ON THE PARASITES ASSOCIATED WITH THE BATHYERGIDAE

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INTRODUCTION

Among the smaller mammals occuring in the Kruger National Park, the mole-rat is certainly one of the most interesting. These animals (Order Rodentia, family Bathyergidae) show remarkable adaptations to their fossorial mode of life and on account of the cryptic nature of the animals very little is known about parasites associated with the bathyergids.

The family is purely Ethiopian. In Southern Africa the genera *Bathyergus, Georychus* and *Cryptomys* occur. *Bathyergus* (the dune mole-rat) ranges along the coast of the south western Cape province from Port Nolloth to Knysna, while *Georychus* (the Cape mole-rat or "blesmol") occurs in the Western Province and along the coastal belt to Port Elizabeth. *Cryptomys* (the common mole-rat or "grysmol") on the other hand has a Republican-wide distribution and also occurs in South West Africa, Angola, Northern and Southern Rhodesia and Portuguese East Africa. In Kenya, Tanganyika, the southern Congo, Northern Rhodesia and Nyasaland, a fourth genus is found viz. *Heliophobius* (the silvery mole-rat) while still further north the genus *Heterocephalus* (the naked mole-rat or sand puppy) is encountered in Abyssinia, Somaliland as well as in Kenya (Ellerman, 1940, 84, 94).

The literature on the subject of parasites occuring in and on the bathyergids is very meagre. Although he collected extensively in South West Africa, Shortridge (1934, 325) states that no external parasites were observed on any South West African *Cryptomys* forms. Roberts (quoted in Shortridge *(loc. cit.)* states that they are not infested with fleas though a certain type of lice is to be found on them. This may refer to the sucking lice recorded as parasites on the bathyergids by Bedford (1932, 401). De Meillon, Davis and Hardy (1961, 266) have reported the occurrence of at least five flea genera associated with *Bathyergus* and *Cryptomys*. Although the latter genus has been trapped and collected frequently by the present author, he has not come across any evidence of the presence of fleas or sucking lice.

Furthermore, the mole-rats also act as hosts for certain protozoans, nematodes, cestodes as well as mites and ticks. An account of the entozoa (Protozoa) and endophyta found in *Heterocephalus glaber* has been published by Porter (1957, 515). Nothing comparable to this work has hitherto been attempted for the southern African bathyergids. Sandon (1941, 128), however, recorded a new endozoic ciliate in *Georychus capensis*. The only other accounts dealing with parasites of the bathyergids, are the papers by Ortlepp (1939, 75; 1961, 837) and the work by Theiler (1962, 226, 227) dealing with helminths and ticks respectively.

The object of this communication is to review and compile the existing knowledge of the subject and to record a number of additional parasites found associated with *Cryptomys* in the Kruger National Park.

REVIEW OF THE PARASITES

Phylum: Protozoa

Subphylum: Plasmodroma

Class: Rhizopoda (Sarcodina)

For a detailed review of the entozoa of the naked mole-rat *Heterocephalus glaber*, Porter (1957) should be consulted. An *Entamoeba (Endamoeba)* species, resembling *E. celestini* has been identified in this mole-rat. It appears that the host was the termite *Cryptotermes havilandi* and that the bathyergid may have become infected from this source. Furthermore, it seems possible that *H. glaber* could have acquired an *Entamoeba* from the sand boa *Eryx thebaicus* which is known to enter the tunnels of the mole-rats in Kenya " . . . . or from other snakes in which *E. serpentes* has been found" (Porter, *op. cit.* 516). Porter points out, however, that it is unlikely that *H. glaber* became infected with *E. serpentes* because of the long retention of food in the alimentary tract of snakes and that *Cryptotermes* is more likely as the source of infection. These *Entamoeba* forms are all parasitic and have become permanently established in the alimentary canal of higher animals (Chandler, 1954, 83).

An *Endolimax* species was also found in *H. glaber* from both Kenya and Somaliland. These occurred in small numbers. They differ from *E. nana* (found in the Primates) and resemble *E. gregariniformes* which is found in fowls. Termites are also hosts to a number of *Endolimax* species, but those found in *H. glaber* are not *E. termites*. Porter *(loc. cit.)* states that neither *Endolimax* species of vertebrates nor those of termites are identical to those found in the sand puppy.

Class: Mastigophora (Flagellata)

The genus *Eutrichomastix (Trichomastix)* has also been isolated in small numbers from the caecum and adjacent iliocaecal junction in *H. glaber*. As to its affinities, the question arose whether this parasite was a true parasite specific to the rodent, or an endocommensal, or whether

it was acquired from some co-inhabitant of the runs of these mole-rats such as termites, into the mounds of which these sand puppies often burrow (Porter, *op. cit.* 519). A specific name was thus not suggested for this protozoan and there is a possibility that the flagellate was originally a termite parasite, not long adapted to the rodent host. This may explain its small numbers and restricted distribution within the host.

A variety of *Trichomonas muris* was also recorded in *H. glaber.*

Furthermore, a *Giardia* species has also been isolated in small numbers. These occured in the faecal pellets as cysts and in still smaller numbers as flagellates and cysts in the pyloric stomach and caecum. These specimens showed some affinities with *G. cuniculi* found in rabbits.

Class: Sporozoa

Porter (*op. cit.* 522) has also identified *Eimeria muris* in its developmental stages in the caecum epithelium of *Heterocephalus* while a number of oöcysts were found free in the contents of the caecum. This form has also been identified in rats and mice, as well as in *Arvicanthis.*

Subphylum: Ciliophora

Class: Ciliata

Among the Ciliophora, *Balantidium* has also been isolated from faecal pellets of *H. glaber.* Porter (*loc. cit.*) states that in some respects this ciliate is more like some of the many species found in Amphibia rather than like those found in Carnivora, Primates and Pisces. Sandon (1941) studied the South African endozoic ciliates and identified *Meistoma georychi* from the caecum of *Georychus capensis.* This form strongly resembles a member of the Protoopalinidae, which occurs commonly in the Southern African amphibians. No ciliate resembling *Meistoma georychi* has, however, been detected in *H. glaber.* "The bare possibility of ingestion of such Amphibia by *Georychus* spp. and the habituation and establishment of their Protozoa in the rodents indicates the need for further investigation" (Porter, *loc. cit.*).

Finally, on the ill-defined borderline between bacteria and Protozoa a number of *Spirillum*-like and *Treponema*-like organisms were identified by Porter in *H. glaber.* Porter (*op. cit.* 523) states that none of these organisms in this mole-rate could be identified with *Cristispira, Spirillum* or *Spirochaeta* found in termites. Furthermore, there was no evidence that their presence had harmful effects in the rodents and it seems that all the described forms do not correspond to those found in *H. glaber.*

Phylum: Platyhelminthes

Class: Cestoidea

Subclass: Cestoda

Order: Cyclophyllidea

Family: Taeniidae

Our knowledge of cestode infection in bathyergids is meagre: accord-

ing to Ortlepp (personal communication) an unidentified cestode has been recorded in *Bathyergus suillus,* collected at Houtbay, near Cape Town.

On the other hand, a cyst of the small tape worm *Echinococcus* sp. was obtained from the internal muscular wall of the abdominal cavity of a specimen of *Georychus capensis* collected at Wynberg, near Cape Town (Ortlepp, personal communication). The cysts were also located in the liver as well as found lying loose in the abdominal cavity.

Family: Anoplocephalidae

The commonest tape worm found in the different species of Southern African rats is the anoplocephalid form *Inermicapsifer madagascariensis* (Ortlepp, 1961, 833). They are common parasites in herbivorous animals and also occur in apes and pigeons (Chandler, 1954, 349). Ortlepp has identified this species in *Rattus chrysophilus* (red veld rat), *R. paedulcus* (black tailed tree rat), *R. (Mastomys) natalensis* (multimammate rat), *Rhabdomys pumilio* (four-striped rat) and *Saccostomus campestris* (pouched mouse). According to Ortlepp it was also found in the vlei rat *Otomys irroratus.* It is of interest to note that it has not yet been recorded in the introduced European rats *Rattus rattus* (black rat) and *R. norvegicus* (brown rat).

Inermicapsifer is of interest to parasitologists because during the last two decades it has also been found to infect children in Africa (Ortlepp, *loc. cit.*).

This tape worm has now also been identified in the bathyergids. It was first reported in *Heliophobius argenteocinereus* in Tanganyika as *I. arvicanthidis* (Ortlepp, *loc. cit.*).

While collecting *Cryptomys* specimens in the Kruger National Park, the present author also obtained a specimen of *I. madagascariensis* in a female *Cryptomys* trapped in the vicinity of Shingwedzi. It was located within the colon and this find thus extends the range of known rodent genera in which this tape worm occurs.

Phylum: Nemathelminthes

Subclass: Aphasmidia

Suborder: Trichurata

Family: Trichuridae

The whip worm *Trichuris* is a common inhabitant of the caecum and large intestine of many animals including dogs, rodents, pigs, various ruminants as well as man and monkeys (Chandler, 1954 375). A female *Trichuris* was reported in *Bathyergus suillus* collected at Strandfontein near Cape Town (Ortlepp, personal communication). This nematode has also been found in a *Georychus* specimen taken at Wynberg, Cape Town. The parasite was located in the caecum. These worms often produce no obvious symptoms, but this depends whether the infection is heavy or not.

Subclass: Phasmidia

Suborder: Ascaridata

Superfamily: Ascaridoidea

The caecal worms of which the genus *Heterakis* is the best known have also been recorded in the alimentary tract of *Bathyergus suillus* (Ortlepp, 1939 98). The dune mole was collected near Strandfontein. The worm was identified as *H. macrospiculum* and was located in the large intestine.

Suborder: Strongylata

Superfamily: Trichostrongyloidea

Family: Trichostrongylidae

This worm family is the cause of a condition known as "verminous gastro-enteritis" to veterinarians and it is also known as "black rush", "black scours" etc. to those farming with sheep. Severe infection is the result of poor nutrition or of heavy initial infections (Chandler, 1954 415). They gain access to their hosts through being ingested with the vegetation. The genus and species *Libyostrongylus bathyergi* has been found in the stomach of *Bathyergus suillus* collected at Strandfontein (Ortlepp, 1939 78).

Family: Heligmosomatidae

This parasitic family occurs especially in rodents. Usually, they are tiny red worms, rolling their bodies in spirals (Chandler, op cit 417). The form *Longistriata bathyergi* has also been recoded by Ortlepp (op. cit. 87) in the duodenum of *Bathyergus suillus* collected at Strandfontein.

Phylum: Arthropoda

Class: Arachnida

Order: Acarina

This order includes a large number of species of ticks which vary in length from half an inch or more to mites which are barely visible to the naked eye (Chandler, 1954 498). This is the only parasitic order found among the arachnids and it is therefore not surprising that both ticks and mites occur on the bathyergids. The majority of species live either in or on the skins of their hosts.

Suborder: Mesostigmata

Superfamily: Ixodoidea

Family: Ixodidae

A small number of tick species have been recorded on bathyergids by Theiler (1962 226, 227). This work lists *Ixodes alluaudi* (adults and immatures) and *Haemaphysalis leachii mühsami* (adults) as ticks occuring on *Bathyergus suillus*. Furthermore, *I. alluaudi* have been found in the

adult and immature stages on both *Georychus capensis* and *Cryptomys hottentotus*. *H. leachii* is also known as the dog tick and is the principal transmitting agent of canine piroplasmosis or biliary fever to dogs in South Africa (Bedford, 1932 289, 290).

Superfamily: Parasitoidea

Family: Parasitidae

A number of mites have also been collected from *Cryptomys* specimens taken in the Kruger National Park. Those collected at the Faai experimental plots and in the vicinity of Pretoriuskop have been identified as *Androlaelaps marshalli*. A nest of *Cryptomys hottentottus* which was discovered in the Faai vicinity (de Graaff, 1962 160) literally teemed with these mites.

A second species, *Haemolaelaps capensis* has been taken off *C. hottentotus* collected in the Cape Province (Bedford, 1932 274). This genus was also identified from a *Cryptomys* specimen collected in the vicinity of Satara and the sandveld near Pumbe on the Lebombo mountains.

Finally, Bateman (1960 227) reported that very young mole-rats *(C. hottentotus)* which had been taken from a nest at King William's Town were infested with mites of the species *H. natalensis,* especially around the mouth.

Family: Dermanyssidae

Myonyssoides capensis has been described " . . . . from numerous specimens taken off *Cryptomys hottentotus* . . . . at Grahamstown, C.P." (Bedford, 1932 272).

Class: Insecta

Order: Anoplura

Suborder: Siphunculata

Family: Haematopinidae

Subfamily: Enderleinellinae

Two species of sucking lice have been found on the bathyergids viz. *Proenderleinellus hilli* and *P. lawrensis*. The former has been described from males and females of *Cryptomys hottentotus* collected at Pietermaritzburg, Natal, while the latter was taken off females of *Bathyergus suillus,* locality unknown (Bedford, *op. cit.* 401).

Order: Siphonaptera

Family: Pulicidae

The flea *Cryptoctenopsyllus (Dinopsyllus) ingens* has been described from specimens taken off *Bathyergus suillus* in the Cape Province (Bedford, 1932 458) and this authority also states that it is known to occur on *Georychus capensis* from the Cape Flats. It is therefore of interest to

note that de Meillon, Davis and Hardy (1961 258) state that no fleas have yet been collected from the blesmol *Georychus capensis*. Geographically, this parasite is confined to the south-western Cape, associated with *B. suillus* which itself is confined to that region. Its status as plague vector is unknown (de Meillon, *et. al. loc. cit.*).

Cryptopsylla ingrami is specific to *Cryptomys hottentotus*. According to de Meillon *et. al.* (*op. cit.* 187) the geographical distribution of this flea is known mainly from the Cape Province, collected in the districts of Calvinia, Clanwilliam, Tulbagh and Port Elizabeth. Although the genus *Cryptomys* is very widely distributed in Southern Africa, these few *ingrami* specimens from the Cape Province are practically the only fleas that have been found, " . . . . probably because insufficient search has been made". As is the case in *Cryptoctenopsyllus ingens*, its status as plague vector is unknown.

It is possible that *Dinopsyllus zuluensis* occurs on species of *Cryptomys*. This rare flea has been found only in Eshowe, Zululand and the type host was described as "a species of mole" (de Meillon *et. al.*, *op. cit.* 251).

The flea *Xenopsylla pirei* has also been identified on *Cryptomys hottentotus*. The principal host is the Namaqua gerbil *Desmodillus auricularis*, while it also occurs on a wide variety of other hosts, which act mainly as chance hosts with certain exceptions (e.g. *Tatera brantsi* and *T. leucogaster)* (de Meillon *et. al.*, *op. cit.* 132).

Finally, the species *Procaviopsylla creusae* has also been located on *Cryptomys hottentotus* (de Meillon *et. al.*, *op. cit.* 74).

The data contained in the paragraphs above, has been summarized in Table 1.

GENERAL

The overall pathological or physiological effects suffered by the host bathyergids resulting from the presence of endo- or ecto parasites, are unknown. This naturally stands in direct relation to the degree of infection of the host. Porter (1957 515) states that death of her *Heterocephalus* specimens may partially be ascribed to amoebiasis and balantidiasis which may have been weakening factors.

As far as can be ascertained, the presence of cestodes and nematodes do not hamper the bathyergids to any visible extent. Furthermore, it is not known whether mites are responsible for the depleted pelage shown by some bathyergids.

The question of the herbivorous bathyergids accidentally ingesting some amphibians is quite feasible and the possibility of this has been conceded. Eloff (1952 223) showed that during certain times of the year (especially during the winter), the frog *Cassina senegalensis* shares the tunnel system of *Cryptomys*, possibly because within the bathyergid nest insects, grubs etc. are to be found, providing food for the amphibian.

Within these tunnels there is a certain humidity and warmth, and as is well known, depriving an amphibian of any humidity inevitably leads to the death of that animal. The frogs evidently reach the nests via tunnels which are constructed towards the edges of pans where *Homeria* bulbs are abundant. This may thus serve as a source of ciliate infection of the bathyergids as proposed by Porter.

The possible role the small grass mites (family Oribatidae) play in the propagation of cestodes found in bathyergids may be mentioned briefly. The life history of no species of *Inermicapsifer* is known, and therefore the mode of infection remains unknown (Ortlepp, 1961 839). In other genera of this family (e.g. *Anoplocepha, Moniezia* — being parasites of horses, lambs and calves), the Oribatinae are intermediate hosts. In the case of *Inermicapsifer* the eggs are released in egg capsules (not liberated singly as in the case of the cestoid genera mentioned above) and it is doubtful whether these small mites would be able to swallow these larger egg packets. The dassies (Hyracoidea) generally show a heavy infestation of these tape worms and collection and dissection of various insects from the vicinity of rock-rabbit habitations may reveal the presence of cysticercoids of these parasites (Ortlepp, *loc. cit.*). Insects may thus eventually prove to be responsible (as intermediate hosts) for the infections encountered in the bathyergids.

Finally, an aspect of the ecology of fleas associated with the bathyergids may be mentioned. According to de Meillon *et. al.* (1961 258) *Bathyergus suillus* occurs sympatrically with *Georychus capensis* and *Cryptomys hottentotus* in the south western Cape Province. The flea *Cryptoctenopsyllus ingens* occurs on the former species but there is evidently no interchange of fleas. Similarly, *Cryptopsylla ingrami* is equally specific to *Cryptomys* which is almost as closely confined to the south-western Cape as *ingens*.

From the remarks contained in the paragraphs above, it is clear that our knowledge of parasites occurring in and on the bathyergids is scanty. Further work on parasitological aspects of the mole-rats is needed to elucidate the role played by these mammals in the ecosystem of nature.

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Table 1.

Bathyergid	Parasite	Locality	Part of body	Source
Heterocephalus glaber	PROTOZOA			
	Entamoeba cf. *celestini*	Somaliland	Intestine	Porter (1957 515-526)
	Endolimax sp.	Somaliland and Kenya	Intestine	" " "
	Eutrichomastix sp.	Kenya	Caecum	" " "
	Trichomonas muris var.	Somaliland and Kenya	Intestine	" " "
	Giardia sp.	Somaliland	Faecal pellets, caecum	" " "
	Eimeria muris	—	Caecum epithelium, caecum	" " "
	Balantidium sp.	Somaliland and Kenya	Faecal pellets	" " "
	cf. *Spirillum* sp.	—	?Intestine	" " "
	cf. *Treponema* sp.	—	?Intestine	" " "
Heliophobius argenteocinereus	PLATYHELMINTHES			
	Inermicapsifer madagascariensis	Tanganyika	Intestine	Ortlepp (1961 837)
Bathyergus suillus	PLATYHELMINTHES			
	Gen. et. sp. indet.	Houtbay	Intestine	Ortlepp (personal communication)
	NEMATHELMINTHES			
	Trichuris sp.	Strandfontein	Caecum	" " "
	Heterakis macrospiculum	Strandfontein	Intestine	Ortlepp (1939 98)
	Libyostrongylus bathyergi	Strandfontein	Stomach	Ortlepp (1939 78)
	Longistriata bathyergi	Strandfontein	Duodenum	Ortlepp (1939 87)
	ARTHROPODA			
	Ixodes alluaudi	South Africa	Pelage	Theiler (1962 226)
	Haemaphysalis leachii mühsami	South Africa	Pelage	Theiler (1962 226)
	Proenderleinellus lawrensis	—	Pelage	Bedford (1932 401)
	Cryptoctenopsyllus ingens	Cape Province	Pelage	Bedford (1932 458) de Meillon et. al. (1961 258)

Bathyergid	Parasite	Locality	Part of body	Source
Georychus capensis	PROTOZOA			
	Meistoma georychi	South Africa	Caecum	Sandon (1941 128)
	PLATYHELMINTHES			
	Echinococcus sp.	Wynberg	Internal muscular wall, abdominal cavity	Ortlepp (personal communication)
	NEMATHELMINTHES			
	Trichuris sp.	Wynberg	Caecum	,, ,, ,,
	ARTHROPODA			
	Ixodes alluaudi	South Africa	Pelage	Theiler (1962 227)
	Cryptoctenopsyllus ingens	Cape Flats	Pelage	Bedford (1932 458)
Cryptomys hottentotus	ARTHROPODA			
	Androlaelaps marshalli	Faai experimental plots	Pelage	De Graaff and National Parks Board Records
	Haemolaelaps capensis	Cape Province	Pelage	Bedford (1932 274)
	H. natalensis	King William's Town	Around mouth	Bateman (1960 227)
	Ixodes alluaudi	South Africa	Pelage	Theiler (1962 227)
	Myonyssoides capensis	Grahamstown	Pelage	Bedford (1932 272)
	Proenderleinellus hilli	Pietermaritzburg	Pelage	Bedford (1932 401)
	Cryptopsylla ingrami	Calvinia, Clanwilliam, Tulbagh, Port Elizabeth	Pelage	De Meillon *et. al.* (1961 187)
	Xenopsylla pirei	—	Pelage	,, ,, 132
	Procaviopsylla creusae	—	Pelage	,, ,, 74
Cryptomys sp.	PLATYHELMINTHES			
	Inermicapsifer madagascariensies	Shingwedzi	Colon	De Graaff and National Parks Board Records
	ARTHROPODA			
	Haemolaelaps sp.	Pumbe sandveld	Pelage	,, ,, ,,
	Dinopsyllus zuluensis?	Eshowe	Pelage	De Meillon *et. al.* (1961 251, 252)