CHAPTER 1

INTRODUCTION

During the past decade it has become clear that taxonomic research on the mammals of Southern Africa has become a necessity. Our knowledge pertaining to many orders and families is often haphazard and scattered and this has led to a virtually chaotic taxonomic position for many groups. It is unlikely that new animals will be discovered in this area and therefore the time may be ripe for revision and synthesis of the information of the fauna hitherto gained.

As far as past research is concerned, the attention has largely been directed to the larger mammalian species which occur in Southern Africa while the smaller mammals were neglected to a certain extent. However, there has been a revival of interest in the smaller mammals during the past 15 to 20 years and the possibility of interesting, rewarding and important research has become evident. A good example of this approach is afforded by the vast amount of work done by the Medical Ecology Unit of the South African Institute for Medical Research in Johannesburg, in order to determine the rodents which act as vectors in the distribution and transmission of plague. At the same time valuable taxonomic information is gained. On a more theoretical basis, the revision done by Meester (1963) on the Southern African forms of Crocidura (shrews), stands out as a prime example of the new research attitude towards the smaller mammals. Similar types of revision will eventually lead to a

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workable, practical taxonomy, a necessity which is still lacking for Southern African mammals up to date. It may furthermore be noted that taxonomic revisions can not be undertaken for all mammalian groups as yet, due to the absence of available study material, lack of relevant information and other similar gaps in our knowledge.

Apart from attempts to consolidate the taxonomy and matters relating thereto, the concept of the ecosystem should be stressed. This useful concept has been neglected in the past, but it is of prime importance in order to understand the intricate mechanism and balance of nature. To date, very little is known about the role played by the smaller mammals in the ecosystem and therefore all facets of information are vitally important for a better understanding of the interrelationships between soil, plants and animals.

This dearth in our knowledge, particularly as far as the rodents are concerned, is probably due to the fact that the taxonomy of this interesting mammalian order is still in a fluid state. In addition, information concerning aspects of ecology, ethology and paleontology is meagre. Absence of this kind of data is especially noticeable in the case of fossorial rodents such as the bathyergids or mole-rats.

The mole-rats (Order Rodentia, family Bathyergidae) are typically Ethiopian animals. Due to their fossorial way of life certain specializations have been developed which are also found in other unrelated fossorial rodent families including the Spalacidae and Geomyidae. These animals all show suppressed development of the eyes, immensely enlarged

incisors/...

incisors and/or claws adapted for digging (Ellerman, 1940, 3). As far as the bathyergids are concerned, it is stated that they have relatively unknown affinities and it appears that they have become fossorial secondarily which has led to a special set of adaptive features.

Beddard (1902, 480) lists a number of features which characterize the several genera contained within the Bathyergidae and which may briefly be paraphrased as follows: eyes small; pinnae of ears reduced to a fringe of skin surrounding external auditory meatus; legs and tail short; a tendency for reduction in the hair-covering of the body which reaches its culmination in the nearly naked sand-puppy Heterocephalus, presently occurring only in Somaliland and Kenya; all the genera are fossorial (i.e. Bathyergus, Heliophobius, Heterocephalus, Georychus and Cryptomys); and incisors standing out in front of the closed lips.

Sclater (1901) lists a number of bathyergids occurring in Southern Africa and this was followed in 1939 by Allen in his wellknown checklist for African mammals. Roberts (1951) in his already classical work, 'The Mammals of South Africa' described the various genera, species and subspecies which he thought occurred in Southern Africa, while this was followed by yet another revision of Southern African mammals by Ellerman, Morrison-Scott and Hayman in 1953. All these works attempted to summarize and interpret the then existing knowledge of Southern African mole-rats, more or less from a taxonomic point of view. This has led to a diversity of interpretations, especially as far as the validity

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and status of the different species and subspecies are concerned.

In the course of this work, special reference will be made to Roberts (1951) and Ellerman et.al. (1953). In the latter, many clearly different forms of bathyergids are lumped together while the former has possibly oversplit the bathyergid species and subspecies to too great an extent. In the present work an attempt is made to find evidence which may merge the two widely diverging interpretations as far as the specific and subspecific taxa of the bathyergids are concerned.

The aim of this work is therefore a revision of the taxonomy of the mole-rats which occur to the south of the Cunene river on the western part of the African continent and the Sambezi river on the eastern half. However desirable, a Pan-African revision of the Bathyergidae is not possible at present and would take a considerable time to complete. Consequently, the extra-limital genera (i.e. north of the Cunene and Sambezi rivers) Heterocephalus (Fornaria) and Heliophobius (Myoscalops) are not considered in this work and the attention is focussed on the three Southern African genera viz. Bathyergus, Georychus and Cryptomys.

For the purposes of the present work, these three genera and their respective species are subjected mainly to a morphological and statistical comparison. It is evident that this approach will contribute a greater amount of evidence than comparing the animals either ecologically or ethologically. Very little is known about the latter aspect although Eloff (1951, 1952, 1958) has investigated behavioural aspects con-

cerning Bathyergus and Cryptomys (mainly under laboratory conditions). Furthermore, very little is known about the embryology, cytogenetics and physiology of the mole-rats. However, any relevant information concerning the ecology, ethology, embryology and physiology has been incorporated in the present work.
It is doubtful, however, whether aspects of embryology and physiology could contribute substantially to unravelling problems concerning specific or subspecific status.

The main body of enquiry of this revision will be directed at the specific and subspecific levels of bathyergid taxonomy. The subspecies concept has been severely critisized recently, while being upheld by other authorities and for an excellent review of the diverging interpretations, the reader is referred to Meester (1963). According to Meester, some workers (e.g. Davis, 1949) confine their attention in taxonomic work to the species as the smallest taxon while Ellerman et.al. (1953) is openly sceptical about the validity of the trinonem. Wilson and Brown (1953), Gosline (1954) and Burt (1954) propose doing away with the subspecies concept entirely or"... at least not giving it formal nomenclatural recognition" (Meester, 1963, 3). On the other hand, Mayr (1954) and Smith and White (1956), while being aware of the shortcomings of this category have produced arguments for its retention. Edwards (1954) and Pimentel (1959) have attempted to standardize the subspecies concept by using statistical inferences, retaining it for geographically isolated populations showing a specified degree of difference (84% joint non-overlap)(Meester, 1963, 3).

The objective reality of this category as a biological unit is proposed by Edwards (1954) and Pimentel (1959) who attempt to solve this problem by referring only those populations to it, which are morphologically divergent and geographically isolated. However, as Meester quite rightly points out: "... from the museum taxonomist's point of view, the biological reality of the subspecies seems to be a secondary consideration. It seems more practical to regard it, with Mayr (1954, 87), as 'a purely subjective category,... a strictly utilitarian classificatory device for the pigeonholing of population samples'. This does not imply that the subspecies can have no objective reality, merely that it need not express any one particular reality". (Meester, 1963, 3).

Still paraphrasing Meester, it is evident that such an interpretation of the subspecies concept allows this concept to be a flexible unit, provided that it is clearly recognisable. This advantage should be used with discretion, otherwise the conventional species is divided into numerous ill-defined and ".... often unrecognisable units". To my mind, this has often been done in the past (e.g. Roberts, 1951) as far as the Southern African mole-rats are concerned, and the subspecies concept lost whatever taxonomic usefulness it may have had.

MATERIAL

The taxonomic revision which forms the greater portion of this work has been done on the genera and species listed below.

Genus Bathyergus: Bathyergus suillus suillus, B.s. intermedius, B.janetta janetta, B.j.inselbergensis/...

B.j.inselbergensis and B.j.plowesi.

Genus Georychus: Georychus capensis capensis, G.c.canescens and G.c.yatesi.

Genus Cryptomys: Cryptomys hottentotus hottentotus, C.h.cradockensis, C.h.bigalkei, C.h.transvaalensis, C.vandami, C.caecutiens, C.damarensis, C.ovamboensis, C.holosericeus holosericeus, C.h.orangiae, C.h.vetensis, C.h.valschensis, C.h.vryburgensis, C.bocagei, C.nimrodi, C.darlingi, C.beirae, C.zimbitiensis, C.natalensis natalensis, C.n.langi, C.n.aberrans, C.n.junodi, C.n. streeteri, C.n.jamesoni, C.n.arenarius, C.n.mahali, C.anomalus, C.montanus, C.komatiensis komatiensis, C.k.stellatus, C.k.melanoticus, C.k.zuluensis, C.rufulus and C.jorisseni.

The following museums and institutions have contributed to the completion of this investigation by loaning specimens or by permitting me to examine their collections. The capital letters preceding the names listed below indicate abbreviations used throughout this work for the various collections:

TM Transvaal Museum, Pretoria.

ME Medical Ecology Centre, Johannesburg.

KP Kruger Park Museum, Skukuza.

NM Natal Museum, Pietermaritzburg.

KM Kaffrarian Museum, King William's Town.

AM Albany Museum, Grahamstown.

PE Port Elizabeth Museum and Oceanarium.

DM Durban Museum.

SA South African Museum, Cape Town.

RM National Museum, Bulawayo.

MM McGregor Memorial Museum, Kimberley.

EM East London Museum.

This revision of Southern African bathergids is based on the examination of 1,423 skins and 1,338 skulls allocated as follows:

	Skins	Skulls
Bathyergus suillus	163	157
B.janetta	130	125
Georychus capensis	115	102
Cryptomys hottentotus	411	374
C. damarensis	38	36
C. holosericeus	80	77
C. darlingi	66	58
C. nimrodi	-	-
C. bocagei	9	8
C. beirae	5	5
C. natalensis	336	327
C. komatiensis	70	69

The following type specimens, housed in the Transvaal Museum were studied:

Bathyergus suillus intermedius Roberts 1926, TM. 2171, ♂, collected 1/10/1917, Klaver, Cape Province.

Bathyergus janetta plowesi Roberts 1946, TM. 9795, ♀, collected 12/6/1942, Oranjemund, South West Africa.

Georychus capensis yatesi Roberts 1913, TM. 1243, ♂, collected 26/10/1912, Belfast, Transvaal.

Cryptomys transvaalensis Roberts 1924, TM. 2463, ♀, collected 19/12/1919, border of bushveld, Zoutpan road, Transvaal.

Cryptomys vandami Roberts, 1917, TM. 1487, ♂, collected 12/1/1915, Griffin mine, Leydsdorp district, Transvaal.

Cryptomys cradockensis Roberts 1924, TM. 2389, ♀, collected 5/10/1918, Cradock, Cape Province.

Cryptomys ovamboensis Roberts 1946, TM. 8229, ♂, collected 2/6/1937, Ondongwa, South West Africa.

Cryptomys bigalkei Roberts 1924, TM. 2806, ♀, collected 14/7/1921, Glen, Orange Free State (and co-type, TM. 2949, ♂, collected 16/9/1921, Glen, Orange Free State).

Cryptomys natalensis Roberts 1913, TM. 1245, ♀, collected 10/12/1912, Wakkerstroom, Transvaal.

Cryptomys jamesoni (Roberts). 1913, TM. 581, ♀, collected 4/6/1907, Houghton, Johannesburg, Transvaal.

Cryptomys anomalus (Roberts) 1913, TM. 1252, ♀, collected 23/2/1913, Skinner's Court Valley, Pretoria, Transvaal.

Cryptomys arenarius (Roberts) 1913, TM. 1265, ♀, collected 3/3/1913, Rietondale (East), Pretoria, Transvaal.

Cryptomys mahali (Roberts) 1913, TM. 1272, ♀, collected 9/5/1913, Rosslyn, Pretoria, Transvaal.

Cryptomys langi Roberts 1929, TM. 4928, ♂, collected 6/1927, Karkloof, Natal.

Cryptomys aberrans (Roberts) 1913, TM. 587, ♂, collected 10/10/1911, Port St. Johns district, Cape Province.

Cryptomys vetensis Roberts 1926, TM. 3512, ♀, collected 18/7/1922, Taaiboschspruit, Vet River, Orange Free State.

Cryptomys orangiae Roberts 1926, TM. 2810, ♀, collected 4/8/1921, Glen, Orange Free State.

Cryptomys/...

Cryptomys holosericeus valschensis Roberts 1946, TM. 2518, ♂, collected 18/6/1920, Bothaville, Orange Free State.

Cryptomys zimbitiensis Roberts 1946, TM. 559, sex unknown, collected 31/1/1908, Zimbiti, Mocambique.

Cryptomys pretoriae (Roberts) 1913, TM. 1244, ♂, collected 19/1/1913, Skinner's Court Valley, Pretoria, Transvaal.

Cryptomys natalensis pallidus Roberts 1917, TM. 2044, sex unknown, collected 12/7/1916, Nwanetzi river, Transvaal.

Cryptomys montanus Roberts 1926, TM. 2838, ♀, collected 17/11/1921, Groenkloof, Pretoria, Transvaal (and co-type TM. 2837a, ♂, collected 16/11/1921, Groenkloof, Pretoria, Transvaal).

Cryptomys palki (Roberts) 1917, TM. 2085, ♂, collected 24/3/1917, Venterskroon, Transvaal.

Cryptomys junodi Roberts 1926, TM. 4175, ♂, collected 20/8/1924, Masiyeni, Mocambique.

Cryptomys komatiensis (Roberts) 1917, TM. 1765, ♀, collected 9/9/1915, Arnhemburg, Carolina, Transvaal.

Cryptomys rufulus (Roberts) 1917, TM. 606, ♀, collected 26/9/1907, Tzaneen Estate, Transvaal.

Cryptomys stellatus (Roberts) 1917, TM. 1950, ♂, collected 22/6/1915, Inkomati river, Transvaal.

Cryptomys melanoticus Roberts 1926, TM. 2123, ♀, collected 7/7/1917, Balloon Farm, Makoetsi river, Transvaal.

Cryptomys natalensis streeteri Roberts 1946, TM. 4334, ♀, collected 20/8/1924, Hektorspruit, Transvaal.

Cryptomys komatiensis zuluensis Roberts 1926, TM. 5002, ♀, collected 10/11/1927, St. Lucia Bay, Natal.

Live/...

Live specimens of Bathyergus suillus (2 individuals) and Cryptomys natalensis (10) were observed in the laboratory for varying lengths of time.

METHOD

The following abbreviations are used for measurements and statistical terms:

H.B. Head and body length

T. Tail length

H.F. Hind-foot length

C.B. Condylo-basal length

B.C. Braincase width

I.W. Interorbital width

Z.W. Zygomatic width

M.W. Muzzle width

U.T.R. Length of upper tooth row

L.J. Length of lower jaw

L.T.R. Length of lower tooth row

M. Arithmetic mean of sample

N. Number of observations

S.D. Standard deviation

C.V. Coëfficient of variation

$S.E._m$ Standard error of the mean

C.D. Coëfficient of difference

% J.N.O. Percentage joint non-overlap

t A value distributed in a definite way, used to estimate probabilities in comparisons of several parameters estimated from small samples

P. Probability that a difference can be ascribed to chance.

The nature of this investigation necessitated a statistical approach in order to unravel the various/...

various problems which presented themselves, especially on the subspecific level. The different statistical approaches and procedures described by Simpson and Roe (1939), Mayr, Linsley and Usinger (1953) and Cazier and Bacon (1949) were consulted and largely followed. Whenever skulls were available, the following eight measurements were taken on each skull (provided that the relevant portions of the skulls were undamaged): condylo-basal length, width across the brain-case at the level of the squamosal constriction, interorbital width, zygomatic width, muzzle width, length of upper tooth row, length of lower jaw and length of lower tooth row. Definitions of the various lengths and breadths are given below. Comparisons with figures and values obtained by other workers have been avoided as far as possible. In some cases t-values were calculated in order to test statistically the differences between populations.

The following information, as available from the specimen tags was recorded: sex, locality, head-body length, tail length and hind-foot length. This implies that the various 'field measurements' have not been remeasured on the specimens available for study. Study skins tend to stretch to a certain extent when prepared and different preparators have different methods in preparing specimens so that the final result is hardly ever an exact copy of the original dimensions of the animal. Study skins are therefore often larger than the values obtained for the original field measurements. These figures are thus accepted for the purposes of this work at their face value. Furthermore, it is well known that

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different people who measure these animals when they are collected, use different techniques and approaches. This leads to an additional possible source of error, and consequently these figures and values derived from museum labels are to be accepted with a certain degree of reservation.

Definitions of the standard measurements, taken where possible on all the specimens studied, are as follows:

Field measurements:

Head and body length	-	From the anterior tip of the nose to the base of the tail, taken by bending the tail up at right angles to the body.
Tail length	-	From the base of the tail - found as above - to the tip of the caudal vertebra, excluding the hair.
Hind-foot length	-	From the most proximal point of the heel to the tip of the longest toe, excluding the claw (s.u.).

Skull measurements:

Condylo-basal length	-	From the anterior portion of the premaxillaries (gnathion) in front of the upper incisors to the most caudad portion of the left condyle (condylion).
Braincase width	-	The width across the braincase where the squamosal makes a definite medially directed constriction, i.e. just anterior to the external auditory meatus.
Interorbital width	-	The narrowest point across the frontals, nearly on the suture between the frontals and squamosals.
Zygomatic width	-	The greatest width across the two zygomatic arches on the level of the jugal bones.
Muzzle width	-	The width across the muzzle on the suture between the premaxillaries and the maxillary portions of the zygomatic arches.

Upper/...

Upper toothrow length - The distance from the occlusal level of the third premolar (anterior edge) to the posterior edge of the occlusal surface of the last molar.

Lower jaw length - The distance between the edge of the alveolar rim of the lower incisor (where the outer edge of the lower incisor enters the alveolus) to the dorsal surface of the condyle articulating with the glenoid fossa of the skull.

Lower toothrow length - The distance between the most anterior point of the occlusal surface of the anterior molar to the most posterior rim of the occlusal surface of the hindmost molar.

Except where otherwise stated, all measurements used in this work are in the metric system. Millimeters are used exclusively in the systematic descriptions.

All the skull measurements were taken with the same sliding vernier calipers, reading to 0.1 mm. Field measurements were taken with a steel rule.

Statistical analyses have been made wherever available samples were of sufficient size to permit evaluation. In the tables, the measurements for males, females and unsexed animals are listed separately, for certain measurements show significant sexual dimorphism. When less than five animals from any of these categories were available from one locality, all the available individual measurements are listed. However, when five or more than five specimens were available, the mean, observed range, standard deviation and number of observations are listed instead.

The illustrations which are incorporated in

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this work are all accompanied by their appropriate comments. Graphs showing variation in condylo-basal length are included for the majority of species.

The age of each specimen was determined according to the following scheme: 'adult' with complete permanent dentition, all teeth showing some degree of wear; 'young adult' with complete permanent dentition, but of recent acquisition; 'juvenile' (immature) with permanent dentition incomplete. These categories are arbitrary since no individuals of exactly known age were available for study.

Whenever mention has been made of vegetation and veld types, the classification followed is that by Acocks (1947). For information concerning vegetation and related matters of Mocambique, Southern Rhodesia and South West Africa, Keay (1959) has been consulted. The rainfall data has been obtained from the 'Normal Annual Rainfall' map of South Africa, printed by the Government Printer and issued in 1957.

In the distribution maps, use has been made of the locus mapping system as used by Davis (1949) and others. The distribution patterns thus obtained do not necessarily indicate the absolute limits and ranges of the species, for in many cases, the distributional data is scanty.

Virtually all the localities in Southern Africa where examples of bathyergids have been collected or recorded are listed in a gazetteer at the end of this work together with their map co-ordinates and loci. Since the bathyergids are a wide-ranging and abundant family, persons working with Southern African collections may save much time by

referring/...

referring to the gazetteer of the localities recorded on museum labels.

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