HANDBOOK OF NEW GUINEA RODENTS

By J. I. Menzies and Elizabeth Dennis

WAU ECOLOGY INSTITUTE
HANDBOOK NO. 6
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PREFACE

We commenced writing the manuscript of this book while we were on the staff of the University of Papua New Guinea in Port Moresby and owe much to our colleagues in that institution for encouragement with our research and to friends all over New Guinea for their help with our field work. JM also spent some time examining specimens in museums around the world and we thank the curators of those institutions for their help and hospitality.

For permission to quote from Kenneth Grahame's "*WIND IN THE WILLOWS*" we are indebted to the publishers, Methuens Children's Books, Ltd., Text Copyright University Chest, Oxford. While the manuscript was in preparation, it was read by a number of friends who were able to make useful suggestions for improvement. In particular we would like to thank Peter Baverstock, John Calaby and Christopher Watts for their help.

All the color illustrations in the book were taken by ourselves, of rats that we had had collected but mainly back in the laboratory under 'studio' conditions. Figures 7 and 8 were drawn by Ian Griffiths, the remaining black and white illustrations are the work of JM.

J.M.,
Roma, Lesotho

E.D.,
Canberra, Australia
September 1978.

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Wau Ecology Institute is very grateful for donation toward publication cost of this handbook by Dr Kintaro Baba of Niigata, Japan.

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Chapter 1

INTRODUCTION

"I beg your pardon," said the rat slowly as he chewed on a straw, I did I hear you say something about 'we' and 'start' and 'this afternoon"

THE WIND IN THE WILLOWS

The large island of New Guinea probably has more than its fair share of bizarre creatures such as birds of paradise, kangaroos that live in trees and mammals that lay eggs, and for this reason the more 'normal' component of its fauna is often overlooked. Moreover, it is often thought that, because the island lies well to the east of Wallace's line, it is a land solely of marsupials, that is mammals with pouches. Actually, the mammalian fauna of New Guinea (excluding bats) is composed almost equally of marsupials and rodents, most being unique to the country. This book calls attention to the rodents, a neglected, but extremely interesting group of animals and presents any available information on their appearance, habits and distribution.

We have included every species of rodent known to occur in New Guinea and nearby islands, except for the Solomon Islands and other archipelagos which do not form part of the Papuan subregion (Fig. 1). Taxonomy in the past has been based mainly on anatomical differences. It may well be that intensive studies based on ecology, biochemistry and genetics will show that some of the species we have listed as single species are groups of close relatives. Multidisciplinary study is just beginning in this country and there is abundant scope for more research into the lives of native rodents. Field observations often lead to detection of differences in habit and habitat and so to the recognition of distinct species formerly confused. Western observation may be less acute than that of local people who have long distinguished animals by behaviour rather than anatomy and have several vernacular names for what we list as single species.

There are about 50 species of rodents in New Guinea and many closely resemble one another. We are unable to allocate english names to each of them, because there are few names for rat and mouse-like animals in the language. We have therefore given an english name to each genus but for the individual species it is better to learn the scientific names. In recent years a number of studies of 'native' taxonomy have produced vernacular vocabularies for rats but they are too fragmentary to make listing them useful. In Europe, size differences make the distinction between rats and mice easy but, in New Guinea, there are no clear-cut size differences and there may even be considerable range in size between members of a single genus. Thus the differences between 'rats' and 'mice' are not easy to define

and in a rather arbitrary manner, we have designated some genera (mostly medium or large in size) as "rats" and others (mostly small-sized) as "mice."

Rodents are generally held to be utterly abhorrent, doing damage and spreading disease; the one exception to this being Kenneth Grahame's Water Rat in *The Wind in the Willows*. By using a few quotations from that book we mean to suggest that New Guinea rats are likeable, inoffensive and well worth studying.

Chapter 2

THE MAMMALIAN FAUNA OF NEW GUINEA

" 'Let's have a look at them!' cried the Rat, jumping up"

THE WIND IN THE WILLOWS

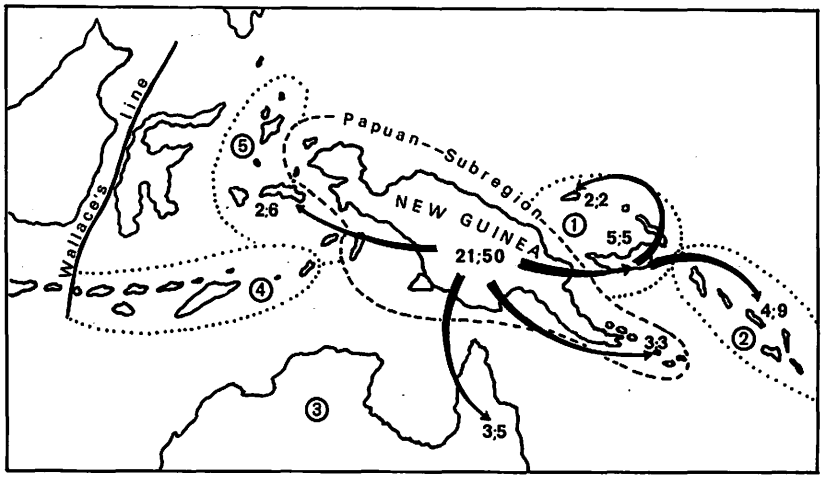
All islands have what is described as a depauperate fauna and, despite its large size, the island of New Guinea is no exception. Depauperate means, not that the actual number of animals is small, but that there is a lack of variety and thus a small number of different kinds of animals. The more remote an island the more depauperate its fauna will be, as it will have little immigration from elsewhere. The islands of Fiji with no native land mammals except bats are an extreme example. The New Guinea fauna is comparatively rich, being adjacent to two large land masses which have provided sources from which fauna has been derived. In fact New Guinea has been part of the Australian land mass for most of its geological history and only became separated some 6000 to 8000 years ago. Consequently, the fauna of New Guinea resembles that of Australia, though as Australia is itself a remote island its fauna is also limited. Mammalian similarities with Australia are the monotremes (egglaying mammals including echidnas) and marsupials (pouched mammals). Of the 53 genera of marsupials and monotremes inhabiting the two regions 14 are shared between them, 10 are peculiar to New Guinea and 29 to Australia.

The origin of our rodents and bats was in the continent of Asia. There is no definite barrier separating the rich fauna of SE Asia from that of the Papuan Region, yet the concept of Wallace's line is useful. This line which runs between Borneo and Sulawesi, Bali and Lombok (see fig. 1), marks the most westerly occurrence of typically Papuan fauna. As one passes eastwards through the Indonesian islands, the kinds of mammals become progressively fewer. Primates (monkeys and apes) are found no further east than the island of Celebes (Sulawesi). Hoofed animals (ungulates) and insectivores occur no further east than the Moluccas and the mainland of New Guinea is reached only by rodents and bats. This attenuation is caused by the breaks in land between the Asian mainland and New Guinea. If there ever were any direct land connections they were too short lived to allow for migration of the major mammal groups between the land masses. The flying bats are not constrained by sea barriers and they, together with a single family (Muridae) of rodents have somehow been able to make the long migration. It is impossible to say whether the rodents came accidentally on floating vegetation or directly on transient land bridges. Probably very few completed the journey and so the rodent fauna of the Papuan region is derived from relatively few ancestors.

Except for animals recently introduced by humans, all the mammalian

fauna of New Guinea was derived from immigrants from Australia or from SE Asia. The two elements are present in approximately equal numbers. Whether one considers the Papuan subregion to be part of the Australian or the Oriental biogeographic region is largely a matter of opinion; this merely reflects the dual origin of the fauna.

Apart from the cosmopolitan genus *Rattus*, all rodents occuring in New Guinea belong to endemic genera and so must have evolved here. Their ancestors are unknown even though the family *Muridae* to which all our rodents belong is of comparatively recent origin. The oldest rodent fossils come from the Miocene of Europe, but the earliest known from Australia (Queensland) are only about five million years old while the oldest known from New Guinea are probably early Pliocene. It seems very likely that the first immigrant rodents arrived in the Australian-New Guinean area about ten million years ago. However, an earlier arrival cannot be ruled out. Despite this relatively recent arrival in New Guinea, our native rodents have undergone a considerable evolutionary radiation, for we now have rats of all sizes from small to more than one kilo in weight, and adapted to a variety of habitats – arboreal, aquatic or simply terrestrial. Presumably the rodents found little competition in the absence of other eutherian mammals and could fill niches they would not otherwise be able to occupy.



1. The Papuan and adjacent zoogeographical subregions and the distribution of Papuan rodents excluding *Rattus* species. Figures at the ends of the arrows indicate the number of genera and species derived from Papuan endemics in each area. Circled numbers are (1) North Melanesian (2) Solomon Island (3) Australian (4) Lesser Sunda and (5) Moluccan Island subregions.

Although studies on native rodents are far from complete, genetic evidence does suggest that, apart from the genus *Rattus*, all New Guinea rodents are closely related; this supports the concepts of recent origin and limited ancestry. The major evolutionary centre is the New Guinea mainland but Papuan rodents have migrated to the nearby islands and to the Australian mainland. These migrations are indicated in figure 1.

A number of exotic mammals have been introduced either accidently or deliberately by man and six of these are rodents. Three are so common that we have put them first in our systematic account. Everyone in New Guinea will come across these introduced rodents sooner or later.

Chapter 3

WHAT ARE RATS? A NOTE ON THE BIOLOGY AND CLASSIFICATION OF RODENTS.

" 'Besides' said the Rat 'there are a hundred things one has to know, which we understand all about and you don't, as yet' "

THE WIND IN THE WILLOWS

A. CLASSIFICATION

The terms "rodent" and "rat" are often thought to be synonymous, but this is not so, for only one division (Myomorpha) of the large order Rodentia could properly be described as "rat-like".

The following outline will help to put the New Guinea rodents into perspective, though it is not a detailed rodent classification.

Order: R O D E N T I A – rodents, are the largest order of Eutherian mammals including more than 300 genera distributed world wide.

Suborder: SCIUROMORPHA (squirrel-like rodents) including squirrels (world-wide except Australasia), beavers and some other North American rodents and a few in Africa.

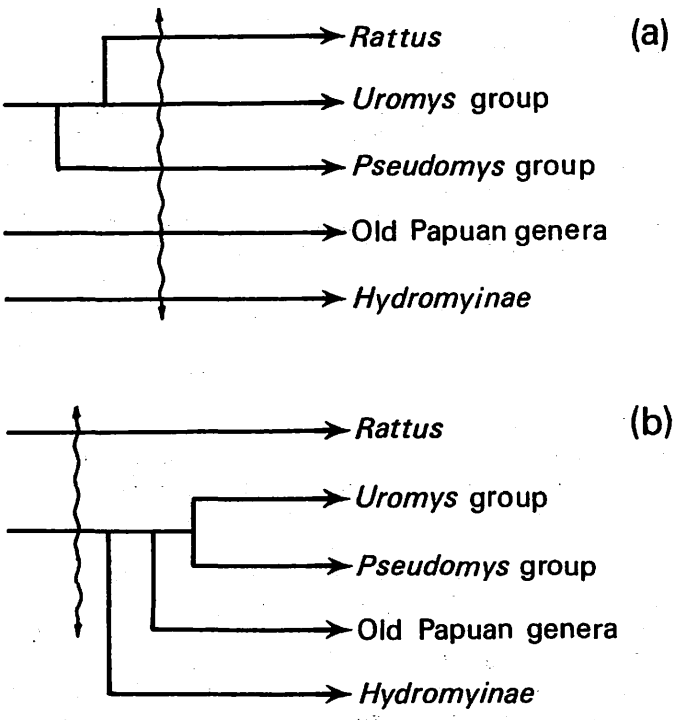
Suborder: HYSTRICOMORPHA (porcupine-like rodents) including porcupines (world-wide except Australasia), guinea-pigs and others of South America, mole rats etc (Africa).

Suborder: MYOMORPHA (rat-like rodents) including rats, mice and similar animals (world-wide). There are two families in this suborder of which only one occurs in New Guinea –

Family: MURIDAE (rats; mice), world-wide, including Australasia. This is the only family of rodents which occurs in the Papuan area although several others are present in Asia and some of them reach as close as the Moluccan Islands.

The most comprehensive review of the rodents of Australia and New Guinea was written by G.H.H. Tate in 1951. The Australian and New Guinea rodents were divided into two subfamilies on the basis of differences in dentition. The first of these is the subfamily *Hydromyinae* (8 genera). This rather unfortunate name implies that its members are water rats but only three of the eight genera of hydromyines are known to be aquatic, the others are terrestrial. In his review Tate divided the second subfamily (*Murinae*) into a number of distinct groups; endemic *Rattus*, the *Uromys* group, the 6 "old Papuan genera" and the *Pseudomys* group.

Figure 2a shows the relationships between these in the manner that Tate envisaged their evolution, with at least 5 ancestral invasions into the region. But recent genetic evidence suggests that the hydromyines, the pseudomys group, the Uromys group and at least two of the "old Papuan genera" are more closely related than Tate thought and may have evolved from a single ancestor within New Guinea. This alternative scheme is depicted in figure 2b. Endemic *Rattus* species, on genetic evidence, appear to be totally unrelated to the others, having different ancestors. In a recent study of the shape of the penises of New Guinea rodents, Dr W.Z. Lidicker of the University of California came to a similar conclusion.



2. Evolution of Papuan and Australian rodents according to (a) Tate, 1951 and (b) recent chromosomal evidence. The wiggly lines indicate the postulated time of entry into the region.

B. BIOLOGY

In terms of numbers of individuals alive in the world rodents are probably more numerous than all other orders of mammals put together and the most numerous rodents are those belonging to the suborder Myomorpha which is undoubtedly one of the most successful groups of mammals.

Why are rodents so successful? They are different from all other mammals in the nature and number of their teeth and the ways in which the skull and jaws are modified to allow the teeth to function in the most efficient way. Eutherian mammals may have up to 44 teeth in all – 11 in each jaw quadrant – these may include incisors with sharp cutting edges, canines with sharp points and cheek teeth – premolars and molars – with broad crowns bearing several sharp points or cusps on their biting surfaces. Rodents, however, never have more than 28 teeth and often far fewer than that. Rats and mice have only a single pair of incisors in upper and lower jaws, no canines and no more than three pairs of molars. Moreover the distribution of enamel on the outer surface only of the incisor teeth ensures that they maintain a sharp cutting edge at all times. The cusps of the molar teeth have become fused into transverse enamel-edged ridges called lophs which may be simple in shape or folded in a quite complex manner. The form of these lophs is used in the classification of rats. Complex molar teeth are not restricted to rodents but are found in many herbivorous animals for hard ridges of enamel resist wear to a greater degree than simple pointed cusps. With a combination of chisel-edged incisors and complex molars, rodents can tackle very hard food.

Reduction in number and specialisation of the teeth is not enough to make for maximum gnawing and grinding efficiency. In rodents, the masseter muscles (one of the pairs of muscles which close the lower jaw and so are involved in grinding and gnawing) do not merely act to raise the jaw but are divided into sections, some of which run obliquely and so pull the jaw backwards and forwards as well as upwards. By this means the molar teeth may be disengaged while the incisors are operating. The rostrum or snout portion of the skull is very high-sided to accommodate these muscles. This gives the rodent skull its characteristic square shape and flat dorsal outline. The lack of canine teeth and small number of molars leaves a long gap between the incisors and the cheek teeth and the cheeks may be folded into this gap separating anterior and posterior parts of the mouth. Thus, using its incisor teeth, a rodent may gnaw through a piece of wood without filling its mouth with wood chips.

The remainder of the myomorph body is unspecialised, and, apart from size, one rat generally looks much like any other. This unspecialised state does enable rodents to occupy a wide variety of habitats and, together with a short life cycle and high rate of reproduction, permits rapid colonisation

of ecological niches. Most rodents can swim and climb well and only slight additional modifications are necessary to produce highly aquatic animals with webbed feet or arboreal ones with long prehensile tails. It has been this ability to colonise a wide variety of habitats with lack of competition from other mammals which has enabled New Guinea rodents to diversify.

Despite their ability to deal with very hard food such as nuts and seeds, rodents are not restricted to this type of diet. Most rodents are basically herbivorous with a tendency towards being omnivores. Some are undoubtedly more specialised, with a diet of insects or even fish, but so few studies have been done on our native rodents that it is not possible to describe their diet. In captivity many species eat a wide variety of food, but they are probably more specialised in nature. The presence, in any one area, of a variety of species suggests ecological differences between them, in diet as well as microhabitat.

Rats are often thought of as being prolific simply because the most familiar kinds, the house rats and mice, are so. These have a short gestation period and, having up to six pairs of mammary glands, can easily cope with large litters. Some African rats exceed this degree of fecundity but in Papuan species litter size is generally small and the young may be born in a comparatively advanced state. The number of pairs of mammae may be as low as one but two or three is more usual and only a single native species has six pairs like house rats.

Chapter 4

FURTHER READING.

" 'Beyond the Wild Wood comes the Wide World,' said the Rat, 'And that's something that doesn't matter, either to you or to me. I've never been there, and I'm never going, nor will you either if you've got any sense at all.' "

THE WIND IN THE WILLOWS

Rat's reluctance to get involved with things outside his own waterside habitat was understandable but anyone wishing to make detailed studies on Papuan rodents must first become aquainted with an extensive literature from overseas sources. Largely as a result of the extensive collections made by the six Archbold Expeditions of the American Museum of Natural History, the rodents of the Papuan and adjacent regions have been the subject of several extensive taxonomic studies. The first of these was by G.H.H. Tate (Bulletin of the American Museum of Natural History, No. 72) in 1936 and includes accounts of all Indo-Malayan species. It is well illustrated with drawings of teeth and skulls. In 1938 Rümmler made a revision in German. Tate's second revision was published in 1951 (Bulletin of the American Museum of Natural History, No. 97), included Australian species as well as Papuan ones and is considerably more comprehensive than either of the two earlier monographs. Tate placed the genera in what he believed to be natural groups and suggested evolutionary relationships between them. He also summarised the geological history of Australia and New Guinea and discussed possible migration routes of the ancestral rodents into the region. Even though his systematic account is often difficult to follow as there are few keys or synopses and it lacks illustrations, it is essential reading for anyone intending to do any research on our native rodents. The only other systematic account that should be mentioned is Eleanor Laurie and J.E. Hill's "Check list of the land mammals of New Guinea, Celebes and adjacent islands" published by the British Museum (Natural History) in 1954. This gives a list of all species and subspecies occurring here, together with bibliographic data and distribution.

All these works are basically taxonomic and, apart from occasional notes in Tate's 1951 monograph, contain little other information. In recent years a number of ethno-zoological studies have been published and these yield some information on the natural history of the animals being studied. P. Dwyer studied in the Mt Elimbari area and his papers are in the Australian Wildlife Research Journal (vol. 2, 1975 and vol. 5, 1978). Ralph Bulmer and Menzies studied in the Schrader Mountains and results

are published in the Journal of the Polynesian Society vols. 81, 82; 1972, 1973. A general account of Pacific mammals is contained in the Pacific World series, published by the Macmillan Company. The volume on mammals is by T.D. Carter, J.E. Hill and G.H.H. Tate and was published in 1946. Ernest Walker's three volume work on 'Mammals of the World' (Johns Hopkins Press, Baltimore, 1964) describes all known genera of rodents and every genus is illustrated. Unfortunately, nearly all the genera of New Guinea rats are illustrated by photographs of museum study skins and these give little idea of what the animals looked like in life. For a general account of rodent biology, there is Peter Hanney's "Rodents, their lives and habits" published by David and Charles, Newton Abbot, in 1975. This is very comprehensive and highly readable, though some of the statements on New Guinea rats cannot be accepted uncritically.

Chapter 5

IDENTIFICATION OF NEW GUINEA RODENTS

" 'Well, of course there are others,' explained the Rat in a hesitating sort of way . . . 'We must make a start and take a chance, I suppose.' "

THE WIND IN THE WILLOWS

In addition to the true rodents, there are a number of similar sized animals which could be mistaken for rats or mice. All of these are marsupials; the snout is long and pointed, the teeth are small and numerous (up to 46) and the large yellow incisor teeth, so characteristic of rodents, are lacking. One of these mouse-like marsupials is illustrated in plate 1a.

Having confirmed that the specimen is a rodent, a number of different methods are possible for its further identification, and four different schemes are presented here.

It is impossible to assign many rats to their correct genera without examination of the molar teeth, so the identification of living, small or medium sized rodents is difficult. Therefore, we offer a guide to the identity of adult females (A) and three keys (B, C, D). The first key (B) is based on easily observable external features only and its use will enable many live rats to be put into their correct genera. Further information may then be obtained from the appropriate species accounts.

The second key (C) uses skull characters only and will be useful for material collected from owl pellets or village middens and from hunters' trophies for the larger species.

The third key (D) assumes that the whole animal is available for measurement and that its skull may be cleaned and examined. This key is based mainly on external characters but reference to the number and types of molar teeth is necessary. A strong hand lens or low powered dissecting microscope will be necessary for examination of the teeth, the tail scales and their hairs.

In keys throughout this handbook, the following abbreviations are used:

M^{1-3} – length of the molar tooth row (figure 5)
IF – incisive foramina (fig. 5)
HB – length of the head and body (figure 6)
Hf – length of the hind foot, excluding the claw (figure 6)
CB – condylo-basal length of the skull

measurements in millimetres (mm); weights in grams (g) or kilograms (kg).

A. Adult Female Rats

Female rats can be placed in one of the following groups provided that the mammary formula can be accurately determined (see Fig. 6). This method is unsuitable for young female rats where the nipples are small and hidden in the fur. Mammary formulae are distributed as follows.

0 + 1 = 2	*Melomys lorentzi*
0 + 2 = 4	all *Melomys* except *lorentzi* all *Pogonomelomys* except *ruemmleri* all *Uromys*, all Hydromyines. *Hyomys, Macruromys, Conilurus*
1 + 2 = 6	*Rattus leucopus, R. niobe, R, richardsoni, R. verecundus. Lorentzimys, Mallomys, Anisomys,* all *Pogonomys Pogonomelomys ruemmleri*, all *Chiruromys*
2 + 2 = 8	*Rattus exulans, R. ruber*
2 + 3 = 10	*Rattus gestroi, R. rattus*
3 + 3 = 12	*Rattus gestroi* (sometimes), *R. sordidus, R. rattus* (rarely), *R. argentiventer, norvegicus*
3 + 2 = 10	*Mus musculus*

B. Key Based on External Characters Alone

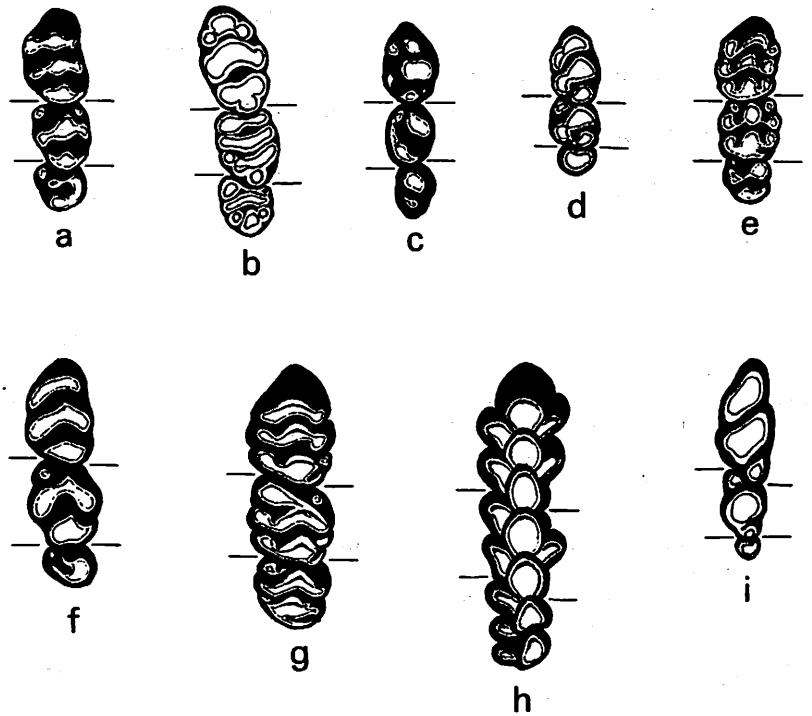
Results obtained with this key should be treated with caution and identifications checked against the accounts in the systematic section.

1. No external ears ..... *Crossomys* (p 53)
   External ears present 2
2. Water rats with soft fur, well haired tails and webbed feet .....
   ..... *Hydromys* (p 52)
   Not so 3
3. Very large montane rats (HB more than 300 mm, weight 1 to 2 kg) with dark, shaggy fur 4
   Not so 5
4. Ears whitish ..... *Hyomys* (p 43)
   Ears blackish ..... *Mallomys* (p.46)
5. Tail hairs long and conspicuous forming a brush or pencil at the tip
   6
   Not so 7
6. Size large (HB more than 150 mm); south Papuan savannas only ....
   ..... *Conilurus* (p 56)
   Size small (HB less than 120 mm); widespread in forests .....
   ..... *Lorentzimys* (p 44)
7. Tail long, upwardly prehensile at the tip ..... *Chiruromys* (p 47)
   ..... *Pogonomys* (p 47)
   ..... *Pogonomelomys* (p 39)
   Tail long or short, not prehensile 8

8. Belly fur pure white (in the central strip at least) 9
   Belly fur grey-based (sometimes a tiny white patch on the thorax) 14
9. Size large (HB more than 250 mm); pelage coarse but not spiny . . . . . *Uromys* group (p 33)
   Size smaller (HB less than 200) or, if large, pelage very spiny . . . 10
10. Pelage very spiny, tail coarsely scaled, lowlands only . . . . . *Rattus leucopus* (p 27)
    Not so 11
11. Tail white tipped 12
    Tail not white tipped . . . . . *Melomys* (p 34)
12. Size small (HB less than 200 mm); pelage soft and dense . . . . . *Leptomys* (p 54)
    Size large (HB more than 200 mm) 13
13. Muzzle very broad with stiff whiskers; terminal 1/3 of tail white . . . . . *Parahydromys* (p 53)
    Muzzle not broadened, whiskers flexible; terminal ½ of tail white . . . . . *Anisomys* (p 42)
14. Very small mice with dense soft fur . . . . . 'moss mice' (p 55)
    Either medium sized or large or, if very small, then pelage not dense and soft 15
15. Very small commensal mice with hairy pelage and hairy tails . . . . . *Mus* (p 21)
    Medium sized or, if small, then pelage soft and tail apparently naked 16
16. Tail white tipped 17
    Tail not white tipped 18
17. Tail mostly white . . . . . *Macruromys* (p 44)
    Tail with only the tip white . . . . . *Paraleptomys* (p 54)
    . . . . . *Rattus niobe* (p 28)
    . . . . . *Rattus verecundus* (p 30)
18. Tail roughly scaled and obviously hairy (fig. 42) . . . . . *Rattus* (p 25)
    Tail smooth and apparently naked (fig. 4b) . . . . . *Melomys* (p 34)

C. Key Based on Skull Characters (the genus Conilurus is omitted)

1. Molar teeth 1 in each row, skull less than 30 mm long . . . . . *Mayermys* (p 55)
   Molar teeth 2 in each row 2
   Molar teeth 3 in each row 5
2. M^{1-2} less than 4 mm . . . . . 'moss mice' (p 55)
   M^{1-2} more than 7 mm 3
   M^{1-2} between 4 and 6 mm 4



3. Crown patterns of left upper molar teeth of various Papuan rats (a) *Rattus* (*Mus* is similar) (b) *Anisomys* (c) *Macruromys* (d) *Lorentzimys* (e) *Pogonomys* (*Chiruromys* is similar) (f) *Melomys* (*Uromys, Pogonomelomys, and Xenuromys* are similar) (g) *Hyomys* (h) *Mallomys* (i) *Leptomys.*

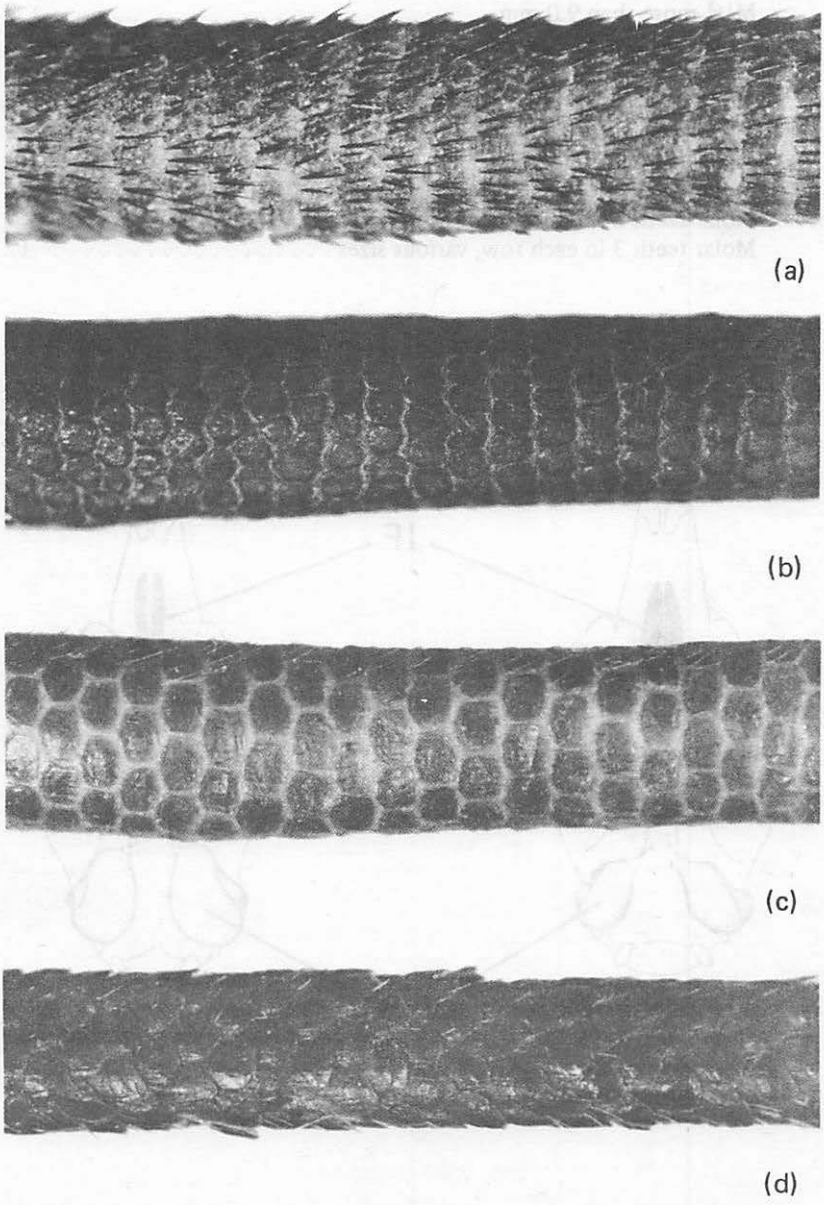
3. M^{1-2} more than 9 mm, skull less than 2 x as long as wide . . . . . *Parahydromys* (p 53)
   M^{1-2} between 7 and 9 mm, skull more than 2 x as long as wide . . . . . *Hydromys chrysogaster* (p 52)
4. M^{1-2} less than 5 mm . . . . . *Paraleptomys* (p 54)
   M^{1-2} 5.5 mm or more, skull more than 7x the length of M^{1-2} . . . . . *Crossomys* (p 53)
   M^{1-2} 5.4 mm or less, skull less than 7 x the length of M^{1-2} . . . . . *Hydromys habbema* (p 53)
5. M^{1-3} as in figure 3i, M^3 minute . . . . . *Leptomys* (p 54)
   Not so 6

6. M^{1-3} more than 14.5 mm, as fig 3g; IF less than 10 mm . . . . . *Hyomys* (p 43)
   M^{1-3} more than 14.5 mm, as fig 3h; IF more than 12 mm . . . . . *Mallomys* (p 46)
   M^{1-3} less than 14.5 mm, not like fig 3g, 3h or 3i
7. Skull length more than 50 mm; M^{1-3} (fig 2b) less than 11 mm, IF less than 5 mm . . . . . *Anisomys* (p 42)
   Not so 8
8. M^{1-3} (fig 3e) between 4 and 7 mm . . *Chiruromys, Pogonomys* (p 47)
   Not so 9
9. M^{1-3} (fig 3c) between 4.9 and 6.6 mm . . . . . *Macruromys* (p 44)
   Not so 10
10. M^{1-3} (fig 3d) less than 3 mm, skull short, less than 2 x as long as broad; IF very short . . . . . *Lorentzimys* (p 44)
    Not so 11
11. M^{1-3} (fig 3a) less than 3.5; skull more than 2 x longer than broad; IF long, reaching back to the level of the first molar . . *Mus* (p 21)
    M^{1-3} more than 3.5 mm 12
12. M^{1-3} (figure 3f) more than 10 mm long . *Uromys, Xenuromys* (p 33)
    Not so 13
13. M^{1-3} as figure 3f, IF generally short, not reaching the level of the first molar . . . . . **Melomys, Pogonomelomys* (p 34, 39)
    M^{1-3} as figure 3a, IF generally long, reaching back almost to, or beyond, the level of the first molar . . . . . **Rattus* (p 25)

* Distinguishing between *Rattus* and *Melomys* on skull characters alone is not easy as the molar crown patterns are quite similar and the length of the incisive foramina varies between species. *Rattus niobe*, for instance has rather short foramina which do not quite reach the level of the first molars while *Melomys lutillus* has rather long ones.

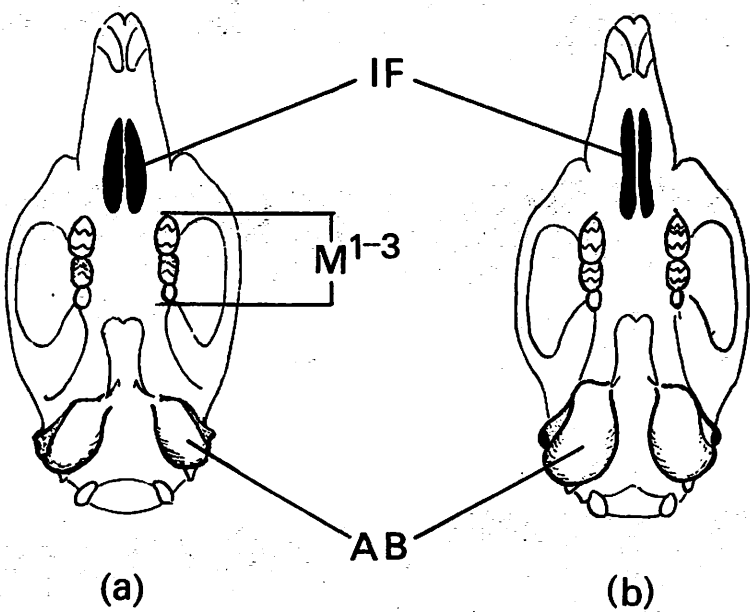
D. Key Based on External and Internal Characters

1. Large or very large rats, HB more than 200mm 2
   Smaller rats, HB less than 200m 8
2. 2 molar teeth in each row 3
   3 molar teeth in each row 4
3. Rats with soft fur, ears present . . . . . *Hydromys*
   Rats with soft fur and no external ears . . . . . *Crossomys*
   Rats with rather bristly fur; ears present . . . . . *Parahydromys*
4. Lower incisor teeth blade-like, much narrower than the upper . . . . . *Anisomys*
   Upper and lower incisors or less equal 5

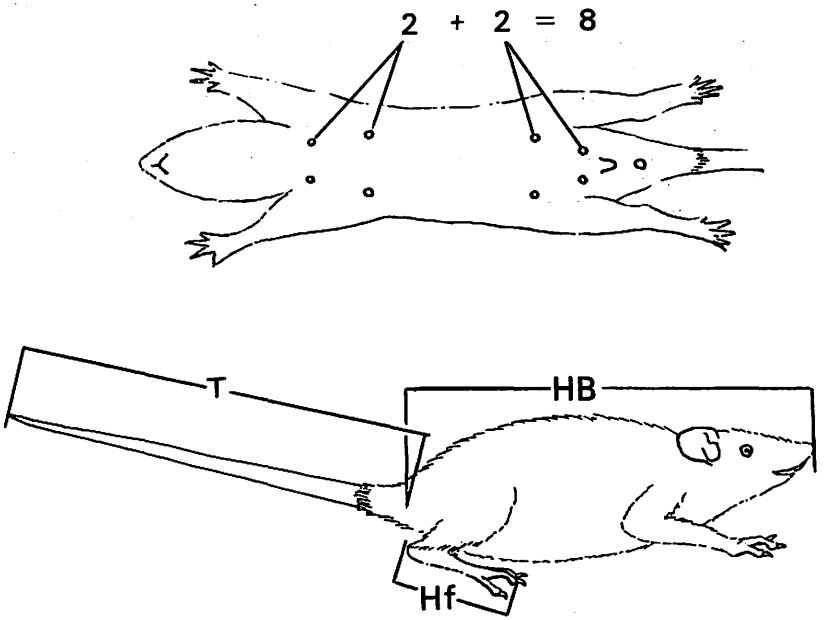


4. Tails of various Papuan rats to show the arrangement of scales and hairs (a) *Rattus* (b)*Melomys* (c) *Pogonomys* (d) *Chiruromys.*

5. M^{1-3} less than 8.0 mm 6
   M^{1-3} more than 9.0 mm 7
6. Molar teeth as in figure 3a . . . . . *Rattus*
   Molar teeth as in figure 3c . . . . . *Macruromys*
7. Molar teeth as in figure 3h . . . . . *Mallomys*
   Molar teeth as in figure 3g . . . . . *Hyomys*
   Molar teeth as in figure 3f . . . . . *Uromys, Xenuromys*
8. Molar teeth one in each row, HB less than 100 mm . . . . . *Mayermys*
   Molar teeth 2 in each row, various sizes 9
   Molar teeth 3 in each row, various sizes 12



5. Ventral views of the skulls of (a) *Rattus leucopus* and (b) *Rattus sordidus* to show difference in shape and size of the incisive foramina (IF) and auditory bullae (AB)



6. Ventral and lateral views of a rat to show method of determining the mammary formula and measuring the body. Ventral view shows 2 pair of pectoral mammae and 2 abdominal (inguinal). Lateral view shows HB (head + body), Hf (hind foot) and T (tail) measurements.

9. Water rats with webbed feet 10
   Not water rats 11
10. No visible external ears . . . . . *Crossomys*
    Obvious external ears . . . . . *Hydromys*
11. Medium size rats (HB up to 130 mm) with the belly fur tipped white or rufous . . . . . *Paraleptomys*
    Small or very small mice (HB less than 100 mm) not colored as above.
    . . . . . *Microhydromys*
    . . . . . *Neohydromys*
    . . . . . *Pseudohydromys*
12. Tail bearing a terminal brush or pencil of long hairs 13
    Tail hairs short, not forming a terminal tuft 14
13. Size very small, HB less than 120 mm, widespread . . . . *Lorentzimys*
    Size larger, HB 150-200 mm, known from vicinity of Morehead River only . . . . . *Conilurus*

14. Molar teeth complex (fig 3e), tail more than 120% of HB . . . . . *Pogonomys, Chiruromys*
    Molar teeth not as figure 3e, tail longer or shorter than HB 15
15. Tail scales overlapping (fig 4a); tail hairy 16
    Tail scales not overlapping (fig 4b); tail apparently naked . . . . . *Melomys*, some *Pogonomelomys*
16. Molar teeth as fig 3i . . . . . *Leptomys*
    Molar teeth as fig 3a . . . . . *Rattus, Mus*
    Molar teeth as fig 3f . . . . . *Pogonomelomys ruemmleri*

Chapter 6

SYSTEMATIC ACCOUNT

Group 1. INTRODUCED RODENTS

" 'You are not one of us,' said the Water Rat,
'nor even, I should judge, of this country.' "

THE WIND IN THE WILLOWS

There are 6 different introduced rodent species, three of these are so common that everyone will come across them sooner or later, for they are widespread in town and country, and are well known for the damage that they do. The three are the house mouse, the black, roof or ship rat and the village or Pacific rat. These rodents may exist in feral populations away from human habitation but generally are found in places where there has been human activity such as abandoned gardens. None of the remaining 3 species is common; the brown or sewer rat is urban while the ricefield rat and *R. nitidus* are rural and have only been recorded in Irian Jaya.

Key to rodents trapped in or around houses and other buildings

(Note: in rural areas, some species of native rodents may invade houses, particularly where the introduced species are absent. In such circumstances, it may be better to start with the key to endemic genera on page 12).

1. Size very small, head and body less than 90mm. . . . . House Mouse (*Mus musculus*) (p. 21)
   Size medium-small, head and body less than 160mm . . . . . Pacific Rat (*Rattus exulans*) (p. 22)
   Size large, head and body more than 160mm 2
2. Tail short, less than, or a little more than, the length of the head and body; ears small, when folded forward they do not cover the eyes; colour nearly always brown; mammary formula always 3 + 3 = 12. . . . . brown rat (*Rattus norvegicus*) (p. 23)
   Tail long, always much more than the head and body; ears large, when folded forward they cover the eyes; colour brown or grey-black; mammary formula usually 2 + 3 = 10 . . . . . black rat (*Rattus rattus*) (p. 24)

Mus musculus – the House Mouse

The house mouse is of central Asian origin and probably became associated with man during the development of settled agriculture in prehistoric times. From the Middle East it spread to the Mediterranean countries and was then carried by trading ships to other places. Like the

black and brown rats it is now world-wide in distribution, but because of its smaller size and the less damage that it does, its spread is not as well documented as that of the two commensal rats. Nevertheless it is a serious pest in New Guinea and can do a lot of harm by chewing books, clothes and food containers, quite apart from what it actually eats.

The small size of the house mouse should enable it to be distinguished from all other commensal species. Adults usually weigh no more than 25 grams, they are always brown above and yellowish below, the ears are large and the tail is as long as, or longer than, the head and body. It is common in coastal towns and villages but feral populations occur in the grass country around Port Moresby and probably elsewhere too. It has a pungent odor.

Like the two house rats, the house mouse is very prolific. Females become sexually mature when less than two months old and may breed throughout the year, with an average litter size of 4. The mammary formula is unusual in that there are more thoracic than abdominal pairs, 3 + 2 = 10. This is the only rodent occurring in New Guinea that has such a formula.

The laboratory mouse is *Mus musculus* which has been bred in white and in other colours.

Rattus argentiventer – the Ricefield Rat

The knowledge of occurrence of this species in New Guinea rests on a collection of five from Tanah Merah on the Digoel River, Irian Jaya, but it is a common and widespread species elsewhere in the Indo-Malayan region. As the name implies this species is a primary inhabitant of ricefields but it also lives in grasslands. It is a medium sized rat weighing about 90 to 180 grams with rather harsh fur olive colour above and silvery below. The tail is shorter than, or occasionally longer than, the head and body.

No specimens have been collected since the original series and no information is available on its present distribution in New Guinea. Another area where it might occur is the Fly River plains of the Western Province of Papua New Guinea. Superficially, the ricefield rat looks rather like the native species *Rattus sordidus*, which is common in the Fly River region but the dorsal fur of *sordidus* is blackish brown rather than yellowish brown. Like *sordidus, argentiventer* females have a mammary formula of 3 + 3 = 12. The only positive way to distinguish the two is by examination of the skulls. The incisive foramina of *sordidus* (fig. 5b) are slit-like and narrowed in the centre while those of *argentiventer* (as fig. 5a) are bowed and widest in the centre.

Rattus exulans – Pacific Rat or Village Rat

This species is frequently called the 'Polynesian Rat' but this name should be discouraged, for it gives a false impression of the rodent's origin

and distribution. The original home of this rat was in southeast Asia where it still occurs but its distribution now extends far out into the Pacific islands, as far as Hawaii, the Marquesas and New Zealand, where it was presumably carried by the migration of people. Throughout this vast area it is a rat of villages, gardens, regrowth and forest edges, from sea level up to 3,000m. Although it is *the* common village rat in New Guinea, it is being displaced in many coastal villages, by the larger black rat, *R. rattus*. It is completely absent from the seasonally dry wooded areas of southern New Guinea and from some of the more remote mountain ranges and has failed to colonise Australia.

In houses, *R. exulans* climbs well and frequently lives in the roofs descending at night to forage yet it is mainly a terrestrial species normally living in holes in the ground. It is a pest and village food stores often have to be protected by being raised on smooth posts. The pacific rat is generally much smaller than the black rat, maximum head and body length being less than 160mm and maximum weight under 65 grams, less than half that of an average black rat. The dorsal colour is a yellowish brown, varying only in shade and the ventral fur is greyish often tinged yellow. The tail is generally shorter than the head and body.

Rattus exulans can breed the year round but seasonal fluctuations do take place. Litter sizes range from 1 to 5, with the mean around 3. The mammary formula is always 2 + 2 = 8, similar only to *Rattus ruber*. These two rats are rather similar in appearance particularly in the highland areas where *ruber* is often larger than *exulans* (HB minimum 150mm) and has stiffer fur. The best distinguishing character is on the dorsal side of the hind foot. In *R. ruber*, the hair there is entirely dark while in *R. exulans*, the dark hair is restricted to a narrow strip running down the centre.

Rattus nitidus

This is another commensal species widespread through SE Asia, Indonesia and the Philippine Islands but its only known occurrence in New Guinea is at Manokwari, Irian Jaya. It is very similar in size and general appearance to *Rattus rattus* but the fur is shorter, more woolly and less sleek. Further collecting around the settled parts of lowland Irian Jaya may reveal that it has a more extensive distribution.

Rattus norvegicus – the Brown or Sewer Rat Plate 1b

It is unfortunate that the country of Norway should be permanently associated with this rat for it is really of temperate east Asian origin and reached Europe in the eighteenth century. It is now world-wide having been transported in ships to most countries but, being a temperate animal, has perhaps done better in the temperate zones. In the tropics it is restricted to larger cities. In Papua New Guinea, with a lack of large cities

and ports it is quite rare; the only specimens that we have seen were shot on the wharf at Kavieng. Doubtless small populations exist at Port Moresby and Lae and it is common in cities in Australia and Indonesia.

The brown rat is terrestrial and aquatic, but not arboreal and it will eliminate the smaller black rat from sewers and urban watercourses, but the two can co-exist by sharing the habitat, the brown rat on or below ground level and the black rat in the upper floors and roof. Differences in appearance between the two rats are given in the key. The common name is little help in identification for most rats including the black rat (*R. rattus*) are brown on the dorsal side.

Brown rats are prolific animals, breeding when a few months old, with litters up to twelve young and capable of becoming pregnant again a few days after parturition. In the tropics they may breed all the year round. The brown rat is one of the world's most noxious animals, causing immense damage to buildings and stored products and carrying diseases which can be transmitted to humans.

The laboratory rat, which may be white, black and white or brown is a domestic variety of the brown rat.

Rattus rattus – the Black, Ship or Roof Rat

The black rat has been in Europe since the middle ages but is a native of tropical Asia where truly wild populations still occur. From Europe it has been carried all round the world in ships and introduced to most countries, including those from which it originally came. Such countries may now have two populations of the same species, one introduced and one native, and chromosomal differences between the two reveal their origin. All black rats which we have examined in New Guinea are the European sort. The black rat is a highly arboreal animal and usually nests high, descending at night to feed. It is very largely commensal, nesting in roofs, but there are feral populations in the country that exist without dependence on human habitations and food.

Differences between this rat and the brown rat are set out in the key on page 21. Altogether it is a more lightly-built animal (average weight about 200 grams) and characteristic of animals from the tropics has large naked ears and a long tail which probably function as heat radiators. It is more successful than the brown rat in the tropics and is a very common commensal rat in parts of New Guinea. "Black rat" is a misleading name for *Rattus rattus* as it is seldom black. One common variety is brown above and has a white belly, another is brown above with a dusky belly, while a third is sooty black all over. All three varieties may be found in the same place.

Like the brown rat this is a prolific animal, becoming mature when only a few months old and breeding throughout the year. Litters average about 6. The mammary formula is usually 2 + 3 = 10 but, occasionally, there is

an extra pair of thoracic mammae giving a total of 6 pairs (3 + 3 = 12). This may cause some confusion with the brown rat which also has this mammary formula but the differences in appearance that are set out in the key should enable the two species to be distinguished without difficulty.

Group 2. THE ENDEMIC RATTUS SPECIES – JUST 'RATS'

These are the most common New Guinea rodents and, although in rural areas some may enter houses or damage food crops in gardens, the majority are harmless animals. They occur in forest and savanna from sea level to the highest mountains and are omnivorous. There is no easy way to recognise a *Rattus* for they vary in size, colour and fur quality, but the snout is always long, the eyes small and the feet narrow. The tail always looks scaly, because the scales overlap like roof shingles giving a rough appearance, and hairy, because the hairs (always three per scale) are large enough to be seen with the naked eye (fig. 4a). *Rattus* are often trapped in the same forest areas as *Melomys* and the best way of distinguishing between the two genera is by the tail. In *Melomys*, the tail looks smooth and naked, because the scales do not overlap and the hairs are too small to be seen without a hand lens. Moreover, the tails of *Rattus* are often scarred and damaged, perhaps in fighting, while those of *Melomys* are usually in good condition. When adult females are available identification is much easier since female *Melomys* never have more than 2 pairs of mammae; *Rattus* never have fewer than three. It is of little help to examine the teeth of these two genera as they are so similar only comparison of a large series would reveal any differences.

Despite their commonness, not much is known about our native *Rattus* species. Though they can climb quite well, all are terrestrial, and they usually live in holes in the ground. There is no evidence that any of them are colonial, though they may live in pairs.

Papuan *Rattus* are divided into two distinct sections which chromosomal studies show have had different evolutionary origins. The group which probably evolved in New Guinea includes five species, these we call the *Rattus leucopus* section. The other group includes three species which are related to the Australian *Rattus*, this is the *Rattus sordidus* section. There is no easy way to distinguish between the two sections without examination of skulls. The most important skull character is included in the key (step 8), and illustrated in figure 5. Since rats of the *sordidus* section are restricted to the open country on the SE coasts of New Guinea, rats collected elsewhere will belong to the *leucopus* section.

Key to endemic and introduced *Rattus* species in New Guinea

NOTE: If adult females are available, refer to the table on page 13.

1. Large *urban* rats (HB more than 200mm, weight more than 250g) with small ears and a tail generally shorter than HB . *R. norvegicus*
   Not as above. 2
2. Large lowland rats with spiny fur *and* white-tipped tails *and* white feet . . . . . *R. leucopus*
   Not as above. 3
3. Fur soft and woolly, when brushed forwards it does not spring back, tail white-tipped or not, mid to high altitudes. 4
   Fur sleek or spiny, when brushed forwards it springs back; tail never white-tipped; widespread 7
4. Hf more than 30mm, tail often white-tipped. 5
   Hf less than 31mm, tail very rarely white-tipped 6
5. Dorsal fur more than 17mm thick, over 3600m in Irian Jaya only . . . . . *R. richardsoni*
   Dorsal fur less than 17mm thick, widespread up to 2000m . . . . . *R. verecundus*
6. Small rats, HB less than 150mm; M^{1-3} less than 6.0mm; grey ventral fur tipped white or buff . . . . . *R. niobe*
   Large rats, HB more than 145mm; M^{1-3} more than 6.5mm; grey ventral fur frequently tinged yellow . . . . . *R. ruber*
7. Large rats (HB more than 150mm); tails long (more than 110% of HB), ears large, when folded forwards (in life) they overlap the eyes; houses, gardens, plantations in lowlands. . . . . *R. rattus*
   Large or small rats; tails shorter than or as long as HB, ears small, not overlapping the eyes. 8

8. Incisive foramina narrowest in centre (Fig. 5b) tail short; generally less than 80% of HB; savannas 9
   Incisive foramina (Fig. 5a) widest in centre, tails generally more than 80% of HB; various habitats 10
9. Occurring in the Popondetta plains . . . . . *R. bunae*
   Occurring in the Port Moresby plains . . . . . *R. gestroi*
   Occurring in the Fly and Digoel River plains . . . . . *R. sordidus*
10. Small rats, HB generally less than 145mm, upper surface of hind feet white with a dark central stripe . . . . . *R. exulans*
    Larger rats, HB generally more than 145mm, upper surface of hind feet entirely dark 11
11. Medium size or large rats with harsh, sleek or woolly fur, dark brown in colour, widespread, sea level to 3000m . . . . . *R. ruber*
    Medium size rats with sleek fur yellow-brown speckled with black, known only from Tanah Merah, Digoel River . . . . *R. argentiventer*

1. the *Rattus leucopus* section

The group of five species is widespread from sea level to montane regions. It may be found in forest and gardens, but generally avoids the more open grasslands, except in the alpine zones. Four of the five species are genetically closely related to one another so may have had a recent origin from a common ancestor. Unfortunately we know very little about the fifth, *Rattus richardsoni* which is the rarest, though there is no doubt that it belongs in this group. Four of the five species are fairly easy to distinguish from one another although they have some common features in appearance. The most difficult to identify is *Rattus ruber*, which is more variable than the others. Only two of the group occur outside the New Guinea mainland, *R. leucopus* in Queensland and *R. ruber* in the Moluccas and Solomon Islands.

Rattus leucopus Plate 1c

This is the only one that also occurs in Australia where it is restricted to rain forests on Cape York peninsula. It is a lowland rat, ascending to 500m in the foothills and in New Guinea is restricted to the southern and southeastern coastal plains, from the Digoel River eastwards to Milne Bay and along the north coast to Popondetta. It is common in the forests and

in the forest outliers within the coastal savannas. Apart from being the largest of the group, the following combination of features make it easy to identify; coarse or spiny hair, white or whitish belly hair, white feet and a tail with the terminal third white, shorter than or about as long as the head and body.

The dorsal colour is yellowish, greyish or dark brown, speckled with black. The hair on the chest is frequently rusty brown; this has been attributed to fruit stains but seems more likely to be glandular secretion. In Australia, it is reported to be mainly insectivorous. Little is known about its reproductive behaviour; litter sizes range from 2 to 5 but our sample is too small to indicate what number is the commonest. Pregnant females have been collected in May, June and October, but again, the sample is too small to indicate seasonal or year-round breeding. Information available from Australia suggests that breeding there is year-round, with rather less activity in mid-year.

Rattus niobe Plate 2a

In the montane forests over 1500m and in the alpine grassland above the tree line this species is extremely abundant and trapping often yields near 100% return. It is widespread and appears to occur on every mountain range from one end of the island to the other, including isolated ranges like those of the Huon Peninsula. At the lower end of its altitudinal range it overlaps with *R. verecundus*, from which it can be distinguished by its smaller size, shorter feet and lack of white tipped tail. In some places it may co-exist with *Rattus ruber*, which is larger and usually has more sleek fur. In the high mountains of Irian Jaya it may be sympatric with *R. richardsoni*, which is larger and has much thicker fur.

R. niobe is a small rat with a head and body rarely exceeding 140mm or a weight of 50g. The tail may be shorter than or longer than, the head and body. The fur is very dense and woolly. On the dorsal side it is usually dark grey, olive or blackish brown and, on the ventral side, grey, tipped with white or buff. Nothing much is known about its dietary habits, though it is probably omnivorous. It is said to climb in low shrubbery to obtain fruits and seeds. Records suggest that breeding takes place throughout the year at a very low level; for few females are pregnant or lactating at any time. Litter sizes range from 1 to 3 with 2 being the commonest. They make homes in U-shaped holes in the ground with two entrance holes or amongst the moss which forms such a thick layer on the floor of montane forests. We have one record of a rat taken from a grass nest in the crown of a fallen tree fern. Since the species appears to be terrestrial, we assume that it made its nest there after the tree had fallen.

Rattus richardsoni

This rat is known only from high altitudes in the Snow Mountains of Irian Jaya, where it appears to be abundant. It is probably more widespread but collecting at high altitudes has been limited. There are no records of its occurrence in Papua New Guinea; if it occurs there at all, the Star and Hindenburg mountains in the far west would be the likely areas.

The only other rats which occur at such high altitudes are *R. niobe* and *R. ruber. R. niobe* is smaller (HB rarely more than 140mm, Hf not over 30mm), while the montane races of *R. ruber* have shorter feet (Hf not over 30mm). *R. richardsoni* has extremely dense fur, more than 17mm thick on the back, where it is a tawny brown colour while the ventral fur is grey-based buff. Nothing at all is known about its reproductive or feeding habits.

Rattus ruber Plate 2b

The scientific name of this species implies that it has a reddish colour but this is misleading for it is very variable in both fur colour and texture and no more reddish than many other species of New Guinea rats. In fact, the red fur color of the original type specimen may even have been an artifact of preservation. Of all the endemic species, it is the most widespread, ranging from the Moluccan islands in the west, through the New Guinea mainland and small satellite islands, to the islands of the Bismarck Archipelago and the Solomon Islands in the east. Within this area it occurs from sea level to at least 3600m. With such a widespread distribution, it is not surprising that the species is very variable in appearance and further studies may well show that several different species are presently included under a single name.

Lowland *R. ruber* have rather sparse, bristly or spiny hair and are large in size (HB up to 250mm and a weight around 200–300g). As one progresses higher, these rats become smaller and the fur denser and softer. At mid-montane altitudes, the general body size is around 150 to 160mm and the body weight about 100–150g. These rats are rather similar to *R. exulans*, which is slightly smaller and has softer fur. For comparative points see the account of that species. At very high altitudes, as on Mt Giluwe, the dorsal fur is up to 21mm long, and very soft and woolly, comparable only with that of *R. richardsoni*. Because of its variability, it is difficult to point to any single character that will enable these varieties of *ruber* to be distinguished from all other species. Their one unifying character is the mammary formula, 2 + 2 = 8, shared only with *Rattus exulans.*

The general body colour is medium or dark brown on the back; the ventral hairs are grey-based but often have an overall yellowish wash. This

should enable montane *ruber* to be distinguished from *niobe* and *verecundus*, where the ventral hairs are tipped with white or buff but never yellow. The tail is always shorter than, rarely as long as the head and body and is never white-tipped. In the large spiny-haired lowland *ruber* the fur on the chest is stained reddish as in many *R. leucopus*.

Rattus ruber is typically a rat of gardens, forest edges and forest regrowth but, where *R. exulans* is absent, it invades houses and is the only village rat in remote areas such as the Hindenburg, Star and Snow Mountains. It is probably omnivorous with the bulk of its diet vegetable matter and it can be a pest in village gardens. It lives in underground burrows which may have more than one entrance tunnel. Litter sizes vary from 1 to 6 with the mean close to 3, rather higher than the other rats of the *leucopus* group.

Rattus verecundus Plate 2c

Looking rather like a smaller, softer – haired version of *R. leucopus*, this species is widely distributed in hill and lower montane forest through much of New Guinea; the eastern and western limits presently known are the Owen Stanley Ranges and the Weyland ranges. In altitude it may be found from just above the coastal plains to about 1800m. At lower altitudes it overlaps with *leucopus* and at the upper level with *niobe*. Points to look for in distinguishing them are listed in the accounts of those species. Throughout its range it may be sympatric with *Rattus ruber*, especially on forest edges but it nearly always has a white tipped tail, which *ruber* never has.

Rattus verecundus is a medium-sized, rather slender rat. Compared with other species the snout is longer but this character is of little use unless more than one species is in hand. The dorsal fur varies from being soft but rather sleek to distinctly woolly, according to altitude. It is usually dark brown with the ventral fur grey, tipped with white or buff. Frequently there is a patch of pure white fur on the chest. The tail may be longer than, or shorter than, the head and body and is nearly always white-tipped.

Rattus verecundus lives in underground nests which are said to have only a single entrance hole, unlike the burrows of sympatric *R. niobe* which have two entrance holes. They seem to be largely insectivorous, for stomachs that we have examined contained remains of many insects and a small amount of seeds.

Reproductive data available suggest that breeding ceases about the middle of the year and recommences around November. The mammary formula is 1 + 2 = 6.

2. The *Rattus sordidus* Section

Rats of this group are widely distributed in Australia but in New Guinea are restricted to three disjunct areas. As there is only one species in each area identification is simple. There is no way to distinguish rats of this group from the *leucopus* section without examination of the skull. Points to look for are the long incisive foramina narrowest in the centre and the large tympanic bullae (illustrated in figure 5). In view of the limited distribution of these rats in New Guinea, comparision of skulls will be unnecessary in most cases.

All are rats of grassland or open woodlands and their present discontinuous distribution must be a relic of a time when such vegetation was more extensive in New Guinea than today and also of a time when it was continuous across what is now the Torres Strait with similar country in Australia.

Rattus bunae

Known only from a series of six rats collected near Popondetta in 1941, this species appears to resemble *R. sordidus* very closely and the description given for that species would equally fit *R. bunae*. As the two do not occur together, we prefer to maintain them as separate species pending further studies.

Rattus gestroi Plate 3a

This rat occurs quite commonly in the eucalyptus woodlands of the Port Moresby coastal plains, the limits of its distribution probably being Marshall Lagoon in the east and the Lakekamu River in the west, a narrow coastal belt some 320km long. It is considerably smaller (HB maximum about 170mm and weight around 70 to 100g) than *R. sordidus* and the fur is less rough. The colour is yellowish speckled with black on the dorsal side and grey with an overall yellow or white tinge below. The eyes are rather large for a *Rattus* and the tail is generally short. The hair is stiff but not nearly so coarse as that of *R. sordidus*. The only other *Rattus* occurring in the Port Moresby savannas is *Rattus rattus*, which is very common around settlements, but it is much larger and has a very long tail. *R. gestroi* is superficially similar to *R. exulans* but that species does not occur in the same area so that further comparison is unnecessary.

We have very little data on the reproductive behaviour of *gestroi*, and have collected only two pregnant females, both during August, the height of the dry season. In each case the number of embryos was 2. The mammary formula of this species is either 2 + 3 = 10 or 3 + 3 = 12, both types appearing equally often. This is the only Papuan rat known to us that has a variable mammary formula.

Rattus sordidus Plate 3b

This species occurs in Queensland from Brisbane up to Cape York but is restricted in New Guinea to the open plains of the Fly and Digoel Rivers. It is a heavy-bodied, short-tailed rat, rather larger than its nearest relative, *R. gestroi*, from which it is separated by 500km of swampy forest around the Gulf of Papua. Average body size lies between 170 and 190mm and the weight is generally over 100g.

The fur is much coarser than that of *gestroi* and verges on being spiny. It is also darker, brown speckled with black, while the ventral side lacks the yellowish wash conspicuous in many *gestroi*. Nothing at all is known about the ecology of *Rattus sordidus* in New Guinea but the species has been studied in Australia, where it has become a pest in some Queensland canefields. Under natural conditions it appears to feed very largely on grasses, with insects forming less than 5% of its diet. The average litter size in Australia is 6 and, if this applies to Papuan *sordidus*, it has the largest litter size of any native rodent. The mammary formula is always 3 + 3 = 12.

Other rats occurring in the same area may include *R. rattus*, which has a very long tail and does not have spiny fur and occurs at the edge of forest outliers, *R. leucopus* which does have spiny fur but has white feet and always has a white-tipped tail. *R. sordidus* could also be sympatric with *R. argentiventer* and comparative notes are given in the account of that species.

Group 3 – **RATS OF THE UROMYS GROUP** – smooth-tailed rats

These are small, medium sized or large rats widely distributed in all types of habitat from sea level to 3000m and, after *Rattus*, are the commonest kind of rats that are collected. This very large group is united by dental characters (the molar teeth, figure 3f, are like those of *Rattus* but are more simple). It is assumed to have evolved in New Guinea, subsequently spreading as far west as the Moluccas, east to the Solomon Islands and as far as southern Australia. The most obvious external character that most of them possess is the apparently smooth, hairless tail, hence our suggested English name for the group. The tail is smooth because the scales do not overlap like those of *Rattus* but form a mosaic pattern (Figure 4b) and so these rats are sometimes called 'mosaic-tailed' rats. Although apparently hairless, there are either one or three minute hairs subtended from each tail scale which can be seen with a hand lens. Since three members of the group (*Melomys albidens, Pogonomelomys ruemmleri* and *Xenuromys barbatus*) have *Melomys*-like teeth and *Rattus*-like tail

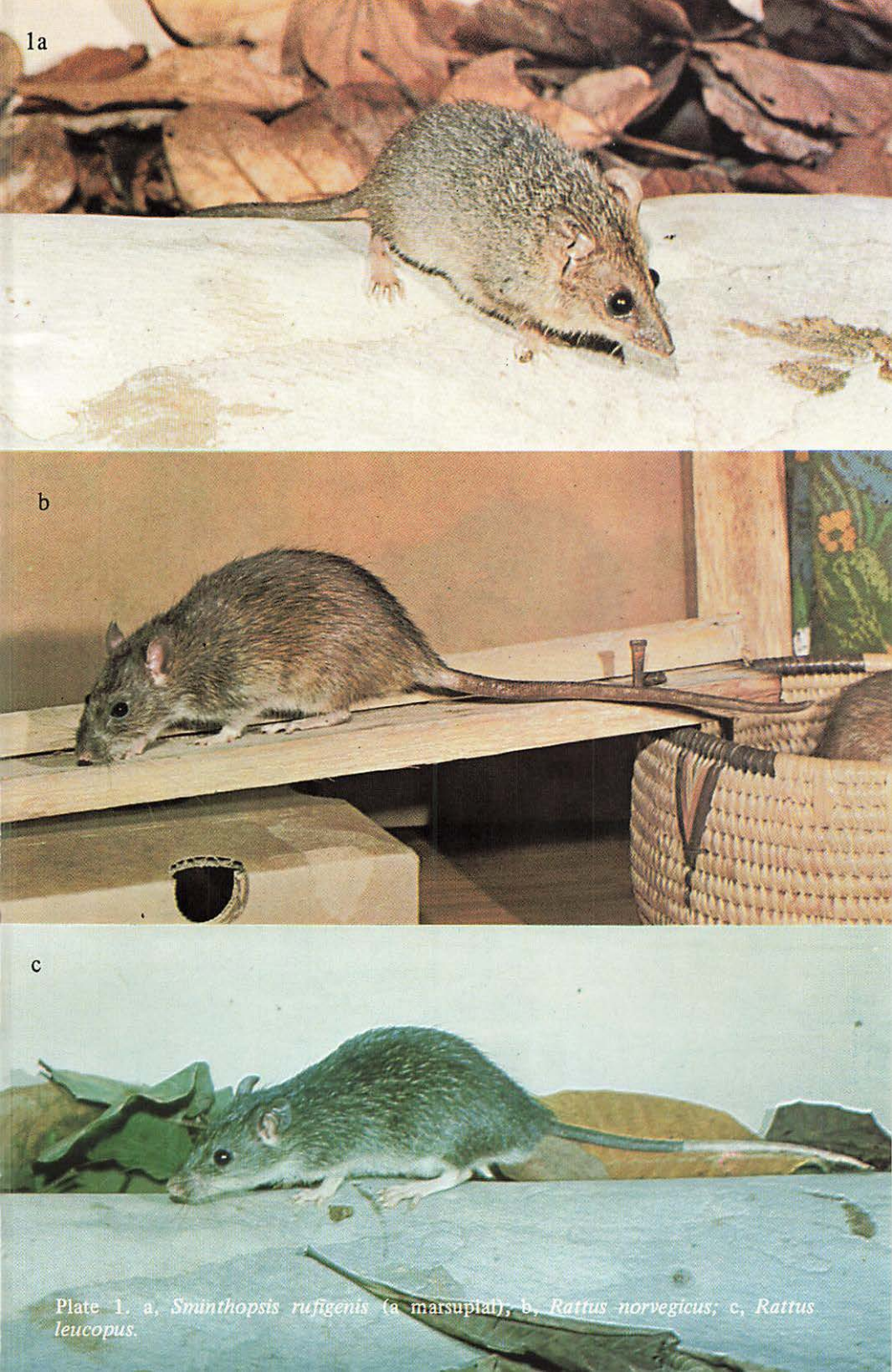


Plate 1. a, *Sminthopsis rufigenis* (a marsupial); b, *Rattus norvegicus*; c, *Rattus leucopus*.

Plate 2. a. *Rattus mobe*; b. *Rattus ruber*; c. *Rattus vorecundus*.

Plate 3. a, *Rattus gestroi*; b, *Rattus sordidus*; c, *Melomys leucogaster*.

Plate 4. a, *Melomys lorentzi*; b, *Melomys lutillus*; c, *Melomys moncktoni*.

scales, their inclusion in this group is unsatisfactory but we feel obliged to leave them there until more studies have been done. As two of the three are very rare being known only from a handful of specimens, the chances of finding more about them seem remote.

The most widespread genus in the group is *Melomys* with ten species on the mainland diminishing to four in the Moluccas, three or four in Australia and two in the Solomon Islands. The next most abundant is *Uromys* with two species on the mainland (one of which extends to northern Queensland), a third in New Britain and three others in the Solomon Islands. A closely related genus, *Solomys* is represented by three species in the Solomon Islands. *Pogonomelomys* has four species of arboreal or semi-arboreal rats with long prehensile tails. The fifth genus is *Xenuromys* with a single, very rare, species.

Key to the genera and species of rats of the *Uromys* group occurring on the New Guinea mainland.

(NOTE: although the group extends beyond the mainland, species restricted to Australia, the Moluccas and Solomon Islands are not included in this key. As these are few their identification poses little problem. Lists of island species are included in appendix 1).

1. Tail rough, obviously hairy, scales overlapping (as Fig. 4a). 2
   Tail smooth, apparently naked, scales not overlapping (Fig. 4b) . . 4
2. Very large rats, HB more than 200mm. . . . . *Xenuromys barbatus*
   Small rats, HB less than 150mm 3
3. Incisor teeth white, ventral fur tipped with pale brown. . . . . *Melomys albidens*
   Incisor teeth yellow, ventral fur tipped with white. . . . . *Pogonomelomys ruemmleri*
4. Very large rats (HB more than 200mm) with rather coarse hair . . 5
   Small or medium-sized rats with sleek or soft fur. 6
5. Lowland rats with light brown hair and tail mottled dark and light . . . . . *Uromys caudimaculatus*
   Montane rats with dark brown hair and black tails. . . . . *Uromys anak*
6. Incisor teeth white or very pale yellow . . . . . *Melomys fellowsi*
   Incisor teeth yellow. 7
7. Belly fur pure white or pure fawn. 8
   Belly fur grey, tipped with white or brown. 12
8. 3 hairs per tail scale 9
   1 hair per tail scale. 11
9. Tail much longer than HB (more than 120%) . . . . . *Pogonomelomys mayeri*
   Tail shorter than, or a little longer than HB 10

10. Small terrestrial rats of grassland (HB less than 120mm; Hf less than 30mm) ..... *Melomys lutillus*
    Larger arboreal rats of forests (HB more than 150mm; Hf more than 30mm) ..... *Pogonomelomys bruijni*
11. Hf less than 28mm, M^{1-3} 6.5mm or less, widespread, lowland and montane ..... *Melomys rufescens*
    Hf more than 29mm, M^{1-3} 6.7mm or more, south coast lowlands only ..... *Melomys leucogaster*
12. 1 hair per tail scale 13
    3 hairs per tail scale 15
13. Hindfoot more than 30mm long ..... *Melomys levipes*
    Hindfoot 30mm or less 14
14. Montane rats with very dense woolly fur, tail as long as, or longer than HB ..... *Melomys rubex*
    Lowland to mid-montane rats with sleek fur, tail shorter than HB. .... *Melomys platyops*
15. Small rats of grasslands, HB less than 130mm, Hf less than 26mm. 17
    Larger rats of forests, HB more than 125mm, Hf more than 27mm. 16
16. Hf more than 35mm long, mammary formula 0 + 1 = 2 .... *Melomys lorentzi*
    Hf less than 32mm long, mammary formula 0 + 2 = 4. .... *Melomys moncktoni*
17. Fur dark brown, very dense and woolly; tail hairs longer than the scales. ..... *Pogonomelomys sevia*
    Fur light brown, not very dense or woolly; tail hairs much shorter than the scales. ..... *Melomys lutillus*

MELOMYS

Small to medium-sized rats with soft or woolly (never spiny) fur. Found in all habitats from low to high altitudes, sometimes abundantly. There are ten species on the New Guinea mainland but some of these may be complexes of several species. *Melomys* have larger eyes and less pointed heads than *Rattus* and the hind foot in many species is broad, an adaptation to an arboreal life. They are basically terrestrial but several species climb about in low vegetation and may be trapped more easily on fallen logs and low branches than on the ground. In at least two species the tail is slightly prehensile, which makes them similar to *Pogonomys* and *Pogonomelomys* but the tails of members of these two genera have scaleless tips unlike *Melomys*.

Not much is known about their diet, though they seem to be mainly herbivorous, feeding on fruits and seeds. They have a low reproductive rate with one or two young being the usual litter size. Newborn young are rather larger and more advanced than those of *Rattus* of comparable age.

The mammary formula of all but one species is 0 + 2 = 4. The exception is *M. lorentzi*, with only a single pair of abdominal mammae, 0 + 1 = 2. *Melomys* seem to be rather docile rats and can be handled soon after capture without any great signs of fright. They are also much quieter than *Rattus*, which often squeal when disturbed.

Melomys albidens

Known only from the type series collected at Lake Habbema in Irian Jaya at an altitude of over 3000m this species is sharply distinguished from all other *Melomys* by a combination of white incisor teeth and a hairy, *Rattus*-like tail. In common with other high-altitude species, the fur is very dense and woolly, dark brown above and pale brown below. Nothing has been recorded about its habits. The only other white toothed *Melomys* is *fellowsi* which also has a very long tail but with the normal, mosaic pattern scales.

Melomys fellowsi

This seems to be quite common in high altitude moss forests in parts of the central ranges of Papua New Guinea. It is one of the larger *Melomys* with a head and body length around 150mm and a tail about 30% longer than the head and body. The very dense dorsal fur is dark reddish brown, while the belly fur is tipped with pale rufous. The tail is dark above and light below and has one hair per scale.

Nothing is known about its habits. The white-toothed *Melomys albidens* also has a long tail but lacks the normal mosaic tail scales.

Melomys leucogaster Plate 3c

This is the largest of the three white-bellied *Melomys* with a head and body length up to 210mm and a weight of 100 to 200g, the smallest being *lutillus* and middle, *rufescens*. It is also the most restricted in distribution. being confined to forest and forest outliers on the south side of New Guinea and some of the offshore islands. The tail may be shorter or longer than the head and body, is dark above and light below, with the scales somewhat raised but not as much as those of *rufescens*. The dorsal fur colour varies from being fairly light sandy-grey to quite dark brown but generally without the reddish tinge of *rufescens*. The ventral fur is always pure white to the roots.

M. leucogaster seems to be a semi-arboreal species though there is no indication that it builds arboreal nests like those of *lutillus* and *rufescens*. On some of the offshore islands it inhabits there are no trees, so there it probably lives in holes in the ground. Although quite common in some localities, little is known about the habits of this rat. Litter size is two but not enough is known to say whether breeding is continuous or seasonal. The diet has been assumed to be vegetarian but two rats of this species were caught foraging on a reef exposed at low tide. What they were foraging for is not known.

Melomys levipes

A medium sized species (head and body up to 160mm and a weight around 100–130g) found in forests at all altitudes from sea level up to 2000m or rather more. As expected of such a wide ranging species it is variable in appearance. Lowland animals are usually reddish brown with a soft, but rather sleek, pelage, while those from higher altitudes have thicker, woollier fur of a dark olive-brown colour. In all cases the ventral fur has a silvery appearance (being grey, tipped with white) and the cheeks are often grey. The tail is dark above and light below and has only one hair per scale. This rat is rather similar to *lorentzi, moncktoni, platyops* and *rubex*, all grey-bellied species. From *platyops* it may be distinguished, with difficulty, by its greater size and from *rubex* by its much greater size. The length of the hind foot is probably the best character to look at. This is usually less than 30mm in *platyops* and *rubex* and more than 32mm in *levipes. Lorentzi* also has a very long foot, frequently more than 40mm in length while that of *levipes* rarely exceeds 35mm. *M. lorentzi* and *moncktoni* both have three hairs per tail scale.

M. levipes is a terrestrial species inhabiting the forest floor but little is known about its habits and the only stomach contents examined contained only vegetable matter. Sparse reproductive data indicate that one or two offspring are the normal litter and that breeding takes place about the end of the year.

Melomys lorentzi Plate 4a

Like *levipes*, this is a wide-ranging species of moderate size (head and body up to 200mm and a weight of 130–150g) and is equally variable in fur colour and texture. A conspicuous feature peculiar to this species is the dark ring around the eye. As in most *Melomys*, the tail is dark above and light below but the dark dorsal colour tapers off some distance before the tip, which is all white. This rat seems quite common in some montane moss forest areas but has not been found to be sympatric with *levipes.* Insufficient records are available to indicate the distribution of the two species but they are similar in size and habitat and, as far as is known, in diet. Their distribution may be mutually exclusive. Points to look for in distinguishing the two species are given in the account of *levipes.*

M. lorentzi nests on the forest floor in burrows and may extend into the alpine grassland above the tree line. Stomach contents indicate that fruits and seeds are the normal diet. One young seems to comprise the normal litter and pregnancies are only recorded for January and May. One baby born in captivity opened its eyes for the first time at ten days old. By six months it was almost as large as its mother. This is the only Papuan rat to have the mammary formula of 0 + 1 = 2.

Melomys lutillus Plate 4b

There are two *Melomys* species that are primarily inhabitants of grassland and open bush rather than forest, *lutillus* is the smaller one and *rufescens* the larger. *M. rufescens* has only 1 hair per tail scale while *lutillus* has three and is the only three-haired *Melomys* that can have pure white belly fur. However, fur colour in this species is very variable. Dorsally it may be sandy-brown or greyish-brown. The ventral fur may be pure white or pure buff to the roots, or grey, tipped with white or buff. The tail can be longer or shorter than the head and body and is dark above, light below. The distribution of *Melomys lutillus* seems to be very patchy. It is moderately common in the south New Guinea savannas. Populations are also known from grasslands in the Agaun valley of SE New Guinea (altitude about 1000m) and from various montane grasslands up to 2000m where it may be locally abundant. This species, or a very closely related one, also occurs in Queensland.

The lowland populations consist of quite small rats with head and body no longer than 120mm and a weight of 30–40g but highland *lutillus* are larger and could be confused with *platyops* or *rufescens*. The combination of pure white or buff belly fur, three haired tail scales and a grassland habitat will distinguish them. Grey-bellied *lutillus* are known only from the lowlands.

Like *rufescens*, this is a scansorial species (though it can be trapped on the ground) that builds nests on grass stems and similar places. Also like *rufescens*, it has a rather broader head, larger eyes and broader hind feet than the purely terrestrial *Melomys*. Nothing is known about its feeding or breeding habits.

Melomys moncktoni Plate 4c

This is another widespread species that is similar to *levipes* and *platyops* but it has three hairs per tail scale, whereas the others have only one. It is about the same size as *platyops* with a maximum head and body length around 150mm, hind foot not exceeding 31mm and a weight of approximately 100g. It is a rather more heavy bodied rat than *platyops* and the tail is comparatively shorter. It seems commonest in hill forest at fairly low altitudes but there are records of its occurrence in moss forest at much higher altitudes. The dorsal fur is greyish or reddish brown while the ventral side is grey, tipped with white or rufous.

Melomys moncktoni is a forest rat and is fully terrestrial. No information is available about its diet and very little about its life history. One female in captivity bore two young of which one (a male) had almost reached adult size six months later.

Melomys platyops Plate 5a

This is probably the commonest *Melomys* in hill forest at low to moderate altitudes (maximum about 1500m) and is very similar to

moncktoni in general appearance with its sleek, soft fur and short tail. It could also be confused with *levipes* and points to look for are given in the accounts of those species. The dorsal fur is yellowish brown or dark brown, usually without the reddish tinge that occurs in other *Melomys*. The cheeks are usually conspicuously grey and the ventral fur is grey, tipped with white.

Melomys platyops seems a fully terrestrial species but, despite its fairly common occurrence, nothing seems to have been recorded about its habits.

Melomys rubex Plate 5b

Next to *Rattus niobe*, to which it shows a superficial resemblance, this rat is the commonest species that can be collected in montane forests over 1600m. It is a small rat, with a head and body length rarely more than 140mm and a weight around 40 to 50g. Its small size is somewhat concealed by the very dense woolly fur which is dark brown above, with or without a reddish tinge, and grey, tipped with white or buff below. The tail is about the same length as the head and body or longer and is dark above and light below. Sometimes there is an indistinct orange line separating the dorsal and ventral colours; this appears to be unique to *rubex*. The cheeks are often orange in colour, rarely grey. At the higher altitudes *rubex* is unlikely to be mistaken for any other grey-bellied species as it is considerably smaller than the sympatric *levipes* and *lorentzi*. At the lower end of its altitudinal range *platyops* may be sympatric. However, *platyops* is rather larger, has a tail usually shorter than the head and body, has grey cheeks and less woolly fur.

Melomys rubex is terrestrial and lives in underground burrows but may often be trapped on logs instead of on the forest floor. Nothing is known about its diet. Usual litter size is two and breeding appears to be concentrated at the end of the year. Despite the collection of large numbers of females of this species very few were pregnant or lactating suggesting a low reproductive rate.

Melomys rufescens Plate 5c

Like *lutillus*, this is a scansorial species inhabiting open country and forest clearings. The typical habitat is in forest edges and forest clearings generally and in the forest outliers that run through the grass country of southern New Guinea. It ranges from sea level to more than 2000m and is the only species of *Melomys* that also occurs both on the mainland and in New Britain and the Solomon Islands. It is a moderate-sized species with a head and body length up to 150mm and a weight of 90g. The tail which is longer or shorter than the head and body, is usually black above and below, the only *Melomys* which does not have a partly-coloured tail. The tail scales are raised slightly, like pebbles, whereas those of other *Melomys*, except *leucogaster*, are quite flat. There is only one hair per scale.

The dorsal fur is quite sleek and soft in lowland rats and usually sandy brown but in the highland races it is more dense and woolly and colour is more variable, sometimes reddish or greyish brown. Some of the ventral fur is always pure white. In the lowland forms, this white fur forms a broad band but in highland races it may be restricted to a narrow central strip or even be divided into separate thoracic and abdominal patches.

M. rufescens may be trapped in the same general areas as *platyops* and *rubex*, but generally prefers a more open habitat. However, neither of those two species ever have pure white belly fur, so confusion is unlikely. Like *lutillus*, *rufescens* builds woven grass nests at some height above the ground but *lutillus* has 3 hairs per tail scale. Two young seem to form the usual litter and breeding may take place throughout the year. It is assumed that this species feeds on vegetable matter but nothing has been recorded on this subject.

POGONOMELOMYS

These are small to medium sized rats with short broad heads, large eyes, long tails and soft fur. The teeth are quite similar to those of *Melomys* but the long tails are upwardly prehensile at the tip, which lacks scales and is like the tail of a *Pogonomys*. With the exception of *P. ruemmleri*, very little is known about these rats because two at least are completely arboreal and therefore not easy to trap.

Pogonomelomys bruijni

This species is known only from three localities, Salawatti Island off the extreme western end of New Guinea, the middle Fly River region and Mt Bosavi. It is a moderately large rat (head and body about 180mm) with grey-brown dorsal fur and pure white belly. The tail is rather longer than the head and body and there are 3 tiny hairs per scale.

Three specimens from Mt Bosavi were taken from a hole in a tree but nothing else is known about their habits. The mammary formula is 0 + 2 = 4.

Pogonomelomys mayeri

This species is only slightly better known than the preceding one with records from various montane localities in Irian Jaya and the far west of Papua New Guinea. The colouration is much like that of *bruijni* with sandy, or reddish-brown upper parts and pure white ventral fur. It appears to be slightly smaller than *bruijni* with a head and body not exceeding 150mm and a very long tail which may be light or dark or mottled. The tail hairs are very short and number three per scale.

Nothing at all is known about the habits of this species. The mammary formula is 0 + 2 = 4.

Pogonomelomys ruemmleri

This is a rather small species (head and body up to 120mm) but with a very long tail which is usually white tipped, and seems to be quite common in some montane localities. It differs from other *Pogonomelomys* in several characters and further studies may well indicate that it should be removed to some other genus. It is at least partly terrestrial and may be trapped on the ground, or on fallen logs in moss forest or in alpine grassland above the tree line. The very thick woolly dorsal fur is usually dark brown in colour while the underparts are grey tipped with white. The tail scales are more like those of a *Rattus* and the tail hairs, three per scale, are about three times as long as the scales and therefore visible to the naked eye. Consequently, the tail looks hairy, while the tails of other *Pogonomelomys* look naked. The mammary formula is 1 + 2 = 6 which is also more like that of a *Rattus*. Limited evidence indicates that the diet consists only of vegetable matter including leaves.

Pogonomelomys sevia

Another small species (head and body up to 140mm) which may be partly terrestrial. *P. sevia* has been recorded from various highland localities as far east as the Huon Peninsula mountains, mainly over 2000 and up to at least 3000m. The tail is long and uniformly dark coloured and there are three tiny hairs per scale. The fur is dense and woolly, reddish brown or dark brown above and grey, tipped with white or buff below. It closely resembles *Pogonomys sylvestris* but that species nearly always has a white-tipped tail. However, examination of the teeth provides a positive distinction. (see Fig. 3).

P. sevia is arboreal when it occurs in moss forests and makes nests in *Pandanus* foliage, or in tree holes. In the alpine zones above the tree line, we do not know whether it lives in burrows or makes nests at ground level. The reproductive data available indicates that litter size is normally one and that breeding takes place at the end of the year. The mammary formula is 0 + 2 = 4.

UROMYS

Very large rats, with a head and body length exceeding 200mm and tails usually much longer than the head and body. The pelage is rather coarser than that of *Melomys* but not nearly as coarse and spiny as those of many large *Rattus*. The teeth are similar to those of *Melomys*, though much larger, and the tail scales, again much larger, are also similar. There is only one tiny hair to each scale. There are two species on the mainland, both can climb readily, though their tails are not prehensile.

Uromys anak Plate 6a

This species is widely distributed in forests throughout New Guinea

from 1000 to 2500m. There are no records of its occurrence above the limit of forests. The head and body length usually is between 300 and 400mm and the weight over one kg. The pelage is dark brown with an ill-defined blackish dorsal stripe, though the lateral hairs may be tipped with white giving an overall silvery appearance. The tail is entirely dark, and being the only large Papuan rat which does not have a white-tipped tail it is unlikely to be confused with any other species. The fur is dense but stiff rather than woolly.

Though it appears to be quite common in the mountain forests, less is known about its habits than those of its lowland relative *caudimaculatus*. It seems to be completely arboreal and makes nests in hollow trees, though we collected one that was chased from a nest in the crown of a pandanus. Several animals may roost together and the diet includes fruits and nuts. We have no records of its breeding behaviour.

This animal is large enough to be worth hunting for food and one often finds the skulls and jaws decorating the walls of village houses in the highlands.

Uromys caudimaculatus Plate 6b

This is a lowland species which is widespread and very common throughout New Guinea and also occurs in Queensland as far south as Townsville. It is slightly smaller than *anak*, with a body length between 200 and 300mm and a weight around 600 to 700g. The general body colour is sandy or tawny brown above and white below (greyish in Australian animals) and the pelage is rather thin and sparse lacking the spines characteristic of many large *Rattus*. The distal half of the tail is white, and dark and light areas may be mixed up, giving a mottled appearance. The only other large rat that would be confused with *U. caudimaculatus* is *Anisomys imitator* which is of similar size and appearance. Both species have white-tipped tails but, in *Anisomys*, the white area covers the distal two-thirds, while in *Uromys*, the white area is never more than one-half. Positive identification can be obtained from examination of the incisor teeth. In *Uromys*, upper and lower incisors are more or less the same size while, in *Anisomys*, the lower incisors are much narrower than the upper. *U. caudimaculatus* is also superficially similar to *Macruromys major* and *Xenuromys barbatus* but these large rats have *Rattus*-like overlapping tail scales.

U. caudimaculatus occurs in both forest and grassland but its typical habitat is probably forest margins and clearings. It can survive close to human habitations, and is often seen crossing the road at night in the outer suburbs of Port Moresby, when it may be mistaken for a bandicoot as it is about the same size. However, the long tail is quite distinctive. These rats are also quite common in coconut plantations where they feed on the flowers and young fruits, so may be a pest. They live in hollow trees, caves or even old mine tunnels where they do not seem to make any sort of nest, being content to rear their young on the bare rock. Litters may

contain one to three young and are recorded for the months of November and December. The young stay with their mother for some time, at least until half grown. The mammary formula is 0 + 2 = 4.

Xenuromys barbatus

This very rare rat is known only from three widely separated localities, one specimen collected last century in the area then known as British New Guinea, one in the northern lowlands of Irian Jaya and a third in the mountains of the Upper Sepik River on the Irian Jaya – Papua New Guinea border. *X. barbatus* is about the same size as *Uromys caudimaculatus* and is greyish above and white below. The tail has its distal half white and its scales are set in overlapping rings, quite different from the mosaic patterned scales of *Uromys*. There are three small hairs per scale.

The head is rather smaller and narrower than that of *Uromys* but the teeth are similar. *Xenuromys* seems to fit half way between *Rattus* and *Uromys* but, unless more specimens turn up, we are not likely to learn more about it.

Group 4 – RATS OF TATE'S "OLD PAPUAN GENERA."

These seven genera form a heterogenous assembly of peculiar rats that do not appear to be closely related to each other or to any other Papuan rodents. Tate only included 5 genera in this group but since the position of the sixth, *Lorentzimys*, seems equivocal to us we have included it. We have raised another taxon *Chiruromys*, which was formerly classed as a subgenus, to generic rank, making seven in all. Although these rats vary in size from very small (*Lorentzimys*) to very large (*Mallomys*) they can be distinguished from each other by several characters, particularly the arrangement of cusps on their molar teeth. The teeth of each genus are specialised in a different direction, some have become more complex and others more simple. Because the molar teeth of these genera are so specialised, Tate suggested that the rats had evolved in isolation in New Guinea and are descendants of much earlier immigrants than those of the *Uromys* and *Rattus* groups. As they have no obvious close relatives either inside or outside the Papuan region, they are all assumed to be endemic, hence his term 'Old Papuan Genera.'

Anisomys imitator – the Narrow-toothed Rat.

The generic name of this rodent refers to the inequality in size of upper and lower incisor teeth, the latter being compressed laterally and blade-like, less than half the width of the upper. In the Papuan region,

this peculiar condition is unique to *Anisomys* and enables instant recognition. Superficially *Anisomys* looks rather like *Uromys caudimaculatus* being about the same size and colouration. But the tail is at least two thirds white, whereas the tail of *Uromys* is no more than half white. Other points of difference lie in the tail hairs, three per scale instead of one, and just large enough to be visible to the naked eye, and a mammary formula, 1 + 2 = 6 instead of 0 + 2 = 4. The head and body length of *Anisomys* lies between 250 and 300mm, the weight around 500–600g and the tail is longer than the head and body. The body hair is short and rather coarse, blackish brown above and pure white below.

Anisomys has other dental peculiarities beyond the disparity in size between upper and lower incisors, as the molars are incredibly small for the size of the rat, the length of the tooth row being less than half that of a similar sized *Uromys*. No one is sure about the reason for these teeth characteristics but the small size of the molars may be related to a diet which includes nuts, such as pandanus, with very hard shells and soft pulpy interiors, which are easy to masticate once opened. *Anisomys* will eat other vegetable matter and is said to raid gardens. It is generally a forest or regrowth inhabitant and ranges from hills just above the coastal plains to the upper limit of montane forest throughout New Guinea. It seems to be commonest about the middle of this altitudinal range. Most specimens have been trapped on the ground but it has the same broad scansorial feet as *Uromys* and presumably can climb easily. Nothing is known about its reproductive habits.

Hyomys goliath – the White-Eared Giant Rat.

There are two very large species of Papuan rats whose size justifies them being called 'giant', one is *Hyomys goliath* and the other is *Mallomys rothschildi*. The two are superficially similar but *Hyomys* is slightly smaller, head and body not exceeding 400mm and a weight around 1kg. Its tail is about as long as the head and body and the tail scales project considerably, giving a very rough, rasp-like appearance. There are one or three tiny hairs per scale and the terminal half of the tail is white. The pelage is dense and shaggy with a rather woolly grey underfur mixed with very much longer, rather coarse, white tipped guard hairs, the overall appearance being blackish, or brownish grey. The ventral fur is grey-based, white-tipped.

The molar teeth of *Hyomys* (Fig. 3g) are particularly massive with 1st, 2nd & 3rd more or less the same size in contrast to the usual arrangement where the third is smaller than the second which is smaller than the first. *Hyomys* can be distinguished from the externally similar *Mallomys* by examination of the molar crowns. In *Hyomys* the three cusps of each loph are more or less merged, and form more or less transverse ovals while in *Mallomys* (fig 3h) the separate cusps are quite distinct.

Hyomys is widespread and fairly common in forest from 1200 to 3000m throughout New Guinea. Though it climbs readily it appears to be more terrestrial than *Mallomys* and is said to make a large nest of leaves between the roots of a tree, between rocks, or in a hollow log. The diet is entirely vegetable and principally bamboo and similar shoots, though people complain that it sometimes raids gardens. Very little is known about its reproductive behaviour though the usual litter may be a single young. The mammary formula is 0 + 2 = 4.

Lorentzimys nouhuysi – Tree Mouse Fig. 7

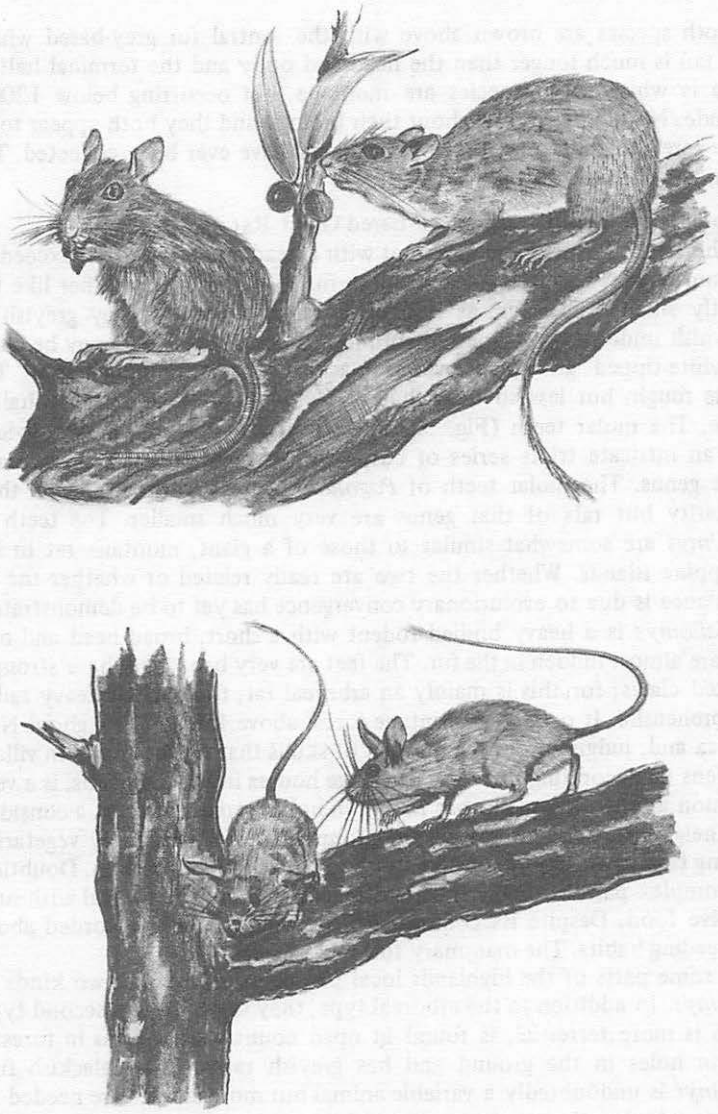
This is one of the smallest of the endemic Papuan rodents, being little larger than a house mouse. Only some of the hydromyine 'moss mice' are smaller. It is widely distributed in forests from sea level probably up to the upper limit of trees throughout New Guinea. Those from higher altitudes have much denser and woollier fur than those from lower down. The head is short and broad as in all arboreal rodents but the hind foot is elongated rather than broad, and the tail, though not prehensile, is long. All these features suggest that *Lorentzimys* runs and jumps through the branches rather than climbing about like the tree rats *Chiruromys* and *Pogonomys*. The fur colour is usually brownish or greyish above with the ventral fur grey-based white or buff. The long, rather hairy, tail carries a thin terminal tuft of hairs which is distinctive, although close examination is necessary to see it. The ears are narrow and pointed and this is a distinctive character, as most New Guinea rats have rounded ears, the other exception being *Chiruromys vates*. The molar teeth are similar to those of a *Melomys* but are rather more simple.

Lorentzimys seems to be completely arboreal, though it may prefer open or disturbed forest where there is abundant low shrubbery, rather than mature forest where tree trunks rise uninterrupted to the canopy. It makes nests in pandanus and similar places and more than one mouse may live together in one nest. One pregnant female carried two embryos. The mammary formula is 1 + 2 = 6.

Macruromys species – Small-Toothed Rats.

There are two species of *Macruromys* rats which are both medium to medium-large in size and are superficially like *Uromys caudimaculatus*. However their tails have *Rattus*-like overlapping scales each carrying three hairs. *Macruromys* are further distinguished by their remarkably small and simple molar teeth, (Fig. 3c) a character which they partly share with *Anisomys*. The length of the molar tooth row in *Macruromys major* is just about half that of a comparable sized *Uromys*. The two species of *Macruromys* may be distinguished from each other as follows:

Size larger, HB between 200 and 250mm; M^{1-3} more than 6.0mm; widely distributed in the central ranges from central Irian Jaya to the Kratke



7. *Conilurus penicillatus,* above; *Lorentzimys nouhuysi,* below.

Mountains of Papua New Guinea . . . . . *M. major*
Size smaller, HB less than 200mm; M^{1-3} less than 5.0mm; only known from the Weyland Mountains of Irian Jaya. . . . . *M. elegans*

Both species are brown above with the ventral fur grey-based white. The tail is much longer than the head and body and the terminal half or more is white. Both species are montane, not occurring below 1200m altitude. Nothing is known about their biology and they both appear to be quite rare, for only a handful of specimens have ever been collected. The mammary formula of both is 0 + 2 = 4.

Mallomys rothschildi – the Black-Eared Giant Rat Plate 8a

This is the largest Papuan rodent with a head and body often exceeding 400mm and a weight up to 2kg. Externally *Mallomys* is rather like the slightly smaller *Hyomys*, as it has the same type of shaggy greyish or brownish underfur, interspersed with long guard hairs. These may be black or white-tipped giving an overall blackish or silvery appearance. The tail is rough, but less so than that of *Hyomys*, and the terminal half is white. The molar teeth (Fig. 3h) are distinct for the crowns are divided into an intricate triple series of cusps with a regularity not seen in any other genus. The molar teeth of *Pogonomys* are slightly similar in their regularity but rats of that genus are very much smaller. The teeth of *Mallomys* are somewhat similar to those of a giant, montane rat in the Philippine islands. Whether the two are really related or whether the resemblance is due to evolutionary convergence has yet to be demonstrated.

Mallomys is a heavy bodied rodent with a short, broad head and ears that are almost hidden in the fur. The feet are very broad and have strongly hooked claws; for this is mainly an arboreal rat, though the heavy tail is not prehensile. It occurs in montane forest above 1500m throughout New Guinea and, judging from the number of skulls that can be found in village middens or decorating the walls of village houses in the highlands, is a very common animal. It usually has its lair in hollow trees (often at a considerable height) but sometimes on the ground. The rat is entirely vegetarian feeding largely on shoots, such as those of the climbing bamboo. Doubtless the complex pattern of the molar teeth is an adaptation to deal with such abrasive food. Despite its commonness nothing has been recorded about its breeding habits. The mammary formula is 0 + 2 = 4.

In some parts of the highlands local people say there are two kinds of *Mallomys*. In addition to the arboreal type, they say there is a second type which is more terrestial, is found in open country as well as in forests, lives in holes in the ground and has greyish rather then blackish fur. *Mallomys* is undoubtedly a variable animal but more studies are needed to indicate whether there is just one variable species or whether there really are two, with different habits. The large size of this species makes it a desirable game animal and hunters will often go to some trouble to extract

it from its lair, an operation not without danger for the large incisor teeth can inflict severe lacerating injuries. The teeth are sometimes extracted from the jaw bones and used for engraving.

CHIRUROMYS and POGONOMYS – Prehensile-tailed tree rats

These two genera have generally been included in *Pogonomys* but recent chromosome studies have shown that they are unlikely to be closely related. They are all small to medium-sized arboreal or semi-arboreal rats found in forest or regrowth throughout the country from sea level to about 2000m. They have short heads with large eyes, dense soft fur, broad feet and very long tails which are upwardly prehensile at the tip, which is scaleless on the dorsal side. Though the tail is in constant use during climbing, it does not appear to be capable of supporting the body in the way that the tail of a cuscus can, but merely gives additional support. Because of their large eyes and very long tails, *Pogonomys* and *Chiruromys* are unlikely to be mistaken for any other genus except perhaps *Pogonomelomys* and examination of the teeth easily separates them from the others.

The molar teeth of *Pogonomys* are quite complexly folded (Figure 3e) and cannot be mistaken for those of any other Papuan rat. They do show some resemblance to the teeth of some Indo-Malayan rodents but this is probably due to convergence and not to direct relationship. Although in captivity they will eat a variety of foodstuff, their natural diet contains a high proportion of shoots and young leaves. This material (especially shoots of grasses and bamboos) is highly abrasive and the complex folding of the teeth with consequent increase in the amount of enamel ridges, is an adaptation to resist wear.

All *Pogonomys* and *Chiruromys* are colonial and nests may contain up to 15 animals, but 3 to 5 seems a commoner number. It is not possible to say if all individuals in a colony are related but certainly both sexes and young of all ages from newly born onwards may be found in one nest. The mammary formula is always 1 + 2 = 6 but litter size is quite small, one to three offspring comprising the usual number. The only newborn young that we have seen have been quite small and totally hairless so they seem to be born in a less advanced condition than those of *Melomys*. This is often a characteristic of animals nesting in holes.

Currently seven species of this group are recognised and these are divided between two genera. The three species in the genus *Pogonomys* are only partly arboreal. They nest communally in holes in the ground and emerge at night to forage in low vegetation, or on the ground. The 4 species of *Chiruromys* are completely arboreal, nest in tree holes and probably do all their foraging in the forest canopy. For this reason they are less easy to trap than *Pogonomys* and so less is known about them. Rats of the two genera are generally alike in external appearance but may

be distinguished fairly easily by examination of their tails (Fig. 4). The tails of *Chiruromys* have a rough appearance, because the scales stand out rather like the teeth on a rasp, while the tails of *Pogonomys* look smoother.

Presumably there are differences in diet and habits between the different species for several may be found in a single locality. So little is known about them that one cannot say what these differences are. *P. loriae* and *P. sylvestris* commonly occur together in the central highlands, between 1500 and 2000m. On the slopes of Mt Simpson, in the Owen Stanley Ranges, *macrourus, kagi, loriae* and *forbesi* have been collected while no less than four species (*macrourus, loriae, sylvestris* and *vates*) occur on Mt Bosavi. Apart from a single record of *P. macrourus* from New Britain neither *Pogonomys* or *Chiruromys* were known to occur outside the New Guinea mainland. However, several *Pogonomys* have recently been collected in N. Queensland.

Key to the species of Chiruromys & Pogonomys.

1. Tail scales raised and strongly overlapping (Fig. 4d); tooth row short (CB/M^{1-3} usually >6.0) . . . . . (*Chiruromys*). 2
   Tail scales flattened and scarcely overlapping (Fig. 4c); tooth row longer (CB/M^{1-3} usually <6.0) . . . . . (*Pogonomys*). 5
2. Ears narrow, more or less pointed . . . . . *C. vates*
   Ears broad and rounded 3
3. Size larger, $CB>28$mm, $M^{1-3}>5.0$ . . . . . *C. forbesi*
   Size smaller, $CB<30$, $M^{1-3}<5.2$ 4
4. Fur shorter, lower altitudes . . . . . *C. lamia*
   Fur longer, altitudes over 1500m . . . . . *C. kagi*
5. Size larger, $CB>29$, $M^{1-3}>5.4$ . . . . . *P. loriae**
   Size smaller, $CB<30$, $M^{1-3}<5.2$ 6
6. Belly fur pure white . . . . . .*P. macrourus*
   Belly fur mostly grey-based . . . . . *P. sylvestris.*

*Large montane *Pogonomys* have generally been known as *mollipilosus.* Present studies suggest that the correct name for these animals is not *mollipilosus* but *loriae.*

Pogonomys macrourus

This small species is distributed from the Arfak Mts of Irian Jaya eastwards at least as far as the hills behind Port Moresby. There are no records from the southeastern peninsula of Papua New Guinea but it is unlikely that such a widespread species would be absent from there. There is also a single record of its occurrence on New Britain, but this needs confirmation. The lowest altitudinal record is from near sea level and the highest, about 1800 m.

Plate 5. a, *Melomys platyops*; b, *Melomys rubex*; c, *Melomys rufescens*.

Plate 6. a, *Uromys anak*; b, *Uromys caudimaculatus*; c, *Pogonomys loriae*.

Plate 7. a, *Pogonomys sylvestris*; b, *Chiruromys forbesi*; c, *Chiruromys vates*.

Plate 8. a, *Mallomys rothschildi*; b, *Crossomys moncktoni* (feet) c, *Hydromys habbema.*

The dorsal fur varies from grey-brown to bright reddish brown and the ventral fur is always pure white to the roots of the hairs. The tail is usually plain coloured but may have a white tip. All specimens for which there is any data were collected at night as they climbed about in low vegetation up to five metres above the ground. Litters may contain up to 3 young. No information is available about diet.

Pogonomys macrourus could be confused with *vates* or *lamia* or juvenile *loriae*, as all these have pure white belly fur. Examination of the tail will distinguish it from the first two. If an animal is juvenile, only examination of the teeth will distinguish *macrourus* from young *loriae*.

Pogonomys loriae Plate 6c, Frontispiece

This is the largest of the *Pogonomys* and the size of adults distinguishes them from *macrourus* and *sylvestris*. It is a very widespread species extending from one end of the mainland to the other and to the d'Entrecasteaux islands where the species is replaced by a subspecies, *fergussoniensis*, altitudes range from about 1000m to nearly 3000m at the limit of forest vegetation. The number of specimens in museum collections supports our field experience that this is a very common species occurring in both mature forest and young regrowth.

The dorsal fur is very dense and woolly and may be medium to dark grey-brown, or rich brown without a hint of greyness. The ventral side is ususally pure white to the roots of the hairs but some populations have the white colour restricted to a narrow central strip, others have a white belly with a grey central strip or even no white at all. Animals with grey were found from the Eastern to the Southern Highlands. All specimens east and west of this area had pure white bellies. Their tails are usually a single colour but may be mottled with white.

Pogonomys loriae forage on the ground and may be trapped there but they probably mainly feed in low vegetation. Stomach contents examined contained all sorts of vegetable matter including flowers and pollen but had a high proportion of tissue derived from grass stems.

When adult, *loriae* cannot be confused with any other species, because it is so much larger. Examination of the tail will distinguish it from larger *forbesi* and anyway, though the two may occur in the same area, *forbesi* is unlikely to be trapped near the ground. *Loriae* may occur in the same area as *P. macrourus* but generally replaces that species at higher altitudes. The underground nest of *loriae* is said to have several entrance tunnels which may be up to many metres long.

Pogonomys sylvestris Plate 7a

This is another wide-spread species, records range from the Arfak Mts in the west to Mt Simpson in the SE. It seems to be purely montane for there are no records below 1000m whereas up to 2000m it seems to be very

common and may be collected in some numbers alongside *P. loriae.*

The dorsal fur is dense and woolly and is always dark brown, or dark greyish brown. The belly is always grey with the tips of the hairs either whitish or buff, never white to the roots. The tail is frequently tipped or mottled with white. Despite their commoness, nothing much seems to be known about these rats except that they nest communally below ground like *macrourus* and *loriae*. They may be trapped on the ground or in low vegetation.

As this is the only small *Pogonomys* in which the belly fur is always grey, it cannot be mistaken for any other species.

Chiruromys forbesi Plate 7b

This is the largest of the *Chiruromys* and appears to be restricted to the SE end of New Guinea. There are no records from further west of the Wau-Bulolo area while to the east of this line it seems to be quite common. All records are from fairly low altitudes, from sea level to 700m in primary forest. They also occur on Goodenough and Fergusson islands (presumably on Normanby Island also). These island specimens are much larger than those from the mainland and are distinguished by the subspecific name, *pulcher.*

The dorsal fur is very dense, but generally coarser in texture than that of *loriae*. The back is usually fairly light grey-brown or sandy-brown and there is a conspicuous dark ring round the eye. The belly fur in mainland animals is always pure white to the roots and this also applies to those from Fergusson Island. However, Goodenough Island rats have the belly fur grey with only a narrow white strip down the centre.

Because they roost high up in hollow trees far less is known about these rats than about the foregoing species, and there is nothing in the literature on their breeding or feeding habits. The only information that we can offer is that a colony taken in December from a tree hole about 10m high contained four adult animals and one newborn young. Another colony collected in the same month contained two males and two females, one of which was pregnant with three embryos.

The large size of this species makes confusion with others, except *loriae*, unlikely. For comparative notes see the account of that species.

Chiruromys kagi

Known only from two localities in the Owen Stanley Mts of SE New Guinea. The first is the type locality, near Kagi village on the Kokoda track, the other is Mt Simpson further east. The species resembles *lamia* in size and coloration but has much denser fur. It appears to replace *lamia* at altitudes over 1500m.

Chiruromys lamia

Like *P. forbesi, lamia* appears to be restricted to the southeastern end of the island but there are very few records of its occurrence and it is either rare or else its habits make it very difficult to collect. All known altitudes for this rat are around 1000m.

The dorsal fur is grey-brown or reddish brown but on the ventral side it is pure white to the roots. The tail appears to be more hairy than that of other species because the hairs are noticeably longer. Nothing is known about the biology of this species.

Chiruromys vates Plate 7c

There are scarcely more records of this species than the last but the distribution does extend from the SE peninsula, through the central province to Mt Bosavi. Known occurrences range from 700 to 1500m in altitude. The dorsal fur varies from fawn to a rich, reddish brown and the belly is always pure white to the roots of the hairs. The cheeks are conspicuously white.

All specimens whose origin is known were taken from tree holes but nothing else is understood about their biology. *Chiruromys vates* is similar in size and color to *C. kagi, C. lamia* and to *Pogonomys macrourus* but the narrow pointed ears will immediately distinguish it from all other species. One female in captivity in June produced a single young.

Group 5 RATS OF THE SUBFAMILY HYDROMYINAE – Water Rats and their allies.

This group of ten genera has been placed in a separate subfamily from other Papuan rodents on the basic differences in their dentition. They show a trend towards simplification and reduction in number of the molar teeth from three to two or even one. Such molar teeth as remain are more simple in structure than those of other rodents and in extreme cases consist only of an oval crown, raised at the margins, that is without any distinct cusps. The simplification of the teeth suggests a diet that is soft rather than abrasive and it is probable that these rats are largely, if not entirely, carnivorous. All have *Rattus*-type, overlapping tail scales and, in most cases the tails are obviously hairy. The subfamily is endemic to the Papuan region, though there are unrelated water rats in other parts of the world. Of these nine Papuan genera (the tenth, *Xeromys*, is Australian), eight are confined to the New Guinea mainland while the other, *Hydromys*, is widespread in both Australia and New Guinea.

Apart from dental peculiarities there are no characters by which hydromyine rodents may easily be recognised. Only two genera are modified for an aquatic life, the remainder are terrestrial and do not differ in any obvious way from other Papuan rats. However, they all have very dense, short fur, rather like moleskin, except for one genus (*Parahydromys*) where the fur is bristly, rather than soft. The tail is usually about the same length as the head and body and never much longer. The mammary formula in all is 0 + 2 = 4.

The first two genera (*Hydromys* and *Crossomys*) in the account that follows are water rats, the remainder are terrestrial.

HYDROMYS – Water Rats

These are medium-sized to large rats with webbed and slightly enlarged hind feet. The fur is soft and dense and the tail is well haired, so that the scales cannot be seen, and its terminal portion looks white or banded. The eyes and ears are small and the snout, which is rather inflated, bears stiff whiskers. Water rats are fully aquatic and find most of their food under stones or buried in the mud at the bottom of the rivers and streams they haunt. The stiff whiskers are tactile sense-organs which help to find this food.

There are three species, one of which is confined to New Britain. The two mainland species may be distinguished as follows:

Size large, HB up to 300mm; widespread up to 1500m . . . *H. chrysogaster*
Size moderate, HB not over 180mm; widespread over 1500m. *H. habbema*

The New Britain Water Rat, *H. neobrittanicus* is similar in size to *chrysogaster* but has dark belly fur and its tail is banded black and white, instead of being white-tipped. Very few specimens have been collected.

Hydromys chrysogaster – Common Water Rat

A fairly large rat with a weight from 500g to one kg or more, a head and body usually around 250-280mm and a tail about the same length. Though rarely seen, it is a widespread and common animal throughout the lowlands of New Guinea and occurs in Australia as far south as Tasmania. It may be found alongside rivers, or by marshes or in mangrove swamps along the coasts. The dorsal fur may be any shade of brown to almost black, while the belly may be pure white, or grey tipped with buff or deep golden yellow. The rather thick tail is black with the terminal portion white.

Water rats live in holes in riverbanks and similar places and are entirely carnivorous, feeding mainly on invertebrates such as crabs, prawns and insects but will also eat fish, frogs and any other vertebrates that venture too close. Water rats were once trapped in Australia for their fine, soft fur

but we have not come across any instances of similar use in New Guinea. Nothing is known about their breeding habits here but in Australia a litter commonly includes four young which remain with their mother for about one month. Two or three litters may be produced each year.

Hydromys habbema – Mountain Water Rat Plate 8c

The general body form of this water rat is much the same as that of *chrysogaster* but it is only about half the size and is colored silvery grey above, slightly paler below. The tail is grey and white tipped. It appears to be common alongside small rivers and streams in the mountains throughout New Guinea from 1500 to 3000m or even higher, wherever suitable habitat occurs.

The diet is mostly insects and small aquatic invertebrates with the addition of frogs and small fish, though we found earthworms in one stomach. Perhaps they search for these under stones along river banks. Nothing is known about their reproductive habits.

Crossomys moncktoni – Earless Water Rat Plate 8b

This is the most highly specialised of all the hydromyines and one of the most easily recognised Papuan rats, with its apparent lack of ears and enormous paddle-shaped hind feet. In size it is intermediate between the common and mountain water rats, with a head and body around 200m and a tail rather longer. The fur is extremely dense and sleek, silvery brownish-grey above, pure white below. The tail is thick and covered with long, white hairs which are raised on the underside to form a crest. Perhaps this is used as a rudder while swimming. The head is broad and smoothly rounded, the eyes are small and the external ears are so short that they are completely hidden in the fur. The whiskers are short, white and stiff and curl forwards.

Crossomys is probably distributed throughout the country, from 1000m upwards but it is not well known. It is entirely aquatic, living in holes in riverbanks and feeding on aquatic insects and other invertebrates plus tadpoles and similar small aquatic vertebrates. The typical habitat of this rat is the small fast-running mountain river but when frogs are spawning in the small mountain creeks the rats may move away from the rivers to hunt for tadpoles. Nothing is known about its reproductive behaviour.

The general shape and soft grey fur of this water rat give it some resemblance to the small gliding possum commonly known as the 'Sugar Glider'. In some parts of the country, the vernacular name, means 'Water Sugar Glider' in English.

Parahydromys asper

Insufficient is known about this large rat to give it any acceptable common name but although it does not show any marked aquatic modifications there are suggestions that it haunts stream banks. Further studies

may indicate that the name 'Waterside Rat' is appropriate. It is about the same size as *Hydromys chrysogaster* but lacks the dense, soft pelage of all other hydromyines. Its hair has a curious texture, rather stiff and upstanding but not spiny, and lacks the long guard hairs of the similiarly stiff-furred *Rattus*. Such hair does not seem a suitable adaptation for an aquatic life, though the hind feet are partially webbed. The general body colour is brown, with the terminal third of the well-haired tail white. Like most hydromyines, the head is broad and smoothly rounded with rather small eyes and ears but the muzzle in this species is exceptionally wide and bears stiffer than usual whiskers. These may well have something to do with its method of finding food. *Parahydromys* seem to be rather rare but it is widely distributed throughout the country, from about 500m upwards. It occurs both in the forest and the fringing vegetation alongside mountain streams, even when these run through cultivated gardens. It is said to feed on insects and other invertebrates which it digs up. The only stomach that we examined contained earthworms. Nothing is known about its reproductive behaviour.

Leptomys elegans

This is the only hydromyine rodent in which the third molar teeth are retained, though they are very much reduced in size. The first two molar teeth (fig. 3i) are much simpler than those of a *Rattus* and show a similarity to the basin-like crowns of other hydromyines. *Leptomys* is a medium-sized rat, with a head and body about 150mm and a white-tipped tail about the same length. The pelage is short, soft and dense; reddish brown above and pure white below. With this size and coloration it could be confused at first sight with either *Melomys leucogaster* or *M. rufescens* but neither of those species have a white-tipped tail. Their tails are apparently naked while that of *Leptomys* is obviously hairy, with three hairs to each tail scale.

Though it is rare, *Leptomys elegans* is known to be widespread, with records ranging from sea level to more than 1500m and from the Owen Stanley Mts in the SE to the Arfak Mountains in the west of Irian Jaya. Nothing is known of its habits.

PARALEPTOMYS

There are two species in this genus and they may be distinguished as follows:

Ventral fur grey based, white tipped . . . . . *P. wilhelmina*
Ventral fur grey based, rufous tipped . . . . . *P. rufilatus*

Both species are medium-sized rats with reddish brown dorsal fur, becoming more reddish on the flanks. They are rather similar to *Leptomys elegans*, but slightly smaller, without the pure white belly fur of that

species. The third molar tooth has disappeared from both upper and lower jaws. *Paraleptomys* are essentially western species with the majority of records from Irian Jaya where *wilhelmina* is widespread and *rufilatus* is restricted to the Cyclops Mts. *P. wilhelmina* also extends into the mountains of the far west of Papua New Guinea, where it seems to be quite common is some localities. Nothing is known about the habits of either species.

MAYERMYS, MICROHYDROMYS, NEOHYDROMYS & PSEUDOHYDROMYS – Moss mice

These four genera contain only five species and it is convenient to treat them together. All are small or very small, all have dense soft short fur, live on the ground in mountain forests and are rare or else very difficult to collect, for very few specimens of any are known. The tails are generally no longer than the head and body and are obviously hairy. Their elongate, rather flat heads and peculiar pelages make them less like mice and more like the insectivorous animals known as shrews, which are common in other parts of the world. Moreover the resemblance is not restricted to appearance; for these animals are undoubtedly insectivores like shrews. Not much is known about the habits of any of them. The following notes may help to distinguish the five species.

Mayermys ellermani has only a single molar tooth on each side of the upper and lower jaws and that tooth is simple and without cusps. No other Papuan rodent has so few teeth. The fur is an even grey both above and below and the tail may be mottled grey and white. The head and body length is around 100mm, slightly larger than that of a house mouse. *Mayermys* is known from several montane localities in Papua New Guinea from Telefomin in the west to Wau in the centre.

Microhydromys richardsoni is smaller than *Mayermys*, with a head and body not exceeding 90mm. It is brownish grey above and paler below, with a mottled tail. The very few records of this species are all in hill forest ranging from Sogeri in the SE to central Irian Jaya, but at lower altitudes than the other "moss mice."

Neohydromys fuscus is about the same size as *Mayermys* but has two molar teeth on each side of each jaw and the tail is shorter than the head and body. The fur is dark brown both above and below and the tail is mottled. Records, all from altitudes over 2500m, are from various scattered highland localities in central and eastern New Guinea.

Pseudohydromys murinus is another small hydromyine about the same size as *Mayermys* and *Neohydromys*. The fur is grey brown above but

paler on the belly and the tail is usually plain coloured throughout. Records range through various localities in Papua New Guinea as far east as Mount Missim, near Wau, but all over 2000m. If the number of specimens in museum collections is a reliable guide, this species is more common than any other of these 'moss mice.'

Pseudohydromys occidentalis is a western species known only from the mountains of Irian Jaya and extreme west of Papua New Guinea (Star and Victor Emanuel Ranges). It is slightly larger than *P. murinus* (head and body up to 120mm rather than 105mm). The fur is dark, blackish brown above and very slightly paler below.

Group 6 RATS AND MICE OF THE PSEUDOMYS GROUP – Australian Mice and Rats

The majority of rats and mice in Australia belong to this group and include more than 40 species, belonging to nine different genera; about three-quarters of all the rodents on that continent. The group can scarcely be said to form part of the Papuan fauna, for its occurrence here is based on specimens of two species collected in the south Papuan savannas. Since this region contains a number of other 'Australian' elements and is not well known other Pseudomyine genera might yet be discovered there. The Australian group includes a wide variety of rodents from very small mouse-like animals to desert hopping mice with elongate hind-limbs and large brush-tailed, tree rats. The group is distinguished by skull and dental characters but as only two species occur in our region neither these details, nor a key, is necessary.

Conilurus penicillatus – Brush-tailed Tree Rat Fig. 7

As far as we know only two specimens of this rat have ever been collected in New Guinea; both were caught near the Morehead River in the Western Province of Papua New Guinea. The species is reported to be common in the Northern Territory of Australia, though it has not yet been found in the closer Queensland. It is a medium-sized animal with a head and body 150 to 200mm long and a tail about the same length. The pelage is rather coarse and thin, greyish above and pure white below. The tail is clad in long hairs, which form a brush at the tip. The hands and feet are white, the latter somewhat elongate. The eyes are large and the ears narrow. The terminal portion of the tail may be either black or white. One of the two Papuan specimens has the tip of the tail missing, the other has it white, so it is not possible to know if the Papuan rats are variable like the Australian ones.

Conilurus may be more common in the Digoel and Fly River regions than we presently suppose; being partly arboreal it may be difficult to catch. The only other rat of comparable size that occurs in that region, and which could be mistaken for *Conilurus*, is *Rattus leucopus;* that also has harsh fur, white hands and feet and a white-tipped tail. However the tail of *R. leucopus* is very rough and its hairs are short and do not form a brush at the end. *Conilurus* also has elongate feet (more than 40mm long) while those of *leucopus* are short, not above 32mm.

Nothing is known about the habits of this rat in New Guinea. In Australia it nests in hollow trees and descends at night to forage. Some have been seen foraging along the sea-shore, apparently finding food along the tide line. The mammary formula is 0 + 2 = 4.

Pseudomys sp.

Recently, the occurrence of a *Pseudomys* species has been confirmed in the Morehead region of the Western Province of Papua New Guinea. No details are yet available so the genus is not included in our keys but any very small mouse (HB less than 100mm) collected in that general area should be examined very closely to make sure that it is not just a common house mouse. If a female is in hand there should be no problem. The mammary formula of all *Pseudomys* is 0 + 2 = 4 while that of the house mouse is 3 + 2 = 10. Otherwise it isn't so easy. Look sideways at the upper incisor teeth, those of the house mouse have a distinct notch on the cutting edge while those of *Pseudomys* do not. We are grateful to John Waithman for this up-to-date information.

Chapter 7

CATCHING RATS, AND KEEPING THEM

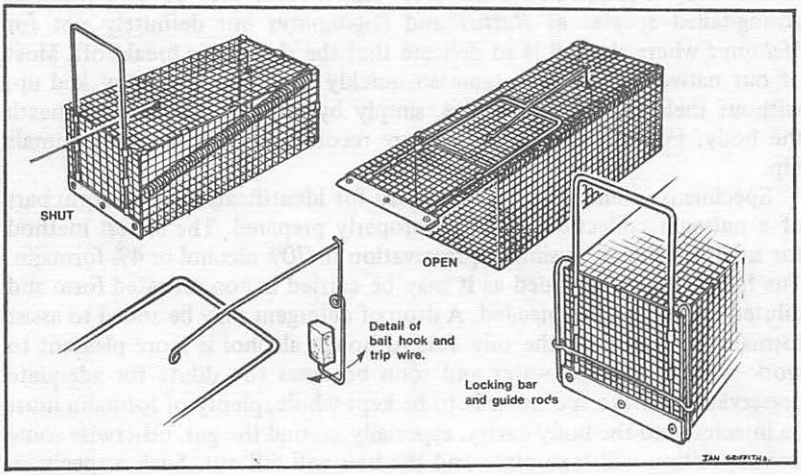
"And then there are – well, traps and things – YOU know."

THE WIND IN THE WILLOWS

Most people, at some time or another, are faced with the problem of catching rats and mice that are infesting their premises. Total eradication of pest species is generally impossible but numbers may usually be trapped with simple break-back traps which are obtainable in various sizes in most trade stores. For those who want to find out something about native species of rodents the solution is not quite so simple. Break-back traps may be used in the bush and often produce a high rate of return, as animals are less suspicious of them than they are of more complex traps which they actually have to enter. The drawback is that rats caught in break-back traps are often so severely damaged that they are useless as museum specimens. Another point worth remembering is that these traps, especially the larger sizes, are quite dangerous and should not be left set during daytime when people, dogs or pigs are moving about.

For those who want whole specimens, or live rats to keep in captivity, several types of traps are available. The three most popular are the Sherman and Havahart traps made in the U.S.A. and the Elliott traps made in Australia. All three of these take the form of a tunnel with a trapdoor at one or both ends and are sold in various sizes. When the rat enters the trap and touches the bait, the doors drop down. The animal is unharmed then, but it may damage its skin in trying to escape so the traps should be checked as soon as possible after daybreak. The small sizes are adequate for most rats and mice but will not catch large rats as they will only have the head and half the body inside when taking the bait so the door merely falls in the middle of the back and the rat can retreat. If a large size trap is used then small rats often go inside, spring the trap and escape through the mesh. The British Longworth trap, another design, is available in one size only and too small for most of our native rodents.

These ready-made traps are expensive but anyone with a bit of ingenuity can make a successful box-trap from chicken mesh and stiff wire, plus a couple of springs. One design is shown in figure 8 and a suitable size for small and medium-sized rats is 25 cm long, 15 cm wide and high. We have even caught bandicoots in such traps, though one would think that such animals could easily push their way out. The simplest trip mechanism has the door handle hooked directly below the bait hook but a more sensitive setting can be obtained by inserting an intermediate wire between the bait hook and the door handle (figure 8). The springs will keep the door shut



8. Construction of a simple box trap for small rodents.

but may be supplemented by a locking bar which drops down when the door closes.

Various baits can be tried but we usually use pieces of sweet potato smeared with peanut better. Though we have caught insectivorous species with this vegetable, baits of animal origin would probably be necessary to attract hydromyine rodents. Sugary baits are generally unsuccessful because they are carried away by insects long before the rats emerge.

So little is known about the lives of our native rodents that studies on captive animals are worth while, particularly breeding studies. Most will eat a variety of food but some like *Melomys* tend to put on fat very rapidly and must be fed sparingly, but sufficiently. A high proportion of hard food must be included in the diet, otherwise the incisor teeth will grow too rapidly and ultimately fail to occlude; this condition is fatal. Ordinary laboratory rat cages are suitable for keeping native rats singly or in pairs but are not usually large enough for more than two animals (never two males!). Whatever sort of cage is used it must be remembered that all rodents can, and usually do, gnaw continuously in keeping their incisor teeth short. Wooden cages may not last long and even hard, plastic laboratory cages are not always immune. For breeding purposes some degree of privacy is necessary, a deep layer of leaf-litter on the floor may be sufficient for terrestrial species but hole-nesters will need a small box for sleeping in.

It is not recommended to follow the custom of handling laboratory rats and mice by the tail, which in those is strong enough to bear the weight

of the body if grasped near the base. This method *may* be used for such strong-tailed species as *Rattus* and *Pogonomys* but definitely not for *Melomys* where the tail is so delicate that the skin often breaks off. Most of our native rats become tame so quickly that they can be picked up, without their attempting to bite, simply by cupping the hands beneath the body. For the cautious, gloves are recommended since some animals nip.

Specimens intended to be sent away for identification or to form part of a museum collection, must be properly prepared. The easiest method for small specimens is simply preservation in 70% alcohol or 4% formalin. The latter is recommended as it may be carried in concentrated form and diluted ten times when needed. A drop of detergent may be added to assist formalin to penetrate the oily fur. Although alcohol is more pleasant to work with it absorbs water and soon becomes too dilute for adequate preservation. If the specimen is to be kept whole, plenty of formalin must be injected into the body cavity, especially around the gut, otherwise some decomposition will take place and the hair will fall out. Such a specimen may be identifiable, but would be useless as a museum specimen. Rather than risk decomposition, the abdomen should be opened and the viscera removed before the rest of the body is preserved. Medium-sized and large rats cannot be preserved satisfactorily in this way but must be skinned.

The usual method of storing small mammals in museum collections consists of making what are called study skins but this process requires skill. A detailed account of the method is outside the scope of this book. Basically the process involves removing the entire skin, replacing the flesh with cotton wool and then sewing up the incision. This is not taxidermy and does not result in a life-like specimen, it is merely a method by which the skin and fur are preserved in a life-like condition. Freshly made-up skins must be thoroughly dried and stored in a dry and insect-proof atmosphere. The skull is removed, cleaned and dried and accompanies the skin, the rest of the body is not usually kept. Before removing the skin or, before preserving the whole specimen in formalin or alcohol, the length of the head and body, tail, hind foot and ear should be taken and the specimen weighed. If a female is opened up it should be noted whether it is pregnant and, if so, how many embryos are present. In addition to a note on the locality and altitude, any details of the habitat and circumstances of capture are worth recording.

Chapter 8

GLOSSARY

Geographical and geological terms

ALTITUDES are given in metres above sea level

LOWLAND, MID-MONTANE and MONTANE are rather imprecise terms referring to altitudes from sea level to about 500m, 500 to 1500 and over 1500m respectively.

NEW GUINEA refers to the whole of the large island including mainland Papua New Guinea and the Indonesian province of Irian Jaya.

PAPUAN refers to the Papuan zoogeographic subregion (fig. 1) comprising New Guinea and nearby small islands.

PLEISTOCENE, PLIOCENE and MIOCENE are the three most recent periods of earth history and include the time during which the modern rodents evolved and entered the Australian region. The Pleistocene was the time from some 2 million years ago to 10,000 years ago and encompassed major glaciations (ice ages) when the sea fell to a maximum of 200m below its present level thus making land connections between what are now separate islands. The Pliocene extended for some three to four million years before the Pleistocene and the Miocene for some 17 million years before that. Rats similar to modern ones are known to have existed in New Guinea as early as the Pliocene.

Taxonomic Terms

TAXONOMY is the classification of living organisms with reference to their postulated evolutionary relationships.

A SPECIES is a group of organisms which resemble one another very closely and normally breed together.

GENUS, FAMILY, ORDER and CLASS are taxonomic groups in increasing order of magnitude. A genus includes one or more species which are closely related but do not normally breed together. A family consists of one or more genera with certain obvious similarities but which are sufficiently different to prevent interbreeding. Members of an order (e.g. Rodentia, the rodents) have certain obvious similarities in anatomy but are not closely related. A class is a major taxonomic unit including organisms with a fundamental similarity in body form, e.g. Mammalia – mammals, Aves – birds, etc.

MONOTREMES are a group of primitive egg-laying mammals confined to the Australasian region.

MARSUPIALS are mammals with pouches and produce their young in a very early stage of development after a very short gestation period. They are confined to Australasia and America.

EUTHERIANS include all those mammals not in the above two groups. They do not have pouches, nor do they lay eggs. Gestation is comparatively lengthy and the young are born in an advanced condition.

Biological terms

COLONIAL ANIMALS are those which live in groups that are not just male, female and offspring.

COMMENSAL ANIMALS are different species which live together to the mutual advantage of one of the partners. In the context of this book, the term refers only to rats which live in association with man.

ENDEMIC refers to animals which are found naturally in the place under discussion, as opposed to those which have been introduced.

EXOTIC refers to introduced species.

HABITAT is the place where a given species is normally to be found. Rodents may be AQUATIC (living in the water), TERRESTRIAL (living on the ground), SCANSORIAL (climbing about in low vegetation) or ARBOREAL (living in trees and rarely, if ever, coming to the ground).

A NICHE is an animal's or plant's place in the natural world and is related to its habitat and all the other factors which interact at that place. These include physical and climatic factors and the influence of all the other organisms living there.

CHROMOSOMES are filamentous structures within the nucleus of every cell of the body and carry the genes or hereditary factors which determine an animal or plant's characteristics. The number and shape of the chromosomes is characteristic for every individual species and so their similarity or dissimilarity may be used as an indication of relationship.

PELAGE is the hair or fur of an animal and, in rodents, it may include three different elements. Guard hairs are long and straight, frequently black-tipped and project above the general fur level. Spines are stiff, usually flattened hairs and, like guard hairs, are only present on the back and sides of the body. Body hairs form the bulk of the covering and may be straight or crimped. They are thin and flexible.

Appendix 1 – Island Rats

This book deals only with species of rodents occurring on the New Guinea mainland. For the benefit of readers living on the islands nearby we list those species of Papuan rodents which occur in these islands. The lists are taken from the literature and are likely to be incomplete, because of lack of studies on these islands.

Bismarck Archipelago (New Britain, New Ireland, New Hanover)
Pogonomys macrourus; Rattus ruber; Melomys rufescens; Uromys neobrittanicus; Hydromys neobrittanicus.

Admiralty Islands (Manus Island)
Rattus ruber; Uromys neobrittanicus.

Solomon Islands
Rattus rennelli; R. ruber; Melomys rufescens; Solomys sapientis; S. salebrosus; S. ponceleti; Uromys rex; U. imperator; U. salomonis.

D'Entrecasteaux Islands (Normanby, Fergusson, Goodenough)
Chiruromys forbesi pulcher, Pogonomys loriae fergussonensis; Melomys moncktoni; Hydromys chrysogaster; Uromys caudimaculatus; Rattus ruber.

Louisiade Islands (Misima, Tagula, Rossel)
Chiruromys forbesi pulcher; Melomys arcium; Rattus ruber.

Moluccas
Rattus ruber; R. morotaiensis; Melomys aerosus; M. fulgens; M. fraterculus; M. obiensis.

Aru Islands
Uromys caudimaculatus; Rattus doboensis.

Appendix 2 – Check list and bibliography of endemic Papuan rodents.

1. Endemic Rattus

R. bunae Troughton
Rattus gestri bunae Troughton, 1946, Rec. Aust. Mus. 21: 408.

R. gestroi (Thomas)
Mus gestri Thomas, 1897, Ann. Mus. Stor. Nat. Genova 18: 611.

R. leucopus (Gould)
Acanthomys leucopus Gould, 1897, Proc. zool. Soc. Lond. 508.

R. niobe (Thomas)
Mus niobe Thomas, 1906, Ann. Mag. N.H. 17: 327.

R. richardsoni Tate
Rattus richardsoni Tate, 1949, Amer. Mus. Novit. No. 1421: 1.

R. ruber (Jentinck)
Mus ruber Jentinck. 1879, Notes Leyden Mus. 2: 18.

R. sordidus (Gould)
Mus sordidus Gould, 1847, Proc. zool. Soc. Lond. 242.

R. verecundus (Thomas)
Stenomys verecundus Thomas, 1904, Novit. Zool. 11: 598.

2. The Uromys group

Melomys albidens Tate
Melomys albidens Tate, 1951, Bull. Amer. Mus. N.H. 97: 286.

M. arcium Thomas
Melomys arcium Thomas, 1913, Ann. Mag N.H. 12: 214.

M. fellowsi Hinton
Melomys fellowsi Hinton, 1943, Ann. Mag. N.H. 10: 554.

M. leucogaster (Jentinck)
Pogonomys leucogaster Jentinck, 1908, Nova Guinea 9:3.9.

M. levipes (Thomas)
Uromys levipes Thomas, 1897, Ann. Mus. Stor. Nat. Genova 18: 617.

M. lorentzi (Jentinck)
Pogonomys lorentzii Jentinck, 1908, Nova Guinea 9:3. 8

M. lutillus (Thomas)
Uromys lutillus Thomas, 1913, Ann. Mag. N.H. 12: 216.

M. moncktoni (Thomas)
Uromys moncktoni Thomas, 1904, Ann. Mag. N.H. 14: 399.

M. platyops (Thomas)
Uromys platyops Thomas, 1906, Ann. Mag. N.H. 17: 327.

M. rubex Thomas
Melomys rubex Thomas, 1922, Ann. Mag. N.H. 9: 263 and Nova Guinea 13: 730.

M. rufescens (Alston)
Uromys rufescens Alston, 1877, Proc. zool. Soc. Lond. 124. 743.

Pogonomelomys bruijni (Peters & Doria)
Uromys bruijni Peters & Doria, 1876, Ann. Mus. Stor. Nat. Genova 8. 336.

P. mayeri (Rothschild & Dollman)
Melomys mayeri Rothschild & Dollman, 1932, Abstr. Proc. zool. Soc. Lond. No. 353: 14.

P. ruemmleri Tate & Archbold
Pogonomelomys ruemmleri Tate & Archbold, 1941, Amer. Mus. Novit. No. 1101: 6.

P. sevia (Tate & Archbold)
Melomys sevia Tate & Archbold, 1935, Amer. Mus. Novit. No. 803: 3.

Uromys anak Thomas
Uromys anak Thomas, 1907, Ann. Mag. N.H. 20: 72.

U. caudimaculatus (Krefft)
Mus macropus Gray, 1866, Proc. zool. Soc. Lond. 221.
Hapalotis caudimaculatus Krefft, 1867, Proc. zool. Soc. Lond. 316.

Xenuromys barbatus (Milne-Edwards)
Mus barbatus Milne-Edwards, 1900, Bull. Mus. d'Hist. Nat. Paris 6: 167.

3. The Old Papuan Genera

Anisomys imitator Thomas
Anisomys imitator Thomas, 1903, Proc. zool. Soc. London. 2: 200.

Hyomys goliath (Milne-Edwards)
Mus goliath Milne-Edwards, 1900, Bull Mus. d'Hist. Nat. Paris 6: 165.

Lorentzimys nouhuysi Jentinck
Lorentzimys nouhuysi Jentinck, 1911, Nova Guinea 9: 166.

Macruromys elegans Stein
Macruromys elegans Stein, 1933, Z. Saugetierk. 8: 95.

M. major Rümmler
Macruromys major Rümmler, 1935, Z. Saugetierk. 10: 105.

Mallomys rothschildi Thomas
Mallomys rothschildi Thomas, 1898, Novit. Zool. 5:2.

Chiruromys forbesi Thomas
Chiruromys forbesi Thomas, 1888, Proc. Zool. Soc. Lond.: 239.

C. kagi (Tate)
Pogonomys kagi Tate, 1951, Bull. Amer. Mus. N.H. 97: 278.

C. lamia (Thomas)
Pogonomys lamia Thomas, 1897, Ann. Mus. Stor. Nat. Genova 18: 615.

C. vates (Thomas)
Pogonomys vates Thomas, 1908, Ann. Mag. N.H. 2: 495.

Pogonomys loriae Thomas
Pogonomys loriae Thomas, 1897, Ann. Mus. Stor. Nat. Genova. 18: 613.

P. macrourus (Milne-Edwards)
Mus (*Pogonomys*) *macrourus* Milne-Edwards, 1877, C.R. Acad. Sci. Paris 85: 1081.

P. mollipilosus (Peters and Doria)
Mus mollipilosus Peters & Doria, 1881, Ann. Mus. Stor. Nat. Genova 16: 698.

P. sylvestris Thomas
Pogonomys sylvestris Thomas, 1920, Ann. Mag. N.H. 6: 534.

4. **Hydromyine rats and mice**

Crossomys moncktoni Thomas
Crossomys moncktoni Thomas, 1907, Ann. Mag. N.H. 20: 71.

Hydromys chrysogaster Geoffroy
Hydromys chrysogaster Geoffroy, 1804, Bull Soc. Philom. Paris 3: 93. 354.

H. habbema Tate & Archbold
Hydromys habbema Tate & Archbold, 1941, Amer. Mus. Novit. No. 1101: 3.

Leptomys elegans Thomas
Leptomys elegans Thomas, 1897, Ann. Mus. Stor. Nat. Genova 18: 610.

Mayermys ellermani Laurie & Hill
Mayermys ellermani Laurie & Hill, 1954, List of land mammals of New Guinea, Celebes and adjacent islands. British Museum (Natural History). 134.

Microhydromys richardsoni Tate & Archbold.
Microhydromys richardsoni Tate & Archbold, 1941, Amer. Mus. Novit. No. 1101: 2.

Neohydromys fuscus Laurie

Neohydromys fuscus Laurie, 1952, Bull, Brit. Mus. N.H. Zool. 1: 311.

Paraleptomys rufilatus Osgood

Paraleptomys rufilatus Osgood, 1945, Fieldiana, Zool. 31: 1.

P. wilhelmina Tate & Archbold

Paraleptomys wilhelmina Tate & Archbold, 1941, Amer. Mus. Novitates No. 1101: 1.

Pseudohydromys murinus Rümmler

Pseudohydromys murinus Rümmler, 1934, Z. Saugetierk. 9: 48.

P. occidentalis Tate

Pseudohydromys occidentalis Tate, 1951, Bull. Amer. Mus. N.H. 97: 224.

Parahydromys asper (Thomas)

Limnomys asper Thomas, 1906, Ann. Mag. N.H. 17: 326.

5. Rats of the Pseudomys group

Conilurus penicillatus Gould

Conilurus penicillatus Gould, 1842, Proc. zool. Soc. Lond. 12.

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WAU ECOLOGY INSTITUTE

This book is published by the WAU ECOLOGY INSTITUTE, which is an organization dedicated to education for ecology and conservation in Papua New Guinea. The Institute is located at Wau (alt. 1200 metres) in the mountains of eastern Papua New Guinea. It encompasses a large arboretum of native plants, a zoo, a small museum, and some facilities for research.

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Publications of Wau Ecology Institute

Handbook of common New Guinea Frogs, by J. I. Menzies. 1976, 75p. 12 col. pl. Price K3.00; US$4.50.

Handbook of common New Guinea Beetles, by J. L. Gressitt and R. W. Hornabrook. 1977. 87p. many illustr., 4 col. pl. Price as preceding.

Guide to biological terms in Melanesian pidgin. By Martin Simon. 115p., illustr. Price K2.50; US$4.00.

Upland birds of Northeastern New Guinea: A guide to the hill and mountain birds of Morobe Province, by Bruce Beehler, 1978. 156p. many illustr., 5 col. pl. Price K5.00; US$8.50.

Guide to Mt Kaindi: Background to montane New Guinea ecology by J. L. Gressitt & N. Nadkarni. 1978. illustr. Price K3.00; US$5.00.

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