and two common Porcupines (*Hystrix* spec.) fell victim to the disease. None of the other rodents present in many species in the same small mammals' house showed any sign of the disease.

WORM INFECTIONS

In 1960 all our Mara (*Dolichotis magellanica*) died as a result of a heavy infection with *Graphioides affinis*, a common stomach parasite in these animals. We had treated the animals with phenothiazine and according to examination of stool samples the animals seemed free from the disease. Apparently the parasites have been able to multiply in a short span of time. Within 4 months nine animals died in ages between one month till about two years.

The deworming of our Okapi (*Okapia johnstoni*)

has been described elsewhere (SMITS and JACOBI, 1965).

About other case histories during 1963-1966 will be reported shortly. This report will tell about difficulties with young lions, the losses and births at our penguin colony and difficulties with young ruminants and the ruminants (pigmy goats and sheep) at the children's farm. These difficulties led to a vaccination scheme that at least is partly successful. May be some other experiences will be included if they appear of interest to others.

STOCKING A NEW BIRD HOUSE

Our antiquated bird house was only suitable to keep very hardy birds that would survive under the prevailing conditions in a draughty, leaking building with a forever failing heating system. As the rebuilding of this house was completed in 1960 we had to acquire an almost completely new collection of cage birds, parrots, parrakeets and lories. Most of the birds came, freshly imported, from dealers and the rest were imported by ourselves. It is not necessary to state here all the risks to which the birds were exposed before, during and after the transport.

Between February 5 and July 16, 1960, when the new house was stocked, 821 birds entered the quarantine. In this period 185 birds died or arrived dead, a percentage of 22,5.

Those with a higher than average death rate were:

Table 6.

Birds	Number	Deaths	Percentage
Fruit suckers	16	9	56
Tanagers	61	30	50
Bulbuls	24	11	46
Lories	35	14	40
Widow birds	36	10	28

As the new birds are put in their new cages and – let us be truthful – too many of them together, in the beginning mostly all is well. When they start to feel at home difficulties begin, fighting etc. This process during the second part of the year combined with some technical difficulties (draught) gave the following result (losses in quarantine included). On a total of 1007 birds the per cent mortality was:

July 16-December 31	25.7%
July 16-October 1 (2½ months)	17.5%
October 1-December 16 (2½ months)	7.6%

In 1961 some more new birds were put on exhibition and the first spring for the birds living together gave new difficulties:

1961 average per cent mortality of birds

in general	24 %
bird house	29 %

Deaths averaged 23 birds a month, the figures of April and May being 50 and 30 respectively. The difference between deaths in the bird house and the rest of the collection ebbs away in the next years.

1962 average per cent mortality of birds

in general	17 %
bird house	21 %
January 1-July 1	14%
July 1-December 31	7%

1963 average per cent mortality of birds

in general	17 %
bird house	18.5%

As comparable figures of other zoological gardens are not known it is not possible to decide whether these figures are normal. We only know that we have experienced, firstly, that spring (the normal time to do so) is the worst season to put new birds in a collection because of breeding tendencies and increased hostility of resident birds and, secondly, that not too many birds should be put into one aviary.

BIRTHS AND DEATHS

MAMMALS

The growth of the collection, the better accommodation and better feeding resulted in a gradual increase of the number of animals born from 115 to 266 yearly. Of course, there are ups and downs. E.g. the year 1964 is especially low in births (Table 7).

The survival percentage (Table 8) could give rise to long discussions. The background of the stated figures is rather complex.

For carnivores the breeding facilities are of paramount importance as for many of the small mammals. In our opinion the general results are not completely satisfactory as a survival percentage of 75 is considered to be within reach.

When looking at these figures the only section where nothing seems wrong is that of the ruminants. However, when sheep and goats are separated from the rest we obtain the following picture (Table 9).

The cause of this is not yet clear.

Table 7. *Mammals born*

	1959		1960		1961		1962		1963		1964		1965		1966	
	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D
Primates	4	2	16	5	19	7	19	7	22	3	11	3	18	10	34	17
Carnivores	56	26	60	19	48	32	76	35	63	22	51	27	73	36	74	24
Ruminants									87	23	72	23	73	27	85	27
Other hoofed animals	42	12	62	18	75	32	78	21					9	6	19	9
									57	19	20	8				
Other mammals	13	1	21	5	33	9	57	16					54	6	54	19
Total	115	41	159	47	175	80	230	79	229	67	154	61	227	85	266	96

B = all animals born with exception of premature births
D = animals still-born or dead within three months

Table 8. *Percentage survival of birth (percentage of mammals born, living after three months)*

Year	1959	1960	1961	1962	1963	1964	1965	1966
Primates	50	69	63	63	86	73	44	50
Carnivores	54	68	33	54	65	47	51	68
Ruminants	71	71	57	73	74	68	63	68
Other hoofed animals							33	53
Other mammals	92	76	73	72	66	60	89	65
Total	64	70.5	54	66	71	60	63	64

Table 9. *Sheep and goats.*

	Born	Dead	Survival percent.
1965	26	5	81
1966	31	7	77
Other ruminants			
1965	47	22	53
1966	48	20	58

Table 10. *Birds hatched (Not included are: tame birds, common Guinea Fowl and Japanese Quail)*

	1959		1960		1961		1962		1963		1964		1965		1966	
	B	D	B	D	B	D	B	D	B	D	B	D	B	D	B	D
Pheasants	79	32	78	40	57	28	62	18	100	51	91	43	22	13	21	9
Other gallinaceous birds	—	—	20	8	38	10	52	20					17	4	14	7
Geese	—	—	—	—	—	—	—	—	8	4	13	3	12	1	6	3
Ducks	4	2	—	—	19	18	28	21	12	4	28	17	26	21	46	19
Penguins	—	—									8	4	16	7	19	7
Others	41	11	40	15	68	28	44	18	25	8	20	19	22	8	32	20
Total	124	45	138	53	182	84	186	77	135	67	160	86	115	54	138	65

Table 11. *Percentage survival after hatching (percentage of birds hatched living after three months)*

	1959	1960	1961	1962	1963	1964	1965	1966
Pheasants	59	49	50	71	49	53	41	57
Other gallinaceous birds		60	74	62			77	50
Geese	—	—	—	—	50	77	92	50
Ducks	50	—	—	25	66	39	19	59
Penguins	—	—	—	—	—	50	55	63
Others	73	63	59	59	68	5	64	37.5
Total	54	62.5	64	59	50	46	46	53

BIRDS (Tables 10 and 11)

The accommodation for breeding birds is not good and very difficult to improve on account of lack of space in our zoo. Installation of a new incubator in 1965 has not yet shown an improvement in 1966 because of a number of minor difficulties. Better results can be expected here in the next years. The increased success with ducks (59% survival of birds hatched) can be attributed to brooding by tame ducks (Musk Ducks, *Cairina moschata*) and isolating foster mother with ducklings for some weeks. The number of birds hatched and their survival percentage are both considered too low, even for our poor facilities.

In the tables 10 and 11 the results with tame ducks, Guinea Fowl and Japanese Quail are not included. The last mentioned birds produced 132 young in 1965 and 142 in 1966, survival percentage 67 and 78 respectively.

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