On encountering a <u>Homeria</u> bulb (which is localized by smell (possibly) and tactile sense (tooth pressure, as was mentioned above)), all interest in burrowing activity is lost and the connection of the stem of the plant with the bulb is severed by a snip of the incisors. By means of the incisors, the husks are then removed. This procedure is done at a rapid pace, but exact observations have shown that this activity is also accompanied by rapid vibrations of the hands. Firstly, these vibrations follow each other rapidly and secondly, during these vibratory movements of the hands the bulb is held by means of the incisors. As soon as the husks are removed, to the satisfaction of the eater, these vibrations only occur in exceptional cases. These vibrations are important in loosening the husks from the bulb and are often executed at more than 30 vibrations per second. The vibrations of the hands occur alternately, while the vibrations executed by the hind-feet in ramming new soil after reparation to a perforation in a tunnel system (as described above) occur simultaneously. Having removed the husks from the bulb, the animal commences nibbling with its incisors and chewing with its molars, at a speed of approximately 10 movements per second, occasionally accompanied by a vibration of one or the other front leg. According to Eloff, the mole-rat's reaction to eat is so strong, that if captured and presented immediately thereafter with a bulb, the animal viciously grabs the bulb and commences to eat the bulb.

I have also kept a number of specimens (<u>Cryptomys</u> and <u>Bathyergus</u>) alive in captivity, and

observed/...

observed the same type of feeding behaviour as described by Eloff. However, no vibratory movement of the hands were seen in the case of Bathyergus. Based on my own experience, the following information may be added in connection with the feeding behaviour of Cryptomys under laboratory conditions:

The animal (a male) was fed regularly every day with at least one carrot, and on this carrot diet it lived for a number of months. Before presenting it to the animal, the carrot was usually sliced into discs approximately 1½" to 2" thick. At feeding time (usually at 8.30 a.m.) the specimen was usually restless and agitated but after the sliced carrot was supplied and the initial excitement had decreased, the first contact was usually made with the submental vibrissae. It would then grab a slice with its incisors and commence with the vibrations of the front paws. It would nibble round the circumference of the carrot slice, as if pealing off the outer thin layer of skin. (This action is possibly similar to the movements seen in the case of Cryptomys removing the husks from the bulbs). As soon as the slice was picked up, the neck would arch backwards for a second or so, suspending the food in the air for a short while. It would then walk around with the food in its mouth and settle down on the surface taking the food between its fore-feet. It assumed a sitting or squatting position, hind-feet wide apart, the stumpy tail used as a small stilt. It could well be that these vibratory movements are intended to shake off any additional particles of grit or sand clinging on to the food or on to the soles or between the fingers

of/...

of the hand. This may well be so, for Shortridge (1934, 322) states that he has never found sand in the mouth of Cryptomys and "nor are the teeth worn in the manner that might be expected if the teeth were habitually used for biting through grit". Finally, the description of Grant (quoted in Shortridge 1934, 324) may be mentioned: "In captivity (i.e. the mole-rats) when feeding they often sit up on their haunches and hold the food in the forepaws like ordinary rats and mice".

Eloff (1952, 216) states that food is hoarded especially during the winter months. The bulbs are apparently carried between the incisors (the lower ones being free to move apart), ensuring a better grip (Roberts, quoted in Shortridge 1934, 325).

The question of storing food in special chambers has been mentioned by various authors. Dreyer (1910, 4) states that all the genera have the habit of storing their surplus food in specially constructed "storage chambers". He states that the stored tubers and bulbs are prevented from growing by previously having their "eyes" (buds) eaten out. Fitzsimons (1919-1920, 149) states that the bulbs have the tops carefully bitten off to prevent them from sprouting. "When potatoes are available, all other forms of diet are neglected, and entering the potato fields, these destructible rodents carry off the tubers to their subterranian retreats and store them up. The crafty little fellows are well aware that in the moist earth the potatoes would soon begin te sprout, so, to prevent this, the buds or eyes of the tubers are carefully nipped out."

Bishop/...

Bishop (1948, 3) states: "Die kos word in spesiale kamertjies weg van die hooftonne (1), gewoonlik twee voet of meer onder die grond, opgeberg. Op hierdie wyse bou die mol 'n goeie voorraad op vir tye wanneer gewasse skaars is".

In the case of Georychus, Roberts (1951, 382) states that the bulbs are usually carried to a storage chamber in some high ground close by. Similarly, for Cryptomys Roberts (p. 384) maintains that they all have the same habit in common of forming a large chamber for the storage of bulbs as a reserve for consumption, "when the feeding grounds are waterlogged or when the soil is too hard for facile burrowing; but one species is known to make a practice of feeding upon certain large tubers (presumably not storing bulbs in that case), nibbling off each day as much as it requires, and another species is known to make large mounds for the storage of bulbs above the flood level of the karroo plains. From the storage chambers, which are normally situated in higher ground that is not likely to be flooded tunnels are made in any and all directions for the purpose of finding bulbs; .....".

On the other hand, Shortridge (1934, 319) poses the question whether Bathyergus does store up food. He concludes from the freedom of movement of the lower jaws of Georychus and Cryptomys that this enables these genera to obtain a better grip on the bulbs which are carried along the tunnels to the storage chambers. In Bathyergus, the lower jaws are ankylosed and "possibly, therefore, Bathyergus does not store up food?". It thus seems that this question of storing food is not yet entirely settled,

and/...

and for that matter it may be said that I, although having opened up and dug out many a Cryptomys from its system (in addition to nests), have not yet come across these so called "storage chambers".

The food eaten, is apparently not chewed very thoroughly. According to Tullberg (quoted in Landry 1951, 71) the bathyergids (Georychus and Bathyergus) do not chew their food very much for large pieces of roots (up to 10 mm. in length) have been found in the stomach.. This has also been seen by me in specimens of Cryptomys captured in the Kruger National Park where portions of roots, bulbs and succulent rhizomes measuring 7-8 mm. in length, were found in stomachs.

Concerning the actual plants which are eaten, some specific data is available. Eloff (1952, 211, 1958, 294) states that Cryptomys specimens especially select Homeria and Moraea (both of the family Iridceae), and in the absence of these, Cyperus-bulbs (family Cyperaceae). As far as Georychus is concerned, Sparaxis grandiflora bulbs (family Iridaceae) and Zantedeschia (Richardia) (family Araceae) tubers are readily eaten (Dreyer 1910, 6, Sclater, 1901, II, 76). Furthermore, they are apparently especially fond of potatoes.

The plants eaten by Bathyergus are less precisely known, and in the existing litereature it is stated that they feed "on roots and bulbs" (Dreyer, 1910, 5, Sclater, 1901, 73).

Shortridge (1934, 325) states that the food of Cryptomys consists mainly of bulbs, tubers, and other roots, especially bulbous grass-roots. Roberts has also found fragments of Aloe leaves in Cryptomys

burrows/...

burrows. "Only certain kinds of bulbs are eaten; others appear to be occasionally attacked (as, in gardens, agapanthus, onions, dahlias). In Kaffraria, a small species of blue iris (Moraea), known as 'tulp', which is extremely poisonous to cattle, seems to be preferred above almost anything else by C. hottentotus. In consequence, this iris and many other indigenous bulbs are difficult to propagate in local gardens."

Roberts (quoted in Shortridge 1934, 325) states that the diet in Cryptomys consists exclusively of vegetable matter like grass roots and bulbs and that they are troublesome in consequence where potatoes and other tuberous crops are cultivated, especially where the animals are plentiful. It may also be that in South West Africa Cryptomys feeds on Pseudogaltonia (family Liliaceae) (Shortridge, 1934, 321).

Finally, Bishop (1948, 2-3) gives an interesting account of the plants eaten by Georychus and Cryptomys: "Hierdie knaagdiere vreet 'n groot verskeidenheid van wortels en knollë, en is besonder lief vir tuingewasse, soos aartappels, patats, geelwortels, witwortels, uie, die wortels van pieterselie, blaarslaai, angeliere en baie ander blombolle".

Before leaving the subject of food, the following interesting observations are worth mentioning. Normally these animals are herbivorous, but Fox (quoted in Shortridge 1934, 325) found that Cryptomys species occurring in Northern Nigeria will eat earthworms greedily, although they show no partiality to insects. On the other hand, Barret-Hamilton has found white ants in the stomach of

C.hottentotus/...

C.hottentotus while Shortridge found the hard heads of cockchafer larvae in the stomachs of C.hottentotus on one or two occasions (Shortridge, 1934, 325).

An important aspect of feeding is the animal's water requirements. In captivity they do not seem to show any interest in water even if it is presented to them. Fitzsimons (1919-1920, 155) states that the mole-rats even occur in the centre of the Kalahari desert, "where their mounds may be found at least a hundred miles from water". A feasible explanation is that these animals obtain their necessary water from ingested food (bulbs, etc.) as well as in the form of metabolic water.

The possible influence of the nature of the diet on the animals has been mentioned by Roberts (1951, 385). In Southern Africa, some species e.g. C. hottentotus and C. damarensis have a wide distribution with little local variation in phenotype. "The habits of the species are such as to confine them to small areas where food is plentiful and when this food differs, new forms have evolved, where as when the food remains much the same over great tracts, such as the Karoo or the Kalahari Desert, little change takes place".

Social life

As far as Cryptomys is concerned, it has been stated by Eloff (1951, 142) that there is no actual group life, for the tunnels do not allow a number of mole-rats to be together boring for food. On the other hand, in the later publication, Eloff (1952, 215) states: "Daar word gewoonlik gemeen dat die mol 'n alleenloper is. Dit is egter foutief.

Die/...

Die mol leef in klein kolonies van ongeveer ses of meer in 'n gemeenskaplike nes". The latter statement seems to be the correct interpretation.

It is well known that one specific tunnel system can ramify into a large number of tunnels, but hitherto, it is accepted that each tunnel system has only one nest. These tunnel systems are also sometimes called colonies and I have in my possesion a collection of Cryptomys specimens from the Witbank district consisting of six female specimens and one male specimen, all from the same colony. Furthermore, six specimens obtained from the Kloof district, Natal, all come from the same burrow. It is therefore evident that these animals are not solitary beings and do lead a certain degree of social life, within a tunnel system.

It is interesting to note that animals coming from different tunnel systems act very aggresively towards each other and are instantly ready to fight, whether they are of the same or opposite sexes. On the other hand, on capturing specimens from the same tunnel system, these specimens get on together very well indeed. Similarly, in the case of Bathyergus, they do occur in tunnel systems which contain more than one specimen. This evidence can be deduced from information on museum labels.

When two specimens of Bathyergus were captured in the Citrusdal area, coming from two different colonies, I put them together in a container, at approximately 15.30 hours and immediately they started fighting. They were both males and the one specimen got hold of the other's nose and

inflicted/...

inflicted a relatively minor injury. Yet, immediately after this brief fight, the hurt animal behaved in a different way, and before nightfall the injured specimen died, probably as a result of its injuries. It is known that the naso-oral region is of the utmost importance to the bathyergid individual and it thus appears that even the slightest (or apparently so) injury may develop into a lethal injury.

Similarly, in the case of Georychus, when placed together in captivity, they instantly fight. A short account of this aspect is to be found in Fitzsimons (1919-1920, 150). They invariably damage each other so severely that both (often) succumb to the wounds inflicted by the enormous incisors. "Often the victor devours portion of the victim".

Roberts (1951, 385) has raised a number of interesting points about the social organization of Cryptomys. "Firstly, that the younger animals are usually first to be trapped, but when the traps are left in the same places for several days thereafter, the older animals are then caught; this suggests that the older animals drive out the younger ones to forage and bring back food to the storage chamber, so that they can subsist without the labour of burrowing. Secondly, on a number of occasions, only males have been trapped in single colonies, which seems to point to segregation of the sexes of the males at certain times." On studying the information on the museum labels in a large series of specimens, sufficient data is still lacking to confirm these statements positively.

Symbionts/...

Symbionts and Commensalisms

An interesting case of symbiosis which has come to light during the researches by Eloff (1952, 223, 1958, 293) is the fact that Cryptomys shares its tunnel system (and possibly its nest) with the frog Cassina senegalensis. Before these facts came to light, it was not known where these frogs retreated when the pans dried up during winter. On opening the nests and tunnel systems, it was found that these frogs inhabit the tunnels. Within the nest there are insects, grubs, etc. which may provide food for the amphibian. In addition, in the tunnels, there is a certain humidity and warmth, for if the frog is deprived from humidity, it shrivels up and dies. On one occasion, Eloff found no less than 15 frogs in one nest. The mole-rat, which normally bites and snaps violently whenever an object touches its body, does no bodily harm to the frog. This is probably due to the fact that the movements executed by the frogs are slow and gradual and therefore evokes no reaction on the part of the mole-rat. Incidentally, the frogs evidently reach the nests via the tunnels, which are constructed in the direction of the edges of the pans where Homeria bulbs are abundant.

Another interesting observation is made by Shortridge: in the case of Cryptomys he often found white ants inhabiting old Cryptomys mounds and ".... which may on such occasions form the nuclei of ordinary ant-hills" (1934, 322).

In the nest of Cryptomys, I have come across the larva of Gonopus (Coleoptera, Tenebrionidae) in the Kruger National Park, while in the Kalahari

Gemsbok/...

Gemsbok Park, lizards (Mabuia sp.) and scorpions (e.g. Opisthopthalmus pictus, O. wahlbergi, O. carinatus and Parabuthus granulatus) were encountered in or near the tunnel systems of Cryptomys damarensis.

Reproduction

Detailed aspects of courtship behaviour under natural conditions are not known, and the act of mating has not yet been observed. Furthermore, it is not known whether the males are monogamous or polygamous. The latter seems to be the most likely alternative.

Some indication of courtship behaviour in Cryptomys has been described by Eloff (1951, 140-141), under laboratory conditions. "The animals often run against each other, whereupon the fierce female immediately charges, the male producing squeaky 'pleading' noises which cause the female to behave quite differently, e.g. walking in front of the male lifting up one hindleg. However, the mole's nose is then kept near the female's external sex organ in the characteristic male animal fashion. Much more intensive work must be done in this connection". Personally, I observed exactly the same pattern of behaviour in captured specimens obtained in the Shingwedzi district in the Kruger National Park.

It has already been mentioned that the respective pairs apparently recognize each other by means of their tactile sense and possibly by means of smell, although the latter sense does not seem to play a very important role in mate recognition.

In the genus Georychus the males are usually equal in size to the females, while the

females/...

females are usually smaller than the males in other genera. However, in Cryptomys there are many instances where the sexes are of the same size. In the case of Bathyergus however, the males are usually definitely larger than the females.

The oestrus cycle of the female has not been determined for any of the three genera. It is probable that they are monoestric annually and that mating occurs towards the end of winter in the case of Bathyergus. In this genus the greatest number of foetuses found in pregnant females were three: these specimens are housed in the South African Institute for Medical Research, Plague Division. In two females there was one foetus in the right uterine horn and two in the left. The weight of one foetus equalled 5 grams and the maternal specimens were trapped on the 18th and 20th of August 1954 respectively. Mating therefore must have occurred some weeks earlier, i.e. towards the end of July.

In another Bathyergus female remnisces of placentae which were retained could be demonstrated. In this case the distribution of young was 3/1 i.e. three foetuses in the left, and one foetus in the right uterine horn. This animal was not pregnant when trapped i.e. the placental scars were relicts of the previous breeding cycle.

As far as Cryptomys is concerned, Shortridge (1934, 325) collected two females, each containing five foetuses from the Grootfontein district, South West Africa on April 26th. He also suspects that the mole-rats have a fixed breeding season.

Actual/...

Actual embryological data about the bathyergids is not yet available e.g. there is no indication of the length of the gestation period.

Smears made from the testes of Bathyergus specimens indicated ripe sperms on the 10th of July 1954 and the 10th of August 1954. This then also points to the possibility of sexual activity towards the end of winter in the south western Cape.

Theoretically, it would be possible for a Bathyergus female to have a litter of six, for the number of mammae usually consist of two pairs pectoral and one pair inguinal (=6), but cases occur where there are two pairs inguinal (Roberts 1951, 382). As far as Cryptomys is concerned, litters of six are known to occur (Eloff, 1952, 210).

Nothing is known about the post-natal development and aspects of parental care as far as the three genera are concerned.

According to Eloff (1952, 211) the genus Cryptomys will propagate quite readily under laboratory conditions as long as a sufficient supply of Homeria bulbs are available.

According to Thomas (quoted in Shortridge 1934, 326) the mammary formula of Cryptomys appears to be always six as indicated from spirit specimens from all localities in the British Museum. On the other hand, Roberts states that in the plateau area of the Transvaal he has never found any of the forms of Cryptomys with inguinal mammae, the two pectoral pairs only being present. According to Shortridge (1934, 326) the pectoral mammae are nearly always longer in C. damarensis than the inguinal mammae for they are apparently used more

often/...

often. The inguinal mammae are often under-developed in immature breeding females ".... although doubtless coming into use with age when full litters are produced. It is suggested that the inguinal mammae may be absolescent in species of <u>Cryptomys</u>." Roberts (quoted in Shortridge) recorded a specimen of <u>Cryptomys</u> with eight mammae (2 pectoral, 4 lateral, 2 inguinal) but suggested that the additional lateral pair may be abnormal.

It is no easy matter to distinguish the sexes externally in many forms of adult <u>Cryptomys</u> specimens. The testes of the male may descend during the breeding season, as in rats. The females (indicated by large mammae), often start breeding before reaching maturity (Shortridge, 1934, 327). It is not exactly known how long the young remain in the nests, although Eloff has stated that only after six weeks or so, do they show any inclination for digging. Eloff (1951, 141) speculates on a number of reasons why the young mole-rat starts boring away from the nest. In the first instance, it may be to search for food, for after weaning, this would be a necessary requirement. Secondly, it may thereby be starting a new system, leading eventually to the animal having its own nest.

<u>Physiological</u>

An important physiological activity in any animal's life is the act of sleeping. The bathyergids tend to sleep in an upright position (as observed under laboratory conditions) with the head tucked between the front legs, close to the chest. This sleeping attitude has been observed by me in

both/...

both Bathyergus and Cryptomys. It is however not known how much of each day is spent sleeping, either in Bathyergus, Georychus or Cryptomys, under natural conditions. An answer to this question can not be given until modern techniques (such as radio-active tagging) are applied.

The bathyergids are very sensitive to fluctuations in temperature. Eloff (1952, 218, 1958, 295) has also discussed this aspect. By means of a specially constructed activity wheel, experiments were conducted to test the possible negative or positive behaviour towards such contrasting stimuli as (i) cold on the one side and heat on the other side of the experiment and (ii) a current of air on the one side and absence of a current of air on the other. In this way it was found that in the case of Cryptomys, a temperature difference of 2°C was discriminated, preference being given to 21°C as compared to 19°C.

Similarly, I have kept captive specimens alive under laboratory conditions. A heater had been burning round the clock under the table on which the glass cage containing a specimen of Cryptomys stood. In this way, the soil was warmed to some extent. For two consecutive days the heater had not been switched on. The date of the experiment was May 8th, i.e. towards the approach of mid-winter, when the drop in temperature can be rather severe, with very cold nights. Consequently the animal got chilled, especially at night, in addition to the fact that the laboratory is south facing. As the laboratory was entered on the third day, the

animal/...

animal seemed sick: its movements were heavy and clumsy and when it walked about (which it did with great effort) it often rolled over on to its side. The physical condition of the animal was so poor that it was tentatively decided to destroy the animal. It was given a carrot which it nibbled with great effort. Here again, it seems that the urge to eat is a deeprooted instinctive action, no matter under what circumstances or in what physical condition the animal may be. Its aggressive nature was subdued: chewing movements were slowed down and this was apparently done without interest. During the day the animal was transferred to the north side of the building where it got a fair amount of sun. The patho-physiological effects wore down and towards 16.00 hours it had resumed its usual nature again: being aggressive and ready to fight at the slightest pretext. All traces of the clumsy gait had disappeared and the animal moved deftly through its cage.

It is possible that the metabolism of the animal may have slowed down to such an extent that it exhibited a kind of cold-stupor. They are evidently very susceptible to cooling down, and this may be expected, for they are accustomed to more or less constant temperature conditions within their tunnel systems.

The question whether these animals hibernate has also not yet been settled, although Shortridge (1934, 324) states quite definitely that the mole-rats in Southern Africa become partly dormant during the colder months "... until about September (the Southern Spring)."

Coupled/...

Coupled to physiological aspects of the animals, is the question of longevity. No direct information is available at present as far as natural conditions are concerned. Eloff (1958, 300) once removed six young mole-rats approximately one week old from their nest and was able to keep and rear them for three years for maturation studies. Apart from this, very little is known about the gerontology of the bathyergids.

In order to study them physiologically, it is necessary to keep these animals in captivity. A photograph of cages in which they thrive in captivity is to be found in Eloff (1952). Furthermore, Fitzsimons (1919-1920, 149-150) states that in captivity these animals live and thrive when fed on bulbs, roots, tubers and fruits. The cage must be warm, "and earth provided for the creature to amuse and excercise itself in, by burrowing". In addition, Fitzsimons adds that these animals make interesting pets and in the course of time become tame. However, it is inadvisable to attempt to handle them for, without prior warning, they often become excited and bite fiercely. When keeping several specimens in the same cage (especially if the newcomer does not hail from the same tunnel system or colony), it is necessary to isolate the newcomer behind a wiremesh partition until the others become familiar with it. Only then, if the partition is withdrawn, will they not fight.

<u>Parasites</u>

Information concerning the parasites associated with the bathyergids is meagre. Shortridge (1934, 325) states that no external parasites

were/...

were observed on any South West African *Cryptomys* specimens, although he collected extensively in that area. Roberts (quoted in Shortridge, 1934, 325) states that they are not infested with fleas, although a certain type of lice is to be found on them. This may refer to the sucking lice recorded as parasites on 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 I have frequently trapped and collected *Cryptomys*, I have not come across any evidence of the presence of fleas or sucking lice. In collaboration with the Biological Section of the National Parks Board at Skukuza in the Kruger National Park, a number of mites which occur on *Cryptomys* have been recorded. Nematodes and cestodes are also known as parasites from *Bathyergus*, *Georychus* and *Cryptomys*. The available information is summarized in the accompanying table. For a more detailed discussion of parasitological aspects pertaining to the bathyergids, see de Graaff (1964, 113).

Table 6.1: Parasites of Bathyergidae in Southern Africa

Genus and species	Parasites	Locality	Source
Bathyergus suillus	PLATYHELMINTHES		
	Gen.et.sp.indet.	Houtbay	Ortlepp (personal communication).
	NEMATHELMINTHES		
	Trichuris sp.	Strandfontein	" " "
	Heterakis macrospiculum	" "	Ortlepp (1939, 98)

Libyostrongylus/...

	Libyostrongylus bathyergi	Strandfontein	Ortlepp (1939, 78)
	Longistriata bathyergi	" "	Ortlepp (1939, 87)
	ARTHROPODA		
	Ixodes alluaudi	South Africa	Theiler (1962, 226)
	Haemaphysalis leachii mühsami	" "	" " "
	Proenderleinellus lawrensis	-	Bedford (1932, 401)
	Cryptoctenopsyllus ingens	Cape Province	de Meillon *et. al.* (1961, 258)
Georychus capensis	PROTOZOA		
	Meistoma georychi	South Africa	Sandon (1941, 128)
	PLATYHELMINTHES		
	Echinococcus sp.	Wynberg	Ortlepp (personal communication)
	NEMATHELMINTHES		
	Trichuris sp.	" "	" " "
	ARTHROPODA		
	Ixodes alluaudi	South Africa	Theiler (1962, 227)
	Cryptoctenopsyllus ingens	Cape Flats	Bedford (1932, 458)
Cryptomys hottentotus	ARTHROPODA		
	Haemolaelaps capensis	Cape Province	Bedford (1932, 274)
	H. natalensis	King William's Town	Bateman (1960, 227)
	Ixodes alluaudi	South Africa	Theiler (1962, 227)
	Myonyssoides capensis	Grahamstown	Bedford (1932, 272)
	Cryptopsylla ingrami	Calvinia, Clanwilliam, Tulbagh, Port Elizabeth	de Meillon *et.al.* (1961, 187)
	Xenopsylla pirei	-	" " ",132
	Procaviopsylla creusae	-	" " ", 74
C.natalensis *	ARTHROPODA		
	Proenderleinellus hilli	Pietermaritzburg	Bedford (1932, 401)

C/...

C.komatiensis**	ARTHROPODA Androlaelaps marshalli	Faai experimental plots, Kruger National Park	de Graaff and National Parks Board Records
C. hottentotus vandami***	PLATHYHELMINTHES Inermicapsifer madagascariensis	Shingwedzi, Kruger National Park	" " "
	ARTHROPODA Haemolaelaps sp.	Pumbe sandveld, Kruger National Park	" " "
Cryptomys sp. ****	ARTHROPODA Dinopsyllus zuluensis?	Eshowe	de Meillon et.al. (1961,251-252).

Footnote.
* : C. hottentotus in Bedford (1932)
** : C. hottentotus in de Graaff (1964)
*** : Cryptomys species in de Graaff (1964)
**** : Probably C.natalensis.

Predators

This aspect has also not received the attention it deserved in the past. Remains of skulls of Cryptomys occur frequently in owl pellets of the barn owl Tyto alba, and therefore points to the fact that the animals move around on the surface of the soil at night. Dogs undoubtedly occasionally come to grips with these mole-rats, but as would be expected of creatures with such enormous incisors (and their aggressive nature) they are not easy customers to deal with. It is known that cats often capture these animals (especially Cryptomys). A. Findlay Esq. (personal communication) states that his cat often kills and eats all mole-rats caught, in contrast to catching alive and often releasing any golden moles which it happens to catch.

Other predators which

seem /...

seem to be of importance are snakes. In the Philadelphia area (between Malmesbury and Cape Town) it has been observed that mole snakes (Pseudaspis cana) prey on Bathyergus. Similarly, I have trapped a shield snake (Aspidelaps scutatus) in a mole-trap which was set in a tunnel of Cryptomys, near Shingwedzi, Kruger National Park. Subsequent investigation showed the presence of the hind quarters of Cryptomys in the stomach of the snake (Fig. 6.4).

Genetical aspects

In view of the fact that these animals occur in different isolated colonies or tunnel systems, and that there is virtually no tendency for inter-breeding between individuals which come from different systems, it would seem reasonable to assume that there is a fair degree of inbreeding within such colonies. Consequently, it would not be unreasonable to expect a high degree of homozygosity within the genotypes of individuals and possibly within colonies. However, hitherto no actual genetical experimental work has been done in this direction.

The apparent isolation which exists between colonies has been aptly commented upon by Roberts (quoted in Shortridge, 1934, 325). "They are very local in my experience, seldom going far from certain spots, doubtless where certain bulbs or roots are always to be found, but not necessarily, as one would expect, where the soil is loose or sandy, very often remaining in the stoniest and hardest ground. I have known these animals to remain 18 years in certain places on rocky kopjes near Pretoria, while not far off, where the ground would seem to be far more suited to them, they never occur. But sandy conditions of

soil/...

soil are nevertheless better suited to them. They have doubtless originated there. They are the most conservative animals I know, and as they seldom leave their burrows, specific isolation is to be expected."

Dispersal

A note on the dispersal of these animals may be of interest. Basically, no information is available, apart from what is to be found in Shortridge (1934, 324). This author quotes Thomas who has stated the following: "One of the causes of wide distribution of similar forms of Cryptomys is no doubt the habit of these animals of frequenting in the dry season the empty beds of rivers, and then when the water comes down in flood, such as survive are carried along to make further colonies lower down, by which process the Cryptomys of rivers hundreds of miles in length are preserved from local isolation". As Shortridge has correctly pointed out however, this theory has not yet been supported by field observations.

Shortridge (p. 322) correctly states, that even where very abundant, the Cryptomys colonies are local. In favoured tracts large aggregations of mounds may be observed close together. Then, suddenly, for miles perhaps, there are none, after which they again appear. This type of distribution is often seen in the Orange Free State.

Economic implications and Eradication

These aspects can be approached as follows: the good that these animals do, and/or the damage they cause. The latter alternative leading to a brief discussion of possible methods of eradication.

Eloff/...

Eloff (1954, 1,2) states that there is no doubt that the mole-hills alone, without the exposure of the lateral tunnels to the wind, have a most beneficial effect on the soil "for not only is the soil turned up, but the resultant increased porocity ensures the admission of water and air." As is known, when these tunnels are disturbed, (e.g. trampling down by livestock) the mole-rats burrow new parallel tunnels connecting the intact portions. "When large herds of game still roamed the open plains of the Free State, this factor certainly contributed in no small way to the burrowing of tunnels and consequently to the increase of porocity of the soil". During the dry seasons, through wind and water action, the lateral tunnels would certainly open up the main tunnels (after removal of the mole-hills) forming effective inlets for rain water into the soil below the hard surface layer of the ground.

Furthermore, Eloff is convinced that the preference <u>Cryptomys</u> shows for <u>Homeria</u> bulbs as well as for the nut grass <u>Cyperus esculentus</u> (the former being poisonous to cattle, the latter being a weed) keeps these undesirable plants in check. Areas (e.g. in the Free State) where mole-rats were numerous because of the presence of <u>Homeria</u>, <u>Moraea</u> and <u>Cyperus</u> were abandoned by them after three years when all these plants had disappeared. <u>Homeria's</u> usually grow in hollows where water collects and the presence of these plants in turn attract the mole-rats. They loosen the soil, so that these areas eventually become overgrown with red grass (<u>Themeda</u>), which is an important food source for cattle. Another aspect deserving attention is that <u>Themeda</u> seeds may lodge in,

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and spread further along a mole-rat tunnel where it germinates in the moist, cool mole-hill. These passages may then promote the spread of this grass. Eloff (1954, 2) also mentions another activity of the mole-rat which can be considered beneficial.

"These result from the instinct of the mole to burrow along the banks of a sluit or furrow which has more or less vertical walls. In this case, the lateral passages through which the mole pushes out loosened soil and which are formed on the side of the sluit, open, not on the surface but on the sides of the bank. The mole continues to burrow all along the steep bank until it finds a place less steep where it then burrows to the bottom level of the sluit. The mole can however burrow through very steep banks. This method of tunneling causes the banks to crumble and tends to level off the banks of such a sluit.

If sloping banks are less conductive to soil erosion than vertical banks, then we may well accept that this method of tunneling characterises the mole as a useful animal".

The possible usefulness of the pelt and the meat may be mentioned here. As far as <u>Bathyergus</u> is concerned, Roberts (1951, 380) maintains that the skin has not much value for it is rather thin and the fur is short. In contrast however, people living in the vicinity of Port Nolloth (Eloff, 1954, 3) regard the meat of the dune mole-rat as a delicacy when baked in an anthill and eaten with salt and pepper. This is probably understandable for the mole-rat is a clean animal without smell living exclusively

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on vegetable matter. Eloff has proved, that it can be reared and fattened in captivity on practically any kind of vegetable matter. People living in regions along the west coast of the Cape trap dune mole-rats for consumption during severe shortages of meat.

I have also seen dune mole-rats (Bathyergus) being trapped for food by coloured people in the Citrusdal district, even in times when there was no shortage of meat supply. These people use Bathyergus as the protein ingredient in stews and trap up to four or five mole-rats per household per week. It is said that often this forms their sole source of proteins, apart from fish which is occasionally purchased.

This is probably as much as can be said concerning the "credit balance" of the mole-rats. In terms of man and his agricultural and economic important ventures, the mole-rat, like the majority of indigenous mammals (in any geographical area) comes in direct conflict with mankind.

Seen in terms of economical implications, the following may be enumerated. During the days of the early colonists in the Cape, one of the important ways of transport was by means of horseback. Schreber (1792) already commented on the fact that due to the tunnels of Bathyergus, horse riding was a dangerous affair, for the horses damaging the tunnel systems fell into the holes up to their knees. Moseley (1879) provided the following interesting description: ".... in galloping over the sand one is very apt to be thrown head-long by one of their galleries giving way under the horse's feet. I had two such falls in one day. A clever horse, brought

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up in the country, learns however, whilst turned out on the run, to lift his foot out of a hole without stumbling."

Roberts (1951, 380) comments that in some places, where the ground is riddled with tunnels, it is dangerous to gallop on horseback "owing to the risk of the horses putting their feet through the surface into the tunnels and becoming a cropper" (Dreyer, 1910, 5) has commented in a similar vein.

It is generally known that these animals do a lot of damage in vegetable gardens. Roberts (1951, 380) however states, concerning Bathyergus, that they apparently do not enter gardens and therefore do not cause such extensive damage as Georychus and Cryptomys. This however, may be "due to their shyness and the pertinacity of residents, in the districts where they occur, in trapping them for food and the furry skins". As far as Georychus is concerned, it does a lot of damage to tuberous crops (Roberts, 1951, 382). Dreyer (1910, 5) has stated that this genus is the most directly injurous of the mole-rats. They are fond of potatoes and other vegetables and rob the farmer of a good percentage of his crop. Their destructivity in potato fields has also been mentioned by Fitzsimons (1919-1920, 154). As is the case in Cryptomys they spoil more than they can actually devour by their habit of gnawing a small portion of the substance and discarding the rest, which usually rapidly rots. Concerning Cryptomys, Eloff (1954, 2) says that when this genus directs its attention to cultivated lands, especially on small holdings, it usually

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is a serious matter. They cause serious shortage and absorption of water through their tunnels and the possibility also exists that damwalls and furrows along river banks may be undermined, thereby hindering irrigation procedures. I have observed on a number of occasions, that Cryptomys is particularly fond of burrowing in soils which constitute the walls of ground dams and reservoirs.

Similarly, I have heard of a small-holding owner south east of Pretoria (on the Delmas road) who cannot cultivate any tuberous crop due to a heavy infection of Cryptomys on his property. A similar complaint was received from farmers in the Zoutpansberg district (on the road to Witvlag) where virtually nothing can be grown which is of direct economic importance, due to the presence of a large number of Cryptomys colonies.

Another important agricultural activity in the southern parts of South Africa, is the production of wheat. When the fields are ploughed, the Bathyergus specimens usually reside in their tunnel systems and nests. These structures are not destroyed by the ploughs, in view of the fact that they are too deep below the surface of the soil. When the wheat is sewn, the animals usually throw up their large mounds in these wheat fields. They do very little damage (relatively speaking) when the wheat germinates and when it has not yet grown to its full height. During the reaping season, the wheat is hoed by means of expensive agricultural machines which have large revolving blades, reminding one somewhat of an oversized lawnmower. Due to the height of the wheat the large mole-hills are usually not visible and these blades then cut through these sand

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heaps, for which they are naturally not constructed. It has been said that these mole-hills, pushed up by *Bathyergus*, shortens the life of these blades by a factor of approximately one half of its otherwise expected length of life. The farmers in those areas consequently regard these animals as absolute pests and try all kinds of means and methods to get rid of these large mole-rats.

Agricultural aspects aside, another interesting statement is to be found in Roberts (1951, 380). "It has also been stated that gangers on the railways are instructed to watch that these animals do not tunnel underneath the lines, as a few of these tunnels close together cause the lines to sag."

Furthermore, it is well known that *Cryptomys* especially, can do (and does) a lot of harm and damage to golf links, bowling greens and even tennis courts.

It is therefore not surprising that some research, as to how to eradicate and combat these animals has been undertaken in the past.

According to Eloff (1954, 2), the control of *Cryptomys* is a relatively easy matter once a knowledge of its habits are known and kept in mind. He states that the danger exists that the mole-rat may even be exterminated by injudicious methods of control, ".... whereby the balance of Nature will undoubtedly be disturbed, and tulips may become the first pest with which the cattle farmer in the Orange Free State will have to contend". The natural food of *Cryptomys* consists of the wild tulips (*Homeria* and *Moraea*) as well as the nut grass *Cyperus* which are all three undesirable plants. The mole-rat burrows solely

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with the object of locating these plants. Furthermore, they do not tolerate any opening caused by man or any other agency admitting an influx of air into the main passage. To control the mole-rats therefore, some tulip bulbs, with tops intact are dug up and each bulb is treated with strychnine - "about half the amount that will go on to the point of a knife is rubbed into incisions made round each bulb" (Eloff, 1954, 2). Two poisoned bulbs are pushed into the tunnel, the one pointing in one direction, the other in the other direction, the tops being allowed to project via the lateral passage. These lateral passages should not be closed and very soon the influx of air will induce the mole-rat to close up the opening. However, "... nothing is as important to the mole as the tulip bulb which he first of all pulls into the hole for food". Eloff states that a greater measure of success can be achieved when the passages leading from the nest are all baited in this way. This method described above, is probably an effective measure of control.

Dreyer (1910, 5) states that an effective control measure in the case of Georychus, is to lead water into their burrows and so to drown them. However it is doubtful whether this method of control is effective in view of the fact that the tunnel system can absorb an enormous amount of water. He also advocates the possibility of poisoned bait with strychnine. Carbon bisulphide is also used against the "blesmol": this often necessitates large quantities of the poison to be used, due to the extent of the passages and therefore the treatment is expensive. Furthermore, this chemical is also

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liable to damage the vegetables which it is purposed to protect. This method is also mentioned by Fitzsimons (1919-20, 156): the chemical evaporates, and the gas being heavy, will travel along the tunnels suffocating the inhabitants. This method is also effective against Cryptomys. Bishop (1948, 4) on the other hand, proposed the use of cyanide powders such as "Cyanogas" or "Calcid". In this case a specially constructed pump is needed (like those being used for the eradication of rodents). The humidity of the ground combines with the powder, and hydrogen-cyanide results which is injected into the tunnel and which is lethal when it is inhaled by **Cryptomys**. "Cyanogas" can however also be applied without the aid of a pump. In this case, the lethal fumes circulate through the tunnels very slowly, and it is possible that the mole-rat, on detecting a foreign smell, will plug off that part of the system.

Another way in which these animals may be eradicated is by means of the use of carbonmonoxide, the waste product of the ordinary internal combustion engine. These gases are led into the tunnels by means of a rubber hose (Bishop, 1948, 4). Others maintain that the use of gascartridges are effective: others however found no permanent positive reaction to this method.

Apart from these chemical methods of eradication, one may use traps. There are various types of traps produced commercially, all effective to a certain degree, often depending on the eradicator and his manipulative ability of the trap. Bathyergus is easily trapped by a kind of "rabbit gin", in which case the animal is caught alive, usually by the hind-foot. Cryptomys can effectively be caught by means of a "snap-trap", which usually kills the animal outright. Another type is used extensively to trap Georychus in the south-western Cape, the so-called trapdoor trap. Cryptomys can be trapped by means of socalled tube traps. In this case, the animals are trapped alive and thus is especially useful for scientific purposes because the specimen is not damaged in any way at all. They can then be killed in a humane fashion with chloroform or ether.

Another method of eradicating these animals (e.g. Cryptomys) is to dig these animals out. Remove the soil above the main tunnel to about two to three inches above the tunnel: open the tunnel at the furthest end, and stand perfectly still above the opening: after a while (depending on the nature of the individual animal), it will come to investigate and the moment ground is being pushed out in order to plug the perforation, the spade can be inserted in front of the mole-rat and the animal scooped out.

Still another method employed to combat these animals, is to shoot them. A tunnel is opened up, (preferably near a new mole-hill) and if everything is quiet, the animal may appear within a few minutes. It can then easily be shot with a firearm. It is best to have the firearm ready for action because the slightest amount of movement will prompt the animal to retract. A good way is to lie flat on the ground with the mouth of the gun (pistol) directed at the opening of the tunnel. When the mole-rat appears, no addi-

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tional movements are required apart from pulling the trigger. It is often of no use firing into the earth which is brought along to plug the opening, for often the force of the bullet is stopped by the column of earth and the animal gets away. Once it has been frightened in this way, it does not return in due course to plug the opening. I have acquired a number of specimens of *Bathyergus* and *Cryptomys* in this way.