

VETERINARY STUDIES ON THE BRITISH ANTARCTIC SURVEY'S SLEDGE DOGS:

I. SURVEY OF DISEASES AND ACCIDENTS

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ABSTRACT. In this review of records held in Stanley, Falkland Islands, an outline is given of the principal causes of death in a permanent breeding population of huskies maintained by the British Antarctic Survey.

Available data on breeding show that there is a considerable wastage due to the loss of young puppies. The main factor responsible for this may be a lack of available manpower to deal with the very arduous task of rearing large numbers of puppies under Antarctic conditions.

The causes of death in registered Antarctic sledge dogs have been classified under 13 headings. For the most part, these categories are what one might expect from a knowledge of the life and environment of these dogs. The exception is the condition now called "cervical lymphadenitis" since its aetiology is unknown.

From this review it can be seen that accidents and fights ("extrinsic" causes), and osteoarthritis, are the most frequent reasons for fatalities. Together, they account for 67.9 per cent of male deaths and 47.5 per cent of female deaths. However, accidents and fighting have most effect on the juvenile husky, whereas osteoarthritis almost invariably affects huskies older than 5 years.

Culling is the only category showing many more female than male deaths. There is a continual tendency to reduce the number of females to that required for breeding purposes and to replace females with males in sledge teams. Considering that this dog population is closed, one could reasonably expect the figures for culling to be higher than they are. Against this, there is the obvious need of continual replacement of fatalities and an inadequate knowledge of the technique of culling.

DESPITE the presence of a permanent breeding population of huskies at the British Antarctic Survey's stations since 1945, when the original dogs were brought from Labrador (Bingham, 1947), no veterinary information became available until M. F. Godsall visited these stations in the austral summer of 1963-64. Apart from a few occasional additions from Greenland in 1954 and 1961, and from Canada in 1954 (Taylor, 1957a), the present dogs are all directly descended from the original imports. The breeding and maintenance of sledge dogs has been well described by Bingham (1941), James (1947), Adie (1953), Reece (1954) and Taylor (1957a).

Nowadays, mechanical transport has to a large extent superseded the dog team but for field work from Stonington Island in the Antarctic Peninsula and Halley Bay on the Brunt Ice Shelf dog teams are still used extensively, and they have long since proved themselves to be a safe and reliable means of transport in mountainous terrain. In this manner, journeys of 600 miles (965 km.) are still undertaken regularly. Although there is no doubt that, in difficult conditions, a well-fed and well-driven team is a most efficient means of travel, modern demands are such that air support has now become essential if the dog team is to operate to its maximum efficiency.

Previous work

Before 1963-64, all research or medical work on the dogs had been done by medical officers or zoologists, producing very good results particularly on the nutrition and work output of sledge dogs. From their work it was shown that seal meat, with its high fat and protein content, was the ideal dog food. Furthermore, seal blubber is vital to the dog's well-being in conditions of poor weather or hard work. However, away from the coastal areas the dogs are fed on the sledging diet, Nutrican* (Taylor and others, 1959). Comparisons of this diet with the previously used dog Pemmican† (Wyatt, 1963), and with Pemmican and seal meat (Orr, 1965), were carried out and the present diet has only been varied in composition when the manufacturers have had to turn to other sources for the basic constituents.

It is now customary to follow Orr's guidance and to feed at least 1½ lb. (0.68 kg.) Nutrican daily when conditions and supplies permit. Feeding at this rate will not stop the members of a

* Manufactured by Bob Martin Ltd.

† Manufactured by Bovril Ltd.

hard-working team from losing weight progressively but fortunately the dogs recuperate very rapidly when Nutrican or seal meat is once again unlimited.

In 1967 vitamins and minerals were added to Nutrican to supplement the vitamins included after Taylor's work (see Bellars and Godsall, 1969, Appendix II).

Sledge loads

For practical purposes, 120 lb. (54.5 kg.)/dog is still considered as a fair maximum sledge load, although air-support facilities often lower this figure. Taylor (1957b) measured the pull exerted by a dog team; he was able to show daily fluctuations of up to 50 per cent and stressed that many factors including gait, changes in temperature, diet, snow surface and the psychological effect of long and monotonous journeys affected the dogs' performance.

Teams

The standard Survey team consists of nine dogs, the leader often being a bitch. The lighter, more responsive dogs are usually in the lead and the heavier workers in the rear. Pups are trained to harness from 6 months onwards and they are usually in full work shortly after reaching the age of 9 months. A normal healthy husky dotes on human company and gives every appearance of thoroughly enjoying its work. The present dogs average between 70 and 95 lb. (31.8 and 43.1 kg.) in weight when well fed and exercised, with the bitches weighing 10–20 lb. (4.5–9.1 kg.) less than the dogs. As a general rule, the Labrador type, with its long strong back and powerful relatively shorter legs, is found to be ideal for the work.

At all of the stations except Halley Bay the dogs are "spanned out" in the traditional manner at all times, the only exception being whelping bitches. At Halley Bay the dogs are put into ice tunnels when the winter temperature drops below -30°C .

Harnesses

Each dog has its own tailor-made harness made from $1\frac{1}{2}$ in. (3.8 cm.) wide lampwick, which is soft and strong, and spreads the load across the shoulders and chest (Fig. 1). There are several methods of attaching the harnessed team to the sledge (Rymill, 1937) but the commonest method is the centre trace. Occasionally the fan method has found favour.

Distances

There is considerable variation in distances travelled on field journeys but a round haul of 900 miles (1,450 km.) is not unusual. A good dog might cover at least 8,000 miles (12,900 km.) during its working life (Taylor, 1957a); one litter of pups covered 1,000 miles (1,610 km.) before they were 1 year old, having started full work at 6 months of age (personal communication from N. W. M. Orr). Much time is wasted because of bad weather, with resultant boredom in both men and dogs during these lie-up periods. Under good conditions in the Antarctic Peninsula a sledging party may average 16 miles (26 km.)/day.

Retirement

The older dogs are usually incapable of further useful work by the time they are 8 years old. They are then destroyed or retained for breeding, or for pup training. Many dogs become too slow before they are 8 years old. It was mainly because this had been observed that M. F. Godsall toured the stations and determined that the reason for this slowing was osteoarthritis.

Present work

Osteoarthritis was found to be a major problem in Antarctic sledge dogs and it was investigated during two summer tours of the Survey's stations. One season was devoted to a pathological survey and another to a clinical approach involving X-radiography. In addition, entropion of the eyelids was found to exist in the dogs and surgical correction was carried out where necessary. In 1967–68, true haemophilia was encountered in two related litters at one station. As both of these conditions are thought to be hereditary in origin, the complete genealogy of the British Antarctic Survey sledge dogs was traced with the aid of G. K. McLeod.



Fig. 1. A typical British Antarctic Survey husky wearing a tailor-made lampwick harness. (Photograph by P. Thompson.)

Where a condition had been reported in the past, advice was given as to its possible cause, treatment and further investigation. Among these were a disease known as "Signy neck" (but referred to here as cervical lymphadenitis), a condition erroneously called "ringworm", pyometra and endometritis, and corneal opacity.

By far the largest part of the work involved the examination of every dog at each station, the instruction of medical officers and station members on aspects of the veterinary treatment of dogs (particularly the treatment of wounds), distribution of appropriate drugs to each station, surgical treatment of individual dogs, and finally, advice on many of the subjects involved with the maintenance of a large colony of dogs. It was a privilege, as novices to the Antarctic, to learn a very large amount from dog drivers and their dogs.

As a result of these visits, great emphasis was placed on the many advantages of carrying out complete post-mortem examinations, and the advisability of continued veterinary investigation at regular intervals. Following recommendations, it is hoped that more dogs will be introduced from the Arctic in the near future.

The results of the present work are given in three separate papers, discussing a survey of diseases and accidents, the occurrence of occupational osteoarthritis, and breeding and hereditary diseases.

SURVEY OF DISEASES AND ACCIDENTS

ALMOST complete records of breeding, mortality and causes of death of British Antarctic Survey sledge dogs have been maintained from about 1950 up to the present day. Following the finding by M. F. Godsall (1964) that osteoarthritis was the cause of the slowing and inefficiency of the ageing dogs, an opportunity to survey the records arose in 1968 in order to evaluate the contribution of osteoarthritis to the overall mortality. This led to a complete

survey of all the available data and enabled the author to draw up a summary of breeding figures, pup mortality and causes of death (both intrinsic and extrinsic) of the adult dogs.

All of the Survey's sledge dogs are registered at the age of 3 months. The records therefore fall into three categories:

- i. Unregistered dogs, covering breeding and pup mortality.
- ii. Registered dogs (extrinsic causes of death).
- iii. Registered dogs (intrinsic causes of death).

BREEDING AND PUP MORTALITY

Table I shows that the total numbers of litters and individuals are known but that in many cases the litters were destroyed without note being made of their sex.

TABLE I. OVERALL FIGURES FOR THE LITTERS BORN DURING 1950-68

	1950-55	1955-60	1960-68
Number of litters	52	86	86
Male pups	151	214	202
Female pups	118	214	167
TOTAL	281	465	409
Mortality (died or destroyed)	139	263	232
Mortality (percentage)	45.9	56.6	57.7
Average litter size	5.23	5.41	4.76
Sex ratio (♂ : ♀)	1.28 : 1	1.02 : 1	1.20 : 1

The figures for average litter size and sex ratio were obtained from data, on 51, 80 and 77 litters for the three columns, respectively. At first sight it might appear that the average litter size is falling, but statistical examination of these figures shows that there is no significant difference in the litter size in the three selected periods and that the sex-ratio figures should be considered as a ratio of 1 : 1.

For comparison with these overall figures, station members at Stonington Island and Halley Bay prepared the figures in Table II from records held at each station up to 1968. All of the compiled information is compared in Table III.

The figures in Table III give some idea of the difficulties in rearing pups at Antarctic stations. It is known that many pups die within 24 hr. of birth due to exposure and chilling, but these cannot be differentiated in the reports from litters born in the field, litters culled at birth and litters destroyed by the bitch. The relatively higher 24 hr. mortality at Halley Bay reflects the lack of shelter for whelping, a situation which has now been corrected.

The figures for overall mortality up to 6 months of age are more striking and they show that there is a large wastage. Many of these pups will have been adventurous individuals that roamed farther afield than their fellows. However, there is obviously a limit to the number that any station can rear in a year and a higher survival rate would have posed severe overcrowding problems besides overworking those members remaining at the station during the field season. Thus, these figures do no more than demonstrate the potential of the breeding that has taken place.

The figures for average litter size suggest that the British Antarctic Survey husky is as fecund as any similar-sized breed in the United Kingdom and that fecundity has not decreased in the last 18 years.

TABLE II. BREEDING RECORDS FOR TWO BRITISH ANTARCTIC SURVEY STATIONS

<i>Stonington Island*</i>		
Pup mortality at age 24 hr. (per cent)	21.5	
Pup mortality at age 6 months (per cent)	43.5	
Average litter size (based on 35 litters)	4.9	
For every fruitful mating, slightly less than 1.9 pups were still alive at 6 months.		
<i>Halley Bay†</i>		
	<i>Number</i>	<i>Percentage</i>
Total number of pups born	143	100
Pup mortality at age 24 hr. died	76	53.1
destroyed	45	31.5
Pup mortality at age 6 months	123	86
Average litter size	5.3	
For every fruitful mating, 0.74 pups were still alive at 6 months.		

* Based on records of 170 dogs, dating from 1954.

† Based on records from January 1961 to March 1968. In this time, 15 bitches produced 27 litters.

TABLE III. COMPARISON OF BREEDING RECORDS

	<i>Overall</i> (1950-68)	<i>Stonington Island</i> (1954-68)	<i>Halley Bay</i> (1961-68)
Number of litters	224	35	27
Total of pups born	1,155	172	143
Average litter size	5.13	4.9	5.3
Mortality at 24 hr.	* (*)	37 (21.5 per cent)	76 (53.1 per cent)
Pups destroyed	*	*	45 (31.5 per cent)
Total pup mortality (i.e. to age 6 months)	634 (53.4 per cent)	75 (43.5 per cent)	123 (86 per cent)
Pups per recorded litter	*	1.9	0.74

* Figures not available.

EXTRINSIC AND INTRINSIC CAUSES OF DEATH IN
REGISTERED BRITISH ANTARCTIC SURVEY SLEDGE DOGS

Up to 7 April 1968, 470 registered Survey sledge dogs had died or had been destroyed. Of these, only 17 (10 males and 7 females) had no records at all; of the remainder, 312 were male and 141 were female. It is normal practice to cull a proportion of the female population so that the working teams shall consist mainly of males. Although most of the culling of females takes place before the age of registration (12 weeks), a number of females are culled later in life.

Even though almost complete records are kept, it is difficult to make clear retrospective

diagnoses. Hence, for simplicity and clarity, broad general headings have been used to cover the possible reasons for, or causes of, death. For instance, in some cases dogs dying of old age or exposure may also have been blind but they have been classified under "old age" as this would seem to have been the over-riding cause of death.

Extrinsic causes

This heading covers causes of death such as accidents, fighting, etc., but many of the terms overlap. For instance, the term "sledging accidents" covers accidents in the field, where part of or an entire team has been tragically lost. The losses of individual dogs have been classified under more specific causes.

Tables IV-VII emphasize the hazardous side of the life of the working husky. The striking figures are those that show the tremendous toll in the first 2 years of life. The losses due to fighting are perhaps inevitable when there has to be a change of driver at least every 2 years. At each change-over there is a pause before control by the driver is once again established. Allowing for the major tragedies, it is suggested that many of the other losses could have been avoided more easily than those due to disease.

The two deaths under anaesthesia occurred during premeditated operations. It is therefore hoped that the instructions and materials left at the stations will prevent further anaesthetic losses.

TABLE IV. PUPS KILLED BY ADULTS*

<i>Males</i>	<i>Females</i>
15 (4·8 per cent)	3 (2·1 per cent)

* In this and all succeeding mortality tables, the figures in brackets give the percentage of the total dead animals of the respective sex, i.e. 470 dogs have died, of which 312 males and 141 females had adequate records. Thus, in this table, 15 is 4·8 per cent of 312 and 3 is 2·1 per cent of 141.

TABLE V. DEATHS AND DESTRUCTIONS AS A SEQUEL TO FIGHTING

<i>Age (yr.)</i>	<i>Males</i>	<i>Females</i>
0-1	3	1
1-2	3	1
2-3	3	1
3-4	1	—
4-5	3	—
5-6	3	—
6-7	2	—
7-8	1	1
8-9	—	—
9-10	1	2
TOTAL	20 (6·4 per cent)	6 (4·3 per cent)

TABLE VI. DEATHS DUE TO ACCIDENTS

<i>Age (yr.)</i>	<i>Males</i>	<i>Females</i>
0-1	17	6
1-2	15	2
2-3	7	1
3-4	8	2
4-5	5	2
5-6	8	1
6-7	3	1
7-8	5	1
8-9	2	1
9-10	—	—
10-11	—	1
11-12	—	1
TOTAL	70 (22·4 per cent)	19 (13·5 per cent)

TABLE VII. CLASSIFICATION OF FATAL ACCIDENTS

<i>Cause</i>	<i>Male</i>	<i>Female</i>	<i>Total</i>
Sledging accidents (involving loss of whole or part of team)	34	6	40
Missing presumed dead	11	3	14
Fractures	7	2	9
Drowned	5	3	8
Strangled on span	1	3	4
Anaesthesia	2	—	2
Dislocated shoulder	1	1	2
Killed in crevasses	9	1	10
TOTAL	70	19	89

Intrinsic causes

This heading is intended to cover the causes of death in Antarctic sledge dogs due to disease. The sub-headings refer either to specific known conditions where possible or to the symptoms by which the condition has become known. Some conditions were not of themselves fatal, e.g. blindness or osteoarthritis, but since they rendered the dog incapable of further useful work, or necessitated its destruction on humane grounds, they have been included here under "fatal" causes. Finally, there are sections covering destruction of dogs for poor conformation, etc. (culling), and deaths and destruction because of illness of unknown aetiology. Where the meaning of a sub-heading is non-specific and obvious to the reader, little comment has been included in the text.

"Cervical lymphadenitis"

Over many years, some of the dogs at the Survey's stations at Signy Island, Deception Island and Hope Bay developed a condition which came to be known as "Signy neck" or "Signy X disease" (Table VIII). Its main symptoms appear to have been swollen cervical lymph nodes, fever, dysphagia (inability to swallow) and occasional secondary respiratory infection. Many cases responded well to antibiotic therapy, particularly if the inspissated lymph nodes had been lanced and drained beforehand. Older dogs withstood the disease better than younger ones. Some post-mortem samples were sent to Cambridge for histopathological examination. Although they arrived in a poor state, it was suggested that there might be changes in the tissues due to viral infection, as well as secondary bacterial infection. As the main cause of trouble (i.e. lymphadenitis) responded well to antibiotic treatment, bacterial infection seems to have been largely responsible for causing the disease. The author did not see this condition, since dogs were withdrawn from the northern stations coincidental with Godsal's visit and no more cases were seen at that time or since. Thus, the aetiology of this disease may remain unknown.

TABLE VIII. DEATHS DUE TO "CERVICAL LYMPHADENITIS"

<i>Age (yr.)</i>	<i>Males</i>	<i>Females</i>
0-1	—	2
1-2	2	1
2-3	1	—
3-4	—	1
4-5	1	—
5-6	1	—
6-7	—	—
7-8	—	1
TOTAL	5 (1·6 per cent)	5 (3·5 per cent)

Pneumonia and/or septicaemia

In some cases pneumonia (Table IX) may have been secondary to other disorders (e.g. exposure) and in other cases generalized septicaemia may have been secondary to a primary pneumonia. All the cases reported were confirmed on post-mortem examination and, in some cases, pleurisy was recorded as well.

TABLE IX. DEATHS DUE TO PNEUMONIA AND/OR SEPTICAEMIA

<i>Age</i> (yr.)	<i>Males</i>	<i>Females</i>
0-1	2	4
1-2	—	—
2-3	1	—
3-4	—	—
4-5	1	—
5-6	—	1
6-7	—	—
7-8	—	2
TOTAL	4 (1·3 per cent)	7 (4·9 per cent)

Meningitis

Two dogs died as a result of symptoms suggestive of meningitis (Table X). No post-mortem examination was carried out in either case and there was no report of primary infection.

TABLE X. DEATHS DUE TO "MENINGITIS"

<i>Age</i> (yr.)	<i>Sex</i>
4·6	Male
4·9	Female

Blindness

Cases included here are those where blindness appears to have been the main reason for destruction (Table XI). One of these dogs was blind in one eye only. The others were bilaterally blind and two of them were senile as well.

TABLE XI. DOGS DESTROYED DUE TO BLINDNESS

<i>Age</i> (yr.)	<i>Males</i>	<i>Females</i>
3-4	2	1
4-5	1	—
5-6	2	—
6-7	1	—
7-8	—	1
8-9	—	1
TOTAL	6 (1·9 per cent)	3 (2·1 per cent)

The aetiology of these cases is problematical. In some instances, they were probably due to corneal opacity caused by foreign matter in the eye. Godsall (personal communication) found this was a recurring clinical problem with some of the dogs at the northern stations, where the spans were on volcanic dust or loose rock. Corneal opacity could also have been caused by hereditary entropion. This condition has been diagnosed in eight huskies at Survey stations but it is possible that other cases have not been diagnosed except as terminal "blindness". Hereditary conditions in Antarctic huskies will be discussed elsewhere.

It is possible that senile cataract was responsible for blindness in some instances.

One dog (included in Table V and *not* in Table XI) was destroyed because of acquired entropion caused by fight wounds of the eyelids. These wounds are a frequent occurrence but they seldom amount to anything severe enough to warrant destruction. The author saw and treated one case of *ectropion* of the lower left eyelid caused by poor healing of a fight wound.

Heart disease

This general description covers those cases where post-mortem examination following the collapse and death of a dog was reported as showing apparent disorders of the cardiovascular system (Table XII).

TABLE XII. DEATHS DUE TO CARDIOVASCULAR DISORDERS

<i>Age (yr.)</i>	<i>Males</i>	<i>Females</i>
0-1	2	None
1-2	1	
2-3	—	
3-4	—	
4-5	—	
5-6	1	
6-7	—	
7-8	1	
8-9	—	
9-10	1	
TOTAL	6 (1.9 per cent)	

Hind-quarter paralysis

This very vague term which has been used in reports could describe the result of a cardiovascular accident. Since these cases could also be due to fight wounds, prolapse of intervertebral discs, severe osteoarthritis or even complications of spondylosis deformans, they have been classified separately (Table XIII) from those under "heart disease".

Exposure and old age

These deaths have been tabulated together (Table XIV), since the onset of senility predisposes to death by exposure. Where the dog was young, or the facts are clearly recorded, the case has been recorded under "exposure". "Old age" refers to dogs that died with no apparent cause or complaint at an advanced age.

TABLE XIII. DOGS DESTROYED DUE TO HIND-QUARTER PARALYSIS

<i>Age</i> (yr.)	<i>Males</i>	<i>Females</i>
0-1	—	None
1-2	—	
2-3	1	
3-4	—	
4-5	2	
5-6	—	
6-7	1	
TOTAL	4 (1·3 per cent)	

TABLE XIV. DEATHS DUE TO EXPOSURE AND OLD AGE

<i>Age</i> (yr.)	<i>Exposure</i>		<i>Old age</i>	
	<i>Males</i>	<i>Females</i>	<i>Males</i>	<i>Females</i>
0-1	2	—	—	—
1-2	—	2	—	—
2-3	—	1	—	—
3-4	—	—	—	—
4-5	1	—	—	—
5-6	1	2	—	—
6-7	1	—	—	—
7-8	1	1	—	3
8-9	—	—	1	2
9-10	—	—	—	—
10-11	—	—	2	—
11-12	—	—	1	—
TOTAL	6 (1·9 per cent)	6 (4·3 per cent)	4 (1·3 per cent)	5 (3·5 per cent)
Average age (yr.)			10·25	8·08

Intestinal obstruction

In some of these cases, foreign bodies such as bone fragments or lampwick caused fatal obstructions (Table XV). Other cases were diagnosed as intussusception but, since this is most

TABLE XV. DEATHS DUE TO INTESTINAL OBSTRUCTION

<i>Age (yr.)</i>	<i>Males</i>	<i>Females</i>
0-1	3	1
1-2	1	—
2-3	1	1
3-4	—	—
4-5	1	2
5-6	4	1
6-7	1	—
7-8	—	—
8-9	—	2
TOTAL	11 (3·5 per cent)	7 (4·9 per cent)

likely to occur only in young dogs, it is probable that the cases in older dogs were true foreign-body obstructions.

Also included in this category are three cases of acute gastric dilatation, one of which died from rupture of the stomach, and one case of perforation of the intestine. Finally, one young bitch died from choking on a bone fragment.

Endometritis and pyometra

These two specific causes of disease in the bitch have been dealt with together, since both have been responsible for fatalities in the Antarctic husky (Table XVI).

TABLE XVI. DEATHS DUE TO DISORDERS OF THE FEMALE GENITAL TRACT

<i>Age (yr.)</i>	<i>Numbers</i>
3-4	1
4-5	—
5-6	2
6-7	2
7-8	3
TOTAL	8 (5·7 per cent)

Post-partum endometritis occurred in the two youngest bitches, aged 3·8 and 5·3 years, respectively. True pyometra occurred in four other cases and three of these were in maiden bitches.

In simple terms, endometritis means infection of the inside of the uterus, usually after parturition. Pyometra is a condition that particularly occurs in the maiden bitch aged 5 years or more. It usually builds up over several oestrus periods and occurs 5–8 weeks after the last oestrus period. In the terminal stages the uterus becomes filled with pus, resulting in dehydration, toxæmia and death. Retrospective diagnosis in these cases is simple from the post-mortem description. Surgical treatment consists of removal of the uterus and ovaries and this is usually successful.

One bitch (aged 8·2 years), destroyed because of osteoarthritis, was found to have early pyometra. Finally, two cases of rupture of the uterus are included in this category. One of these bitches (aged 7·8 years) was found to have been pregnant. The other was aged 7·8 years and its previous history was not recorded.

Neoplasia

Only four cases of neoplasia have been recorded in the Survey's huskies. None of these cases was confirmed by histopathological examination but all four cases would seem to have been suffering from malignant neoplasia (Table XVII).

TABLE XVII. DOGS DESTROYED DUE TO NEOPLASIA

<i>Cause</i>	<i>Number</i>	<i>Sex</i>	<i>Age (yr.)</i>
"Cancer" mouth	2	Male	6·8
		Male	8·1
"Tumour" spleen	1	Male	5·6
"Cancer" liver	1	Male	6·9
TOTAL	4 (1·3 per cent)		

Culling

This is a most important process in the maintenance of a healthy, relatively closed population of dogs (Table XVIII). Although "poor conformation" covers all possibilities in this group, temperament and over-long hair have been separated as they are more specific problems. The term "cull" itself has been reserved here for dogs destroyed for reasons such as station evacua-

TABLE XVIII. DOGS DESTROYED DUE TO FAILURE OF CONFORMATION

<i>Reason</i>	<i>Male</i>	<i>Female</i>
Poor conformation	5	7
Culling	6	5
Temperament	—	4
Over-long hair	1	3
TOTAL	12 (3·8 per cent)	19 (13·5 per cent)

tion. One bitch was destroyed because it continually slipped its harness and was "uncatchable". One dog was destroyed because it killed four well-grown pups. Both of these cases are included under "temperament".

Miscellaneous causes of death

In this category are the remaining conditions (Table XIX) which have not accounted for more than two cases.

TABLE XIX. MISCELLANEOUS CAUSES OF DEATH IN ANTARCTIC HUSKIES

<i>Condition</i>	<i>Males</i>	<i>Females</i>
"Hard pad"	2	—
Haemophilia	2	—
Haematemesis	1	—
Recurrent hair loss	—	2
Parodontal disease	1	—
TOTAL	6 (1·9 per cent)	2 (1·4 per cent)

"*Hard pad*." This "disease" is now known to be a symptom produced by certain strains of canine distemper virus. It was seen in two young dogs that died in 1956 on their way south for the Trans-Antarctic Expedition. Serum studies on a husky brought back to the United Kingdom in 1968 showed that it was completely susceptible to canine distemper virus, suggesting that an outbreak of the disease on a sledging station would produce many fatalities.

Haemophilia. One dog died from, and one dog was destroyed due to, apparent haemophilia. Another dog, also suffering from the condition, was brought back to the United Kingdom for further study and the condition was confirmed as being true haemophilia. A report on these will appear elsewhere.

Haematemesis. Vomiting of blood was the terminal symptom in one aged dog. It could have been the result of many different disease processes but no more is known since no post-mortem examination was carried out.

Recurrent hair loss. This became a problem necessitating destruction of two female huskies. Three aged male dogs suffered periodic bilateral and symmetrical hair loss on the flanks but they were finally destroyed due to osteoarthritis.

Parodontal disease. This term describes infection of the tooth root under the gum. It is a rare condition in the Antarctic husky compared with its incidence in pet dogs in the United Kingdom. One 8-yr.-old female husky, which was destroyed due to osteoarthritis, was found to have an abscess of the root of one canine tooth. One 7-yr.-old female husky underwent extraction of the right upper carnassial tooth and the tooth was found to have caries. Dental caries is a rare condition in dogs.

It is not surprising that the Antarctic husky is almost free from dental disease, when one considers the natural form of the diet. However, it was noted that dogs that have been fed on a Nutrican sledging diet for long periods build up deposits of tartar on their teeth. This accretion is very commonly the first stage of parodontal disease in domestic dogs.

Cause of death unknown

This heading (Table XX) covers all those cases where no reason was found for the apparently sudden death of a dog. In many cases, post-mortem examination was carried out but it showed nothing abnormal.

TABLE XX. AGES OF HUSKIES THAT HAVE DIED FROM UNKNOWN CAUSES

Age (yr.)	Males	Females
0-1	5	2
1-2	3	—
2-3	3	—
3-4	2	—
4-5	4	3
5-6	6	4
6-7	7	1
7-8	—	—
8-9	—	1
9-10	—	—
10-11	1	—
TOTAL	31 (9.9 per cent)	11 (7.8 per cent)

Osteoarthritis

Godsal found that 26 out of 34 dogs examined *post mortem* had erosions of the articular cartilage of hip and shoulder joints. He was able to show that this was osteoarthritis (Bellars and Godsal, 1969). From the records, a further 30 dogs were confirmed as suffering from osteoarthritis. In all of these confirmed cases the dogs had been destroyed because they had become incapable of further work, showing slowness, stiffness and occasionally lameness (Fig. 2).

In this survey, it is desirable to indicate whether the confirmed cases of osteoarthritis are a fair sample of the clinically affected dogs. In the absence of a post-mortem examination, it has been assumed that a dog was destroyed because of osteoarthritis if its record card stated as a reason for destruction either stiffness, slowness, rheumatism or arthritis (Fig. 3).

These histograms show clearly that there is a difference in incidence between confirmed and assumed cases of osteoarthritis in female Antarctic huskies. This difference, and the one between the incidence in males and females, is explained by the practicalities of team selection. Apart from the general tendency to cull females rather than males, team drivers would prefer to destroy slightly affected females than more severely affected males, and this would explain why there are no female survivors over the age of 9 years. With this in mind, the dogs were put into four classes and the figures were examined statistically (Table XXI).

From Table XXI it is clear that there are no significant differences between the values for the four classes. By plotting the figures on probability graph paper, it was shown that the frequency distribution of death due to confirmed and assumed osteoarthritis is normal.

From these calculations, it is reasonable to assume that the data shown in Figs. 2 and 3 are drawn from the same population, and that therefore the terms slowness, stiffness, etc., are good evidence of osteoarthritis in Antarctic sledge dogs.

For final emphasis of the role of osteoarthritis of hip and shoulder joints in limiting the useful working life of sledge dogs, Table XXII shows the percentages of dogs of either sex that have been destroyed due to osteoarthritis, when compared with the losses due to "extrinsic" and "intrinsic" causes.

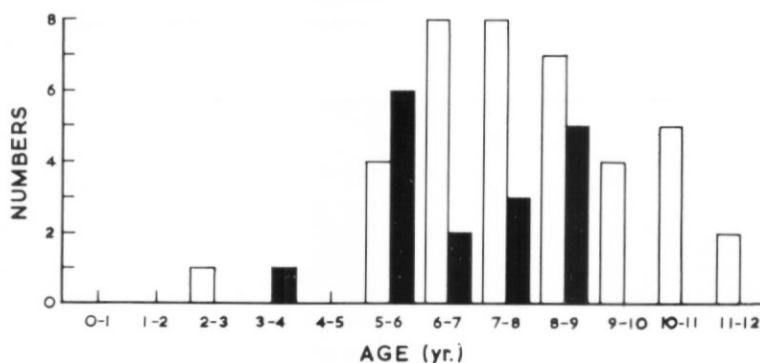


Fig. 2. The age and sex of dogs destroyed due to slowness and stiffness, confirmed at post-mortem examination to be caused by osteoarthritis (1950–April 1968).

	Total	Average age (yr.)
Males (open columns)	39	7.9
	(12.5 per cent)	
Females (solid columns)	17	6.7
	(12.0 per cent)	

Of the 26 cases destroyed by Godsall, some were destroyed earlier than they might have been because sledging at the Signy Island station ceased in that year. This accounts for the bitch (aged 3.4 years) which had in fact slight osteoarthritis of both hip joints. The male husky (aged 2.5 years) was one of a litter which began heavy work at 6 months of age, and this may account for the unusually early incidence.

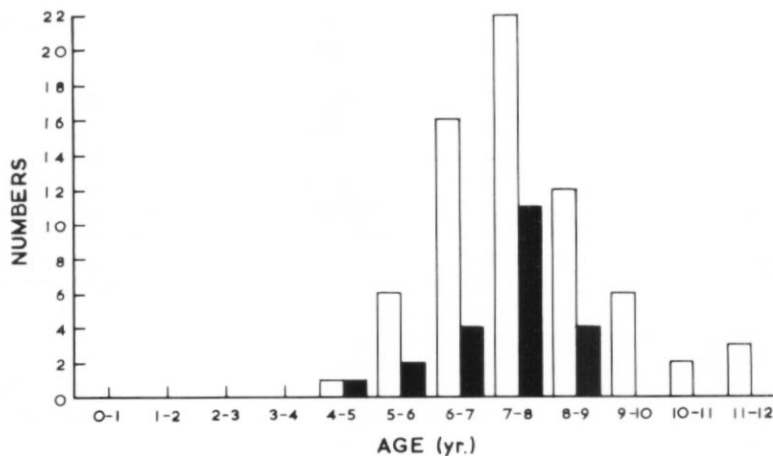


Fig. 3. The age and sex of dogs destroyed due to slowness and stiffness, assumed to be caused by osteoarthritis (1950–68).

	Total	Average age (yr.)
Males (open columns)	68	7.6
	(21.8 per cent)	
Females (solid columns)	22	7.3
	(15.6 per cent)	

TABLE XXI. MEAN AGE AND STANDARD ERROR FOR THE DESTRUCTION OF ANTARCTIC HUSKIES DUE TO OSTEOARTHRITIS

<i>Class</i>	<i>Sex</i>	<i>Mean age and standard error of mean (yr.)</i>
Confirmed osteoarthritis	Male	7.9±0.32
Confirmed osteoarthritis	Female	6.7±0.96
Assumed osteoarthritis	Male	7.6±0.16
Assumed osteoarthritis	Female	7.3±0.25

TABLE XXII. PERCENTAGE LOSSES DUE TO OSTEOARTHRITIS IN REGISTERED BRITISH ANTARCTIC SURVEY SLEDGE DOGS

	<i>Males</i>			<i>Females</i>		
	<i>Total</i>	<i>"Osteo-arthritis"</i>	<i>Per-centage</i>	<i>Total</i>	<i>"Osteo-arthritis"</i>	<i>Per-centage</i>
Deaths due to osteoarthritis expressed as a percentage of the total mortality	312	107	34.3	141	39	27.6
Deaths due to osteoarthritis expressed as a percentage of the mortality due to "intrinsic" causes	207	107	51.7	113	39	34.5
Deaths due to osteoarthritis expressed as a percentage of the mortality due to "intrinsic" causes in the Survey's sledge dogs older than 5 years	147	105	71.4	71	37	52.1

CONCLUSION

These results show clearly that osteoarthritis is the largest factor resulting in the death of British Antarctic Survey sledge dogs. In this paper the only concern is with mortality, whereas the actual incidence of erosions of the hip and shoulder joints is probably higher. With an insidious disease such as osteoarthritis there are obvious opportunities for other disease processes and accidents to supervene fatally. It is thus all the more striking to observe the large number where osteoarthritis was the predominant factor resulting in death.

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REFERENCES

- ADIE, R. J. 1953. Sledge dogs of the Falkland Islands Dependencies Survey, 1947-50. *Polar Rec.*, **6**, No. 45, 631-41.
- BELLARS, A. R. M. and M. F. GODSAL. 1969. Veterinary studies on the British Antarctic Survey's sledge dogs: II. Occupational osteoarthritis. *British Antarctic Survey Bulletin*, No. 22.
- BINGHAM, E. W. 1941. Sledging and sledge dogs. *Polar Rec.*, **3**, No. 21, 367-85.
- . 1947. The Falkland Islands Dependencies Survey, 1946-47. *Polar Rec.*, **5**, Nos. 33, 34, 27-39.
- GODSAL, M. F. 1964. Veterinary report on British Antarctic Survey sledge dogs, 1963-4. 16 pp. [Unpublished.]
- JAMES, D. 1947. The sledge dogs of the Falkland Islands Dependencies Survey, 1945-46. *Polar Rec.*, **5**, Nos. 33, 34, 40-43.
- ORR, N. W. M. 1965. Food requirements of dogs on Antarctic expeditions. *British Antarctic Survey Bulletin*, No. 7, 53-67.
- REECE, A. 1954. Sledge dogs of the Norwegian-British-Swedish Antarctic Expedition, 1949-52. *Polar Rec.*, **7**, No. 47, 32-37.
- RYMILL, J. 1937. The dogs of the British Graham Land Expedition. *Polar Rec.*, **2**, No. 14, 153-57.
- TAYLOR, R. J. F. 1957a. The breeding and maintenance of sledge dogs. *Polar Rec.*, **8**, No. 56, 429-40.
- . 1957b. The work output of sledge dogs. *J. Physiol., Lond.*, **137**, No. 2, 210-17.
- , WORDEN, A. N. and C. E. WATERHOUSE. 1959. The diet of sledge dogs. *Br. J. Nutr.*, **13**, No. 1, 1-16.
- WYATT, H. T. 1963. Further experiments on the nutrition of sledge dogs. *Br. J. Nutr.*, **17**, No. 3, 273-79.