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Two New Species of *Oxymycterus* (Rodentia) from Peru and Bolivia

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ABSTRACT

Two new species of *Oxymycterus* were recently discovered in the yungas of Peru and Bolivia. Both are much smaller than any species previously known. A description of the two species and a review of the characters of the oxymycterine group suggest certain relationships. Some shared characters suggest monophyly for a subgroup of the Tribe Akodontini including the genera *Oxymycterus, Podoxymys, Microxus, Lenoxus, Geoxus,* and *Blarinomys.* However some of the shared characters may be results of convergence, and electrophoretic data suggest that at least *Microxus* does not belong with this group. Thus, the concept of an oxymycterine group remains unclear.

RESUMEN

Dos especies nuevas de *Oxymycterus* descubrió recientemente en los yungas de Perú y Bolivia. Ambos son más pequeños que cualquiera de los previamente conocidos. Descripción de los dos especies y revisión de los caracteres del grupo oxymycterine sugieron cierto relaciones. Algunos caracteres compartidos sugieren que un subgrupo monofiletico de la tribu Akodontini, incluimos los géneros *Oxymycterus, Podoxymys, Microxus, Lenoxus, Geoxus,* y *Blarinomys.* Sin embargo algunos de estos caracteres compartidos pueden ser resultados de convergencia y datos electroforeticos sugiriendo que el *Microxus* no corresponde a este grupo. Asi el concepto de grupo oxymycterine no queda aclarado.

INTRODUCTION

While members of the 1984 Bolivian Expedition were camped in the Siberia Cloud Forest near the border between Cochabamba and Santa Cruz (fig. 1), several interesting

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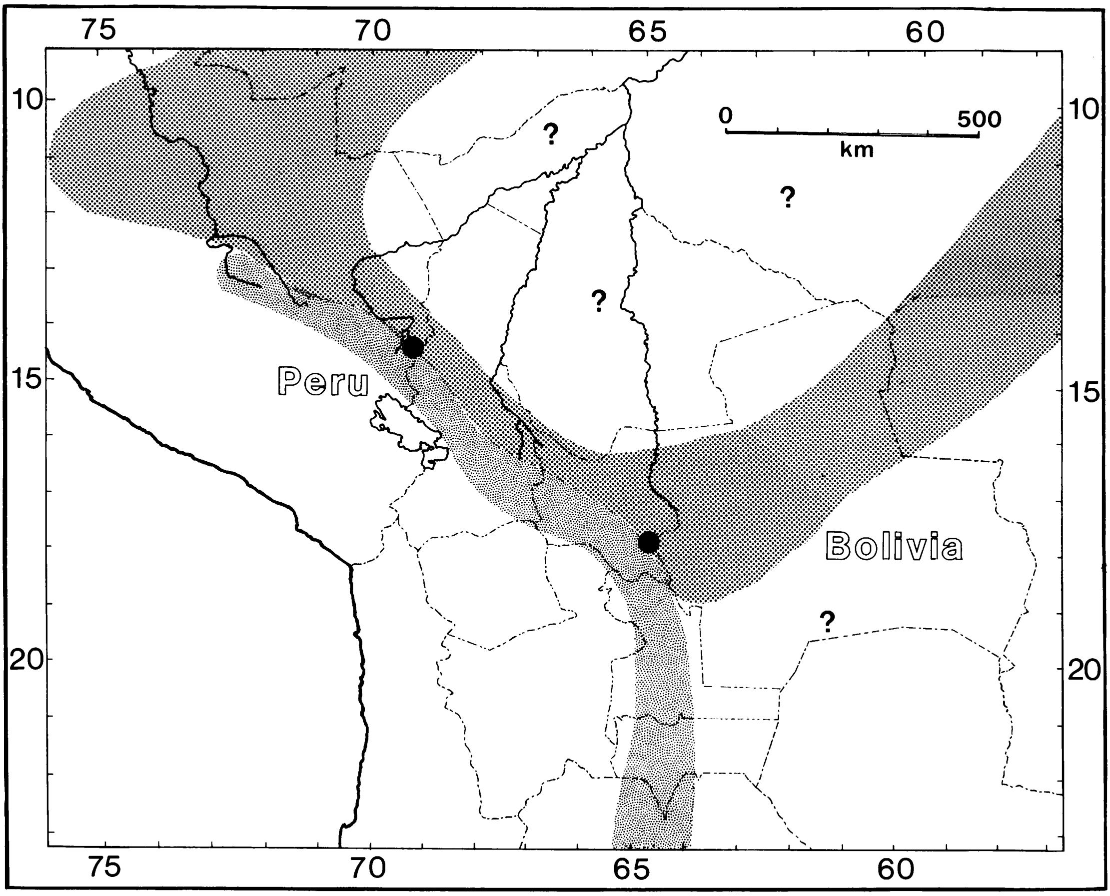

Fig. 1. Map of Bolivia, southern Peru, and adjacent areas showing the known localities (dots) of two new species of *Oxymycterus* and the distributions (gray patterns) of the two widely ranging species previously known in these countries. *O. inca* is known from about 17 localities below 2350 m in elevation within the darkly stippled area, and probably occurs also in the area with question marks. *O. paramensis* is known from about 35 localities above 2450 m in elevation within the finer stippled area.

species of akodont rodents (including *Microxus mimus* and species of *Akodon*) were trapped on the mossy, fern-laden, and humid forest floor. Among these was one small mouse, distinguishable at the time by its relatively long claws as belonging to the genus *Oxymycterus,* in spite of superficial similarity in size, color, and gross appearance of pelage to *Microxus* and *Akodon* being taken in the same trap lines. The well-worn teeth indicated that the animal could not be a young individual of one of the other two species of *Oxymycterus* known from Central Bolivia. Other distinctive characters also clearly indicated that an undescribed species was represented. A second and earlier specimen, taken in 1955 by O. P. Pearson, was then recognized as the same species, and finally a third specimen, taken in 1979 by Greg Schmitt, was found with a series of *Microxus mimus* at the American Museum of Natural History.

Three specimens of small dark *Oxymycterus* were trapped by Patton in 1985 in Peru, in humid forest along the eastern flanks of the Andes. These also belong to no known species of the genus. Three additional specimens were obtained in 1986 at the same place.

We have assembled five of these specimens for comparison with each other and with other species of *Oxymycterus* and have concluded that the Peruvian specimens represent a second new species, rather than a population of the new species represented by the Bolivian specimens.

No comprehensive revision of *Oxymycterus* exists. It is necessary, nonetheless, to place the new species in the current taxonomic and morphological context. Therefore, in this paper we review the morphological characters within the oxymycterine group, diagnose the genus *Oxymycterus,* and name and characterize the new species.

ACKNOWLEDGMENTS

Assistance and encouragement for work in Bolivia has been given generously by many officials and colleagues. The type specimen of the new Bolivian species was obtained on an expedition supported in part by the National Science Foundation (Grants BSR 83-16740 and 84-08923, to the American Museum of Natural History (AMNH) and the University of New Mexico). The Undergraduate-Graduate Research Participation Program of the AMNH enabled Hinojosa to participate in this research. Skull photos are by Peter Goldberg. Photos (SEM) of dentitions are by Lauren Duffy and Nancy Olds. We are grateful to Guy G. Musser, Philip Myers, and Robert C. Dowler for helpful reviews of this paper.

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METHODS

Cranial measurements in table 1 were taken by Hinojosa or Anderson with a stage craniometer as described by Anderson (1969).

Specimens of *Oxymycterus* in a number of museums have been examined by Anderson. Only specimens referred to specifically in text or figures are listed in Appendix A.

ELECTROPHORETIC ANALYSIS: Samples of liver and kidney were frozen in the field and transported to the laboratory in liquid nitrogen where they were stored at −76°F. Aqueous extracts were examined by standard electrophoretic procedures (Harris and Hopkinson, 1976) for 28 enzyme and other protein genetic loci. A complete list of loci examined and gel running conditions will be given elsewhere. Vouchers for all specimens examined are cataloged in the collections of either the Museum of Zoology, University of Michigan (UMMZ) or the Museum of Vertebrate Zoology, University of California, Berkeley (MVZ).

TAXONOMY

SUPERFAMILY MUROIDEA, FAMILY MURIDAE, SUBFAMILY SIGMODONTINAE

TRIBE AKODONTINI VORONTZOV, 1959

OXYMYCTERINE GROUP

The oxymycterines are members of an informal group, above the genus and below the tribe, that has been frequently mentioned in the literature. Hershkovitz (1966: 86) stated that the oxymycterines include *Oxymycterus, Podoxomys, Lenoxus,* and *Abrothrix.* (He considered *Microxus* to be a synonym of *Abrothrix*; however, Reig, 1980, regarded *Microxus* as a distinct genus and *Abrothrix* as a subgenus of *Akodon,* a treatment with which we agree.) To these oxymycterine genera we would add *Blarinomys* and *Geoxus.* Reig wrote that he did not find cogent reasons to separate the oxymycterines from the akodont group. However, he was considering only groups judged to warrant recognition as tribes, not whether groups existed within the Akodontini.

We think that all groups are interesting, not just those with formal taxonomic names, and that not every group needs to be expressed in the formal classification. Some looseness in the linkage between phylogenetic (phenetic, cladistic, or any other) model and formal classification is both inevitable and desirable, because stability in the formal classification can be increased only by allowing our knowl-

TABLE 1
Measurements (mm) of Four Species of *Oxymycterus*

Measurement	*O. inca* 260604 ad. male	*O. paramensis* 249003 yg. male	*O. hiska* 171519 ad. female	*O. hiska* 171518 yg. female	*O. hucucha* 260583 ad. male	*O. hucucha* 119948 ad. female	*O. hucucha* 246721 yg. male
Head and body length	184	124	100	114	116+	109	99
Tail length	110	93	77	80	60+	71	75
Hind foot length	34	25	25	23	23	21	21
Ear length	19	17	16	15	14	15	14
Weight (g)	120	50	30	35	36	—	25
Length of bulla	4.72	4.08	3.63	3.82	3.45	3.74	3.74
Alveolar length of maxillary tooth row	5.93	5.14	5.01	4.79	4.26	4.10	4.66
Length of palate	4.97	4.22	3.22	3.13	3.91	3.58	3.70
Length of zygomatic aperture	11.07	8.85	7.35	8.01	7.75	6.85	7.03
Length of incisive foramina	8.33	6.27	6.06	6.57	5.88	5.29	5.58
Condyloincisive length	35.90	28.13	25.10	25.93	25.41	24.09	24.23
Breadth of mesopterygoid fossa	2.60	2.07	1.92	2.35	1.87	1.53	1.61
Interdental palatal breadth	4.02	2.88	2.96	3.23	2.72	3.12	2.93
Breadth of postdental constriction	4.77	4.15	3.93	3.86	3.34	3.01	3.55
Breadth of rostrum	7.41	5.64	5.23	5.70	4.81	4.50	4.89
Palatal breadth	7.27	6.36	5.66	6.01	5.50	5.50	5.36
Breadth of paroccipital process	10.78	8.98	8.50	8.20	8.12	6.93	8.03
Anterior zygomatic breadth	15.24	11.92	11.30	11.55	11.45	10.76	10.63
Posterior zygomatic breadth	17.57	14.49	13.63	13.84	13.01	12.19	12.44
Breadth of M1	1.69	1.73	1.21	1.17	1.33	1.08	1.30
Occipito-interparietal length	4.62	3.47	2.70	2.99	3.07	2.89	2.85
Length by which nasals exceed premaxillae posteriorly	1.98	1.50	1.12	1.98	1.31	1.27	1.03
Occipitonasal length	39.82	32.87	29.75	30.63	29.29	27.76	28.02
Nasal length	15.85	12.25	11.43	12.51	11.79	9.40	10.27
Length of rostrum	14.83	11.79	11.43	11.96	11.03	10.36	10.43
Interorbital breadth	6.77	5.86	6.32	6.34	5.39	5.19	5.50
Breadth of braincase	14.28	13.33	12.68	12.44	11.55	12.14	12.45
Lateral incisive exposure	3	2.38	2.02	2.39	2.40	2.30	2.33
Depth of bullae	3.66	3.71	3.66	3.01	2.95	2.51	2.50
Depth of skull	12.76	10.59	9.50	10.17	9.24	8.69	9.95
Width of zygomatic plate	3.13	2.11	1.76	1.76	2.03	1.40	2.03

edge to cease growing or at the cost of a loose linkage (Anderson, 1974: 68).

The probable number of categories required to express all hypothesized clades has been estimated by making certain assumptions based on the prevailing pattern of diversity (Anderson, 1975). Since frequency distributions (such as species per genus) in most groups are about the same as they would be if extinctions and splits of species had occurred randomly, it is assumed that a Monte Carlo model based on randomness can be used to predict the most probable number of branching points in the lineage with the most branching points. In the groups under consideration, the most probable numbers of categories would be as follows: in the Sigmodontinae (73 genera), 12 categories from level of genus to subfamily; in the tribe Akodontini (with 11 living genera), 5 or 6 categories from level of genus to tribe; in the oxymycterine group (assuming for the moment that the 6 genera are monophyletic), 4 levels from genus to the entire group.

Although the tribe Akodontini is generally recognized, it still lacks a clear diagnosis and no hypothesis of synapomorphy has been elucidated to support its monophyly.

We begin with the existing characterization of oxymycterines, briefly noting the distribution of the characters within the "oxymycterines" and the more inclusive "akodonts." We consider some pros and cons for the possibility of oxymycterine monophyly, list its characteristics, and indicate what genera are included.

Characteristics of oxymycterines (with the content noted above) as listed by Hershkovitz (1966: 86, in a footnote, with our comments added) are:

1. Skull "low-domed" and smooth. Skull is also relatively smooth in many other akodonts. The ratio of skull depth to length might provide a measure of "low-domed," however we have not assembled measurements to test this quantitatively.
2. Rostrum long and narrow. The rostrum is quite broad in *Lenoxus* and heavier in large than in small species of *Oxymycterus*. The proportional length of rostrum (RL/skull length) for oxymycterines ranges from 33.9 (*Geoxus*) to 44.0 (*Oxymycterus paramensis*), however this ratio is 37.4 in *Akodon torques*. *Microxus mimus* is in the "oxymycterine" range.
3. Nasals and premaxillaries together projecting as a tube beyond incisors. The degree of projection beyond incisors varies among oxymycterine genera and within *Akodon*. *Oxymycterus* is most extreme and only in this genus have the dorsally flared or trumpetlike nasals developed. Within *Oxymycterus* different degrees of flaring occur, from scarcely evident to prominent. We have noted small prenasal ossifications (fig. 2, left; fig. 7A) in at least eight specimens of *Oxymycterus* that still have tissue adhering to the tip of the nasals, and prenasal ossifications seem to be present in the photo of *Blarinomys* (Matson and Abravaya, 1977). Other oxymycterines should be examined for prenasal ossifications and their development, structure, and chemical composition should be studied. No *Podoxomys* or *Microxus* skull that we have examined has tissue adhering to tip of nasals that could be examined.
4. Zygomata weak but complete, low, and hardly spreading wider than braincase. The degree of weakness and lowness varies among oxymycterine genera and among species of *Akodon* so that there is some overlap between these two groups.
5. Zygomatic plate "degenerate" and sloping "backward and outward" (fig. 3), its greatest anteroposterior width less than half interorbital breadth.
6. "Interorbital region rounded." At constriction, the region is somewhat flattened near the midline, then curves fairly uniformly downward onto the sides. Posterior to the constriction, the curvature downward is more abrupt or angular. A slight tendency for the temporal ridge to grade into supraorbital angularity in *Oxymycterus inca* is less than in most other akodonts. Supraorbital beading among akodonts is best developed in *Bolomys lasiurus*.
7. Interorbital "breadth more than greatest width of rostrum." This is true also of some other akodonts and is not true of some *Oxymycterus*. For example, in some *O. inca* these breadths are about the same.
8. Antorbital foramen "with slight dorsal excision."
9. "Antorbital bridge short, narrow, with strong downward deflection."
10. "Dorsal and lateral frontal sinuses well inflated." More so than in most other akodonts, but inflation is noticeable also in *Akodon* (*Chroeomys*) *jelskii*, *A. torques*, and *Abrothrix longipilis*.
11. Incisive foramina elongate, extending behind anterior plane of M1. Foramina are most elongate in *Podoxymys* and *Oxymycterus* and barely reach the level of M1 in *Geoxus* and in *Lenoxus* (in

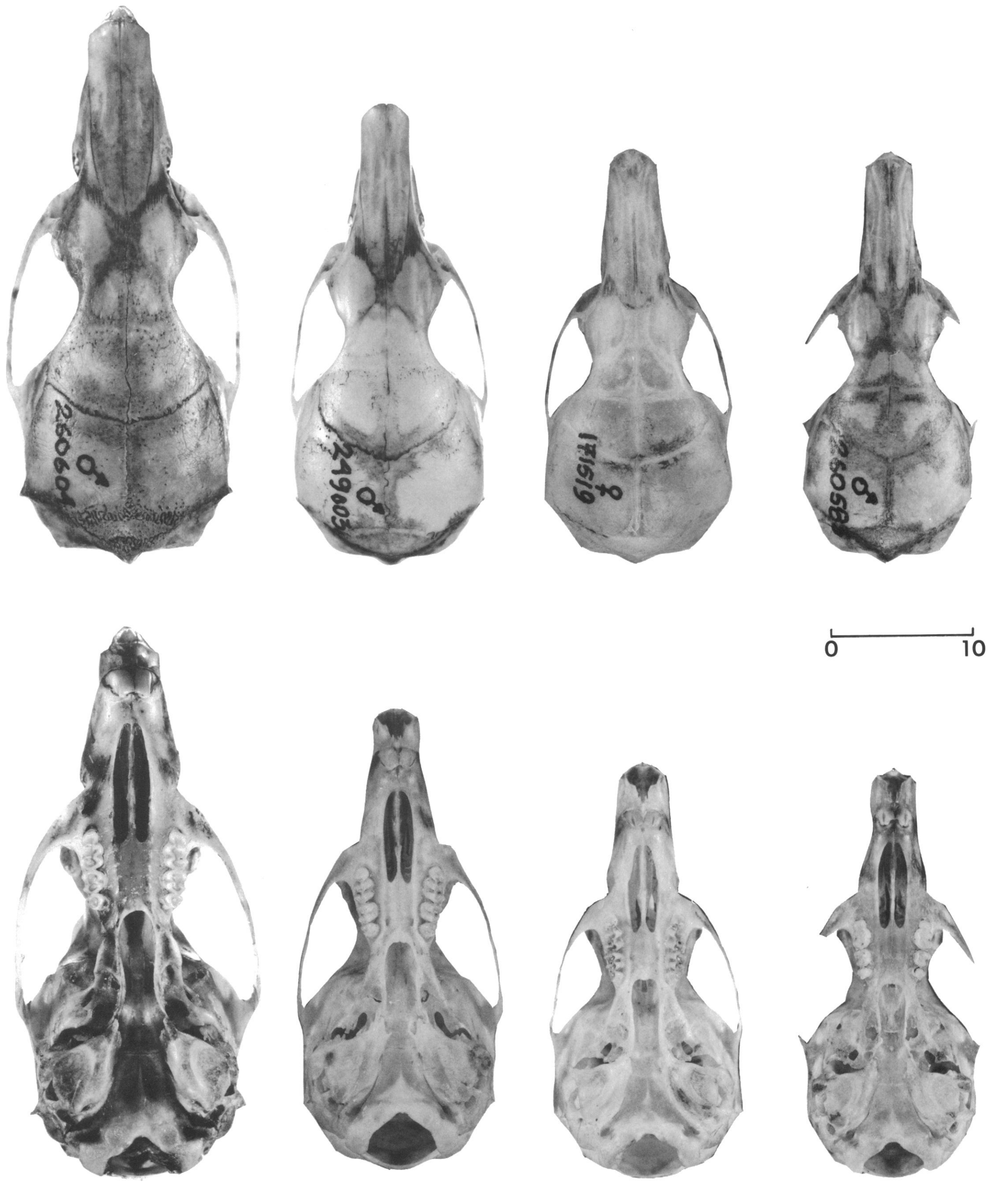

Fig. 2. Dorsal and ventral views of skulls of four species of *Oxymycterus*, from left to right, *O. inca*, *O. paramensis*, *O. hiska*, and *O. hucucha*. Scale in millimeters.

which they are broadest). Foramina are long in all akodonts, except *Notiomys*.

12. "Interparietal reduced." This is true of akodonts generally. Interparietal is very small in *Microxus* and *Podoxymys*, in fact it is not visible in one of two skulls examined. Whether this has resulted from failure to develop or from fusion is not clear.

13. Palate "long" (i.e., "with median pos-

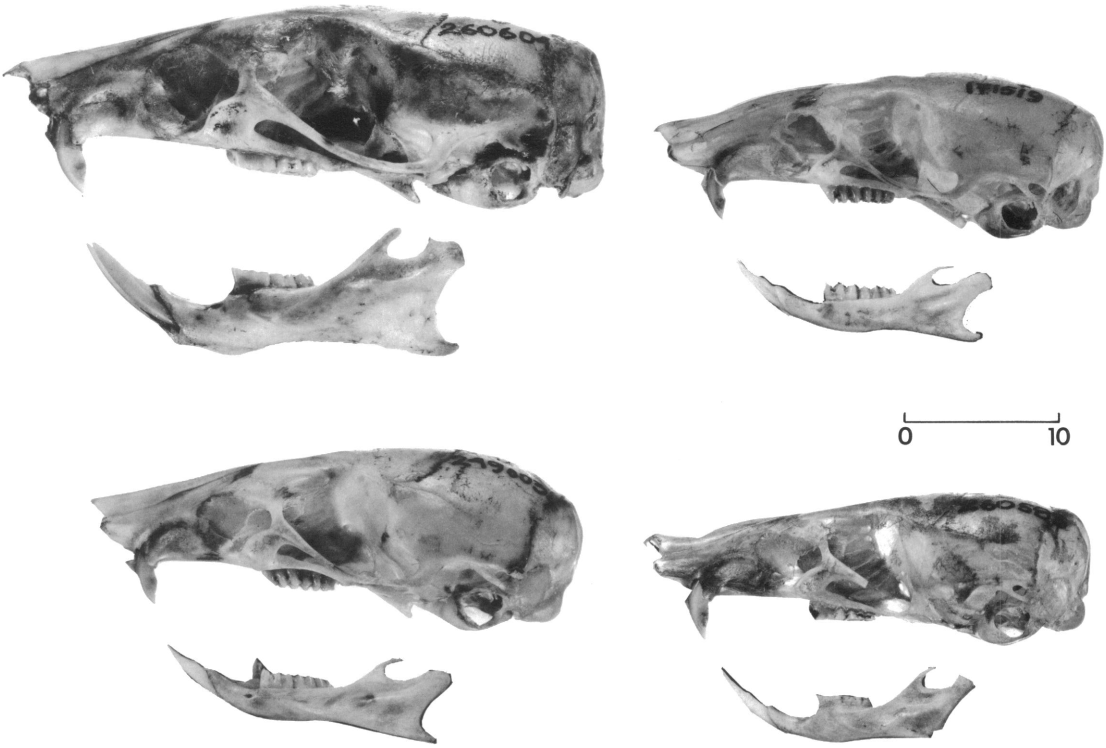

Fig. 3. Lateral views of crania and dentaries of the same four specimens of *Oxymycterus* shown in fig. 2; *O. inca* at upper left, *O. paramensis* at lower left, *O. hiska* at upper right, and *O. hucucha* at lower right. Scale in millimeters.

terior borders of palatines extending behind posterior plane of third molars," Hershkovitz, 1962: 55). It is shorter in *Podoxymys* and *Oxymycterus*. The mesopterygoid fossa does not extend to between M3s in any akodont.

14. Palate "wide" (i.e., "with distance between inner borders of first molars less than length of first molar," Hershkovitz, 1962). The palate is very wide, as are most parts of the skull, in *Blarinomys*. A wide palate is general among akodonts.
15. Palate "relatively uncomplicated" (see Hershkovitz, 1962: 55, for his concepts of palate length, width, and complexity). This also is general among akodonts.
16. "Mesopterygoid fossa broad and wider than parapterygoid fossa measured at base of hamular processes." This is true of akodonts generally although in *Geoxus* and some species of *Akodon* the mesopterygoid fossa is relatively narrower. The narrowing of the parapterygoid fossa is greatest in *Bolomys lasiurus*. The mesopterygoid fossa is especially broad in *Lenoxus*.
17. "Parapterygoid fossa shallow." This trait is shared with most phyllotines (see Olds and Anderson, in press) as well as with other akodonts.
18. "Sphenopalatine fissures or vacuities small or absent." True of some *Akodon* but not of others. The fissures are larger in *Bolomys lasiurus, Chelemys, Notiomys, Akodon* (*Chroeomys*), *Akodon* (*Abrothrix*), and *Geoxus*.
19. "Mandible weak, elongate, angle longer than high." Angular process relatively long and slender as is entire dentary (see fig. 3), which seems most slender in *Podoxomys*; a bit less slender in *Oxymycterus, Lenoxus, Geoxus,* and *Microxus*; and much less slender in *Akodon*. The condition in *Microxus mimus* is approached by *A. torques* and *A. orophilus*.

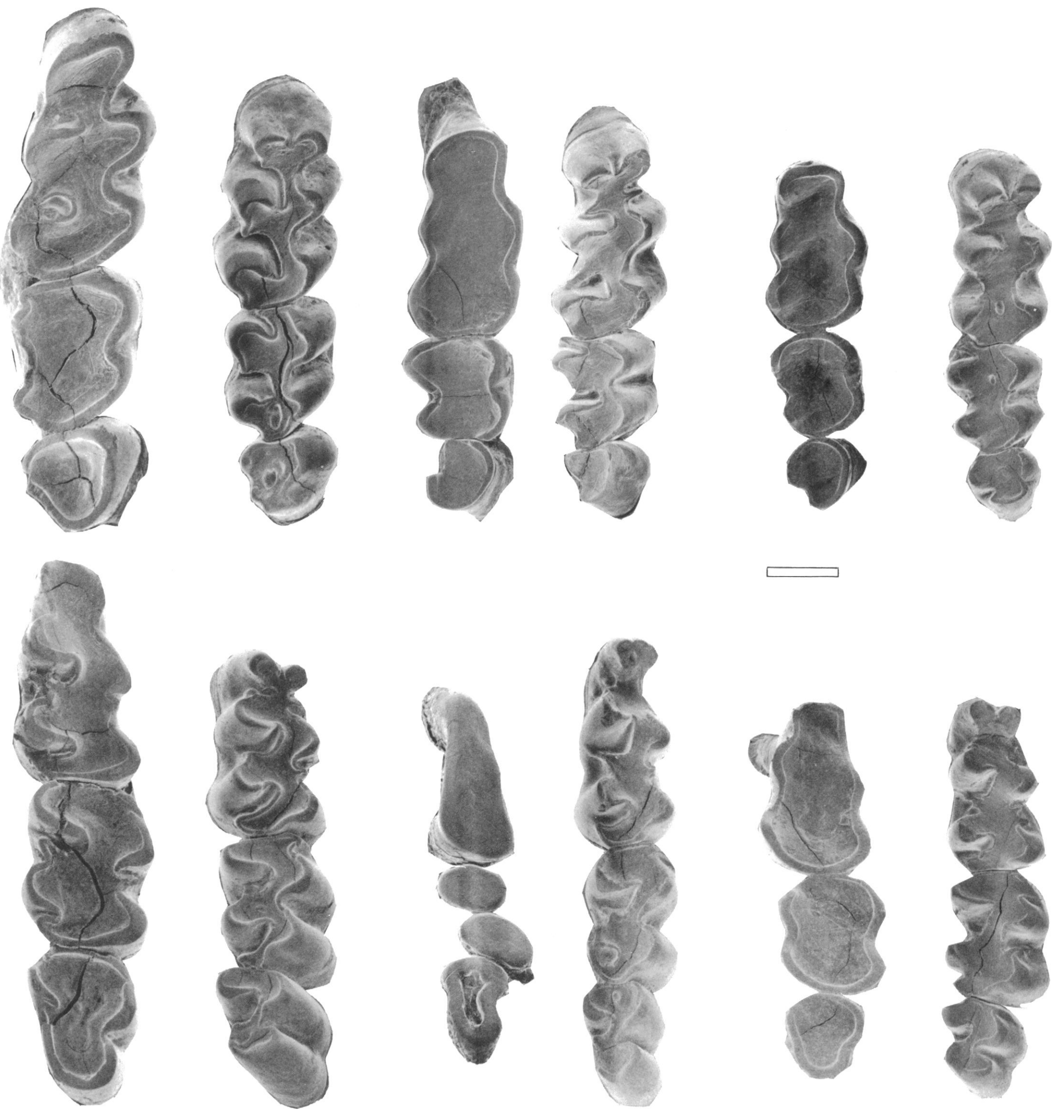

Fig. 4. Photographs of molar toothrows of the four specimens of *Oxymycterus* shown in fig. 2 and a young individual of *O. hucucha*; top row upper right teeth, bottom row lower right teeth. From left to right, *O. inca, O. paramensis, O. hiska* (old and young), and *O. hucucha* (old and young).

20. "Capsule of [lower] incisor root not forming a projecting tubercle" (also visible in fig. 3). This contrasts with the distinct tubercle of most *Akodon,* and is correlated with characters 19 and 21. A weak tubercle is present in *Geoxus*.
21. "Incisors weak." They are relatively narrow. Some species of *Akodon* also have weak incisors, including *A. boliviensis, A. torques, A. subfuscus, A. orophilus,* and *A. orientalis.*
22. Upper incisors "short and opisthodont" (see fig. 3). True in comparison to those of most *Akodon. Akodon* (*Abrothrix*), *Microxus,* and *Geoxus* are about equally opisthodont.
23. Lower incisors "slender and pointed." Slender presumably has about the same

meaning as weak under 21 above. Some *Akodon* have pointed lower incisors, but often the tip is blunter or slightly squared. There is an average difference from *Akodon* in this character but some overlap in length-to-width ratios of the exposed parts of the teeth.

24. Incisors "pale" (yellowish). This differs also on the average in comparison with *Akodon*. In *A.* (*Chroeomys*) these teeth seem as pale as in the oxymycterines, but in most *Akodon* they are more reddish-orange.
25. "Molars small" (largest and width-to-length ratio greatest in *Lenoxus*). This is true of akodonts generally.
26. Molars "hypsodont." Crowns are relatively high prior to wear. This is true of akodonts generally, but perhaps a bit more extreme on the average in oxymycterines. This needs critical quantitative verification.
27. Upper molars "crested to terraced" (for descriptions of these and other occlusal wear conditions see Hershkovitz, 1962: 87). True but not diagnostic since a similar range of tooth wear forms occurs among phyllotines.
28. Upper molars "tetralophodont," becoming "bilophodont or 8-shaped" with wear (fig. 4). Or, M3 becoming a simple rounded lake. Only M2 is truly tetralophodont; other characters apply to akodonts generally.
29. "M2 longer than wide." This is true also of some *Akodon*, but there is a generally more elongate tooth row (length to width of teeth, not relative to length of skull) than in *Akodon*.

Most of these 29 characters seem true in some regard after restudy. However some are true not only of the oxymycterines but of the larger group, the tribe Akodontini, and so do not serve to diagnose the oxymycterine subgroup. Some characters need qualification or differ only on the average between oxymycterines and other akodontines.

The subgenus *Abrothrix*, as represented by its type species *Akodon* (*Abrothrix*) *longipilis*, shows a few oxymycterine-like characters (2, 3, 6, and 11) and a slight tendency in that direction in a few others (1, 5, and 8), but most characters (4, 7, 9, 10, 19–22) are *Akodon*-like rather than oxymycterine. Other characters (12–18, 23–29 among the 29 listed above) are those of akodonts in general (oxymycterines included, or at least of oxymycterines and some species of *Akodon*), or of even larger groups.

Many of the characters can be grouped in character complexes; perhaps most relate to one complex of specializations for feeding on invertebrates. Thus convergence or polyphyly seem more plausible than they would if the characters were less functionally correlated. The hypothesis that oxymycterines are monophyletic is weakly supported by the morphological evidence at this time. Polyphyly certainly cannot be ruled out. Other characters should be studied to test these hypotheses. In contrast, the electrophoretic data noted below support a hypothesis of polyphyly.

An electrophoretic analysis (see fig. 5 and Appendix for species names and other data) comparing three genera of oxymycterines (*Lenoxus, Microxus,* and *Oxymycterus*) to other akodontines (including three species of *Akodon* and *Bolomys amoenus*) was undertaken as a partial assessment of phyletic relationships within and among these taxa. A more detailed analysis will be published elsewhere, but the following summary pertains to the question of the oxymycterines as a definable group.

Ninety-three alleles, or electromorphs, for 28 genetic loci were distinguished. Of these, 43 are unique to single taxa and 5 are shared by all. *Lenoxus* is the most strongly differentiated taxon, possessing unique alleles at 14 of the 28 loci examined. Each of the two species of *Oxymycterus* has six unique alleles, while *Microxus* has but two, and no species of *Akodon* or *Bolomys* has more than four. The remaining 45 alleles are phylogenetically informative, being variably distributed among the eight species and five genera examined. The two *Oxymycterus* share electromorphs at three loci (ICD-1, NADH-DH, and ME-2); *Oxymycterus* and *Lenoxus* are linked by but a single allele at the LGG locus. However, none of these 45 electromorphs are shared by the three genera *Oxymycterus, Lenoxus,* and *Microxus*, but *Microxus* shares alleles at six loci with *Akodon* and *Bolomys.* On this

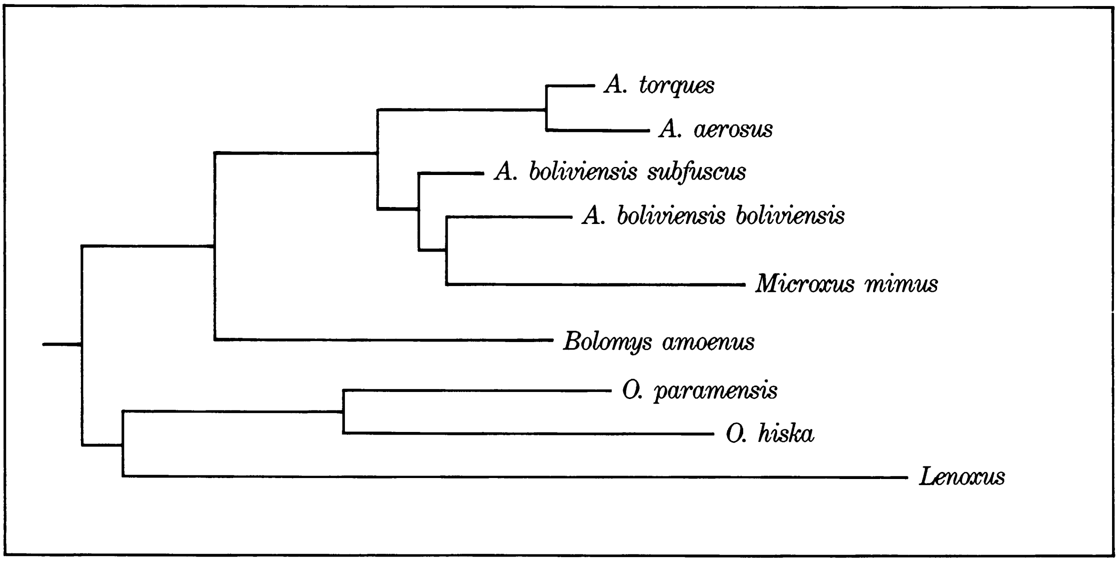

Fig. 5. Minimal length electromorph character tree rooted by designating *Oxymycterus* and *Lenoxus* as an outgroup. The branch lengths are proportional to the number of character state changes along each. Total length = 104; consistency index = 0.779.

basis, *Microxus* does not appear to be aligned closely with either *Lenoxus* or *Oxymycterus*; rather, it is closer to *Akodon* and *Bolomys*.

These data were examined further by the PAUP computer program (Swofford, 1985), with each allele, or allelic combination, at individual loci considered as a character state (following the approach recommended by Miyamoto, 1983, and Buth, 1984). PAUP builds minimum-length trees when outgroup taxa are identified a priori. In the present case, however, it was not possible to specify a clade composed of the oxymycterine genera *Oxymycterus, Lenoxus,* and *Microxus* as opposed to one of *Akodon* and *Bolomys*; *Microxus* is consistently linked to the latter taxa in all trees. It is possible, however, to specify a tree with *Oxymycterus* and *Lenoxus* as sister-taxa separable from a clade comprised of *Bolomys, Akodon,* and *Microxus* (fig. 5).

The linkage of *Microxus* with *Akodon* (in the strict sense) is also supported by the few available chromosomal data. *Oxymycterus* species are generally characterized by moderately high diploid numbers (2n = 54) with uniform karyotypes (Gardner and Patton, 1976; Vitullo et al., 1986). The karyotypes of most other oxymycterines are unknown, but *Microxus* shares a chromosomal complement with a diploid number of 24 and with 40 chromosomal arms (FN) with several species of *Akodon,* including *aerosus, albiventer, boliviensis,* and *varius* (Gardner and Patton, 1976).

While the remaining oxymycterine genera need to be examined chromosomally and electrophoretically, the data at hand do not support Hershkovitz's oxymycterine group as a monophyletic lineage, at least with regard to the inclusion of *Microxus*.

Genus *Oxymycterus* Waterhouse, 1837

Type Species: *Mus nasutus* Waterhouse, 1837.

Diagnosis: Oxymycterine akodont rodents modified for fossorial habits by having relatively strong feet and claws, those of front feet being especially long, curved, and sturdy; unguis of pollex a pointed claw rather than a blunt wide nail; manal D5 short, pedal D1 and D5 relatively short; midregion of skull including pterygoids relatively elongated and thus palatal area and molars more anteriorly placed relative to other parts of the skull. (Molars relatively more elongate and cusps higher, but more detailed measurement and study needed, differences here being matters of degree.)

DISCUSSION: The diagnosis is based on the analysis of characters 30–68 as given below. Some of these characters (34–36, 50, 51) are included in the above diagnosis. However some are duplications, many belong to correlated complexes of characters, and some are diagnostic at a higher level than the genus. The major correlated complex of characters includes rostral elongation (40, 45), distinctive zygomatic modifications (48, 49), and slenderness of dentaries (55) and teeth generally (59). This complex is not diagnostic of *Oxymycterus* but of the oxymycterine group of genera. These genera differ in the degree to which these several trends have developed. Examples of duplications or high correlations of characters in the list include 2 and 44, 3 and 45, 5 and 51, 11 and 53, 12 and 58, 13 and 52, 17 and 57, 19 and 55, 25 and 59, 29 and 61, 31 and 34. Four other characters (21–23, 68) are about the same also.

The taxonomic history of the genus was summarized by Tate (1932). The content of the genus has changed through the decades with the discovery and addition of new species, the synonymizing of some previously described species, the removal of some species to separate new genera (*Lenoxus, Microxus, Blarinomys*), and reassignment of some species to other already recognized genera. Reasons for changes have often been documented scantily or not at all. *Oxymycterus* has not been comprehensively revised. The most useful general treatments of the genus were those of Gyldenstolpe (1932), Tate (1932), Ellerman (1941), and Cabrera (1961). Characteristics of *Oxymycterus* (from Gyldenstolpe and Ellerman, with our comments added) have been given as follows:

The numbering sequence begun in the oxymycterine-group account above will be continued here, for convenience in cross referencing.

External characters:

30. Rather large size. This is no longer true, as new species are small. Head and body length of adults ranges from 114 to 186 mm.
31. Modified for fossorial life, though less so than *Geoxus* or *Blarinomys*. We assume that this refers chiefly to the strong front feet and claws (as in number 34).
32. Tail moderately to poorly haired and with annulations visible. This is true of most Sigmodontinae.
33. Tail shorter than head and body. Within the oxymycterine group it ranges from about 28 percent in some *Blarinomys* and 34 percent in *Geoxus* to 125 percent in some individuals of *Lenoxus*. Within *Oxymycterus* it ranges from about 63 to 93 percent.
34. Front claws long and pointed. The pollex has a narrow pointed claw. Hind claws are also long and curved but less so than on front feet. In figure 6, note long and strong claws and clawed pollex in *Oxymycterus*, long and slender claws and shorter claw of pollex in *Podoxomys*, relatively shorter and weaker claws and blunt unguis of pollex in *Microxus*, short and strong claws and blunt unguis of pollex in *Lenoxus*, and claws shorter than those of any of the oxymycterines in *Akodon varius* (although in relation to size the claws are not shorter than in *Lenoxus*).
35. Manal D5 strongly reduced. More so in *Oxymycterus* than in other genera (see fig. 6).
36. Pedal D1 and D5 much shorter than other three. Comment same as for 35.
37. Fur "long and fairly soft" or "usually not thick." It is longest and thickest in *Oxymycterus paramensis paramensis* of higher elevations. Length of middorsal hair ranges from about 6 to 13 mm.
38. Ear small to medium. Ear length ranges from about 16 to 22 mm. Among oxymycterines, *Blarinomys* and *Geoxus* have the shortest ears.
39. Snout long and mobile. This is more or less true of all oxymycterines, but the details of anatomy and function have not been studied.

Cranial characters:

40. Skull long and narrow. As in *Podoxymys, Geoxus,* and *Microxus,* but more so;

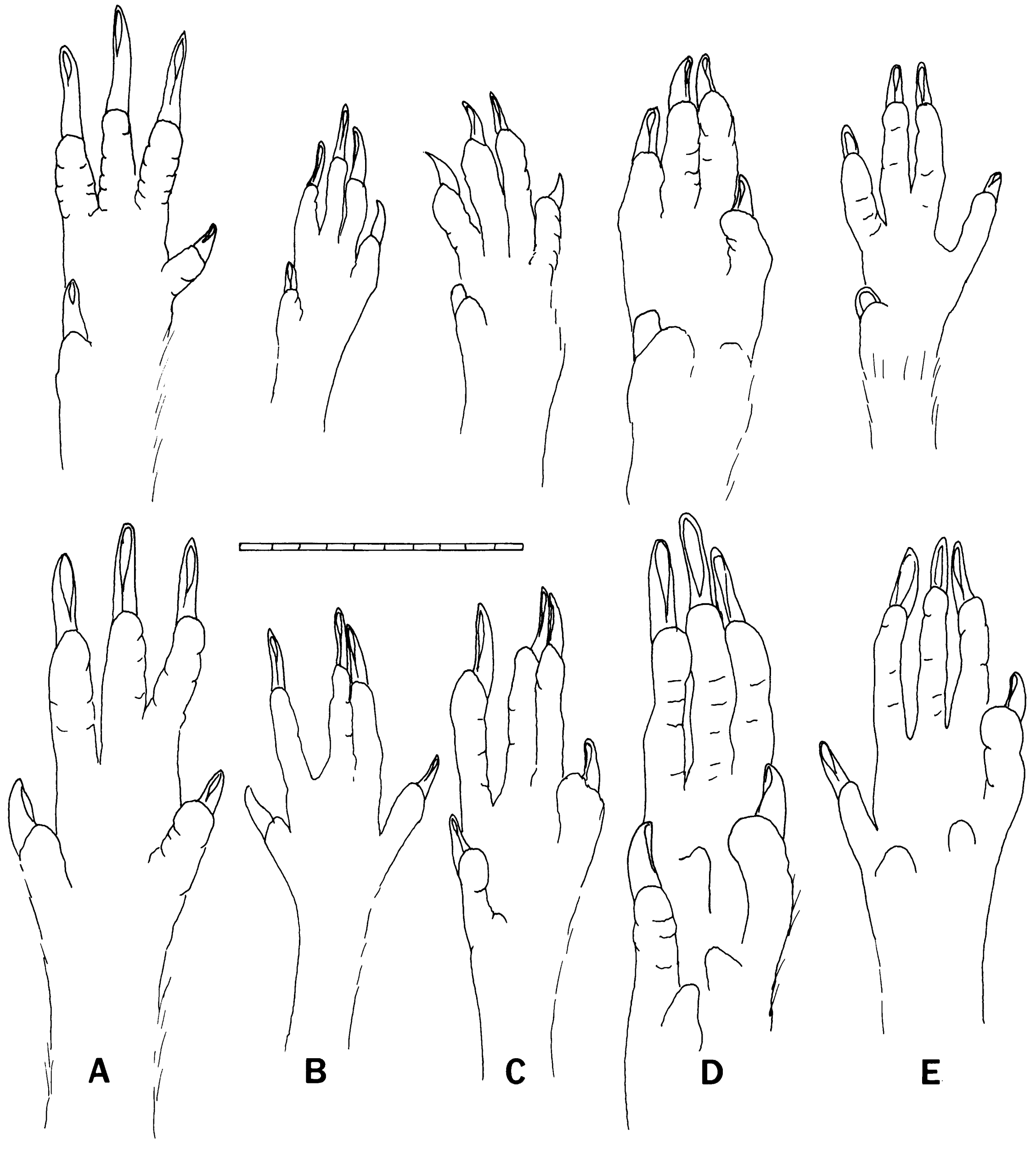

Fig. 6. Feet of four genera of oxymycterines and one other akodont, front feet above, hind feet below, scale represents 10 mm. **A.** *Oxymycterus inca* (AMNH 260604), **B.** *Podoxymys roraimi* (AMNH 75585), **C.** *Microxus mimus* (AMNH 246709), **D.** *Lenoxus apicalis* (AMNH 72607), and **E.** *Akodon varius* (AMNH 260465). Drawn from dried specimens with a camera lucida by Flavio Hinojosa.

Lenoxus and *Blarinomys* have relatively broader skulls.

41. Interorbital region broad and unconstricted (Ellerman) or narrow (Gyldenstolpe). Broad and narrow are relative terms and without measurements or comparisons they do not mean much.
42. Supraorbital area unridged, evenly rounded. As in other oxymycterines, see character 6.

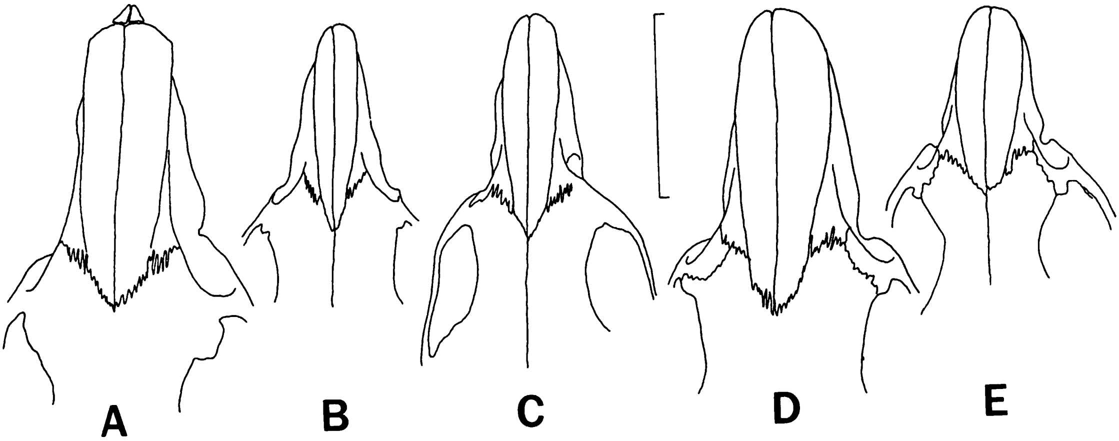

Fig. 7. Rostral parts of skulls of the five specimens used for fig. 6. The relatively long posterior projection of the nasals of the four oxymycterines is noticeable.

43. Braincase large, smooth, rounded. See character 1.
44. Rostrum long and narrow. Noted also as character 2. This distinguishes *Oxymycterus* from *Lenoxus* and *Blarinomys* but not from *Microxus, Geoxus,* and *Podoxymys.*
45. Nasals expanded, project forward over incisors, and join premaxillaries to form trumpetlike tube. As in other oxymycterines, but less extremely so in *Microxus.* Same as character 3.
46. Nasal opening relatively high. We presume that this refers to the upward flaring of the nasals visible in figure 3. Perhaps more extreme than in other oxymycterine genera.
47. Nasals extend behind premaxillary–maxillary suture. This occurs in oxymycterines (see fig. 7) and also in some other akodonts.
48. Zygomatic plate low and rarely very slightly angular, slants backward from maxillary origin, is visible from above, and has its superior border rounded. Same as character 5, true of oxymycterines generally.
49. Infraorbital foramen well open. We presume that this means not much narrowed ventrally and relatively large for size of skull. This is correlated with narrowing of zygomatic plate and other characters (4, 5, and 48).
50. Pterygoid fossae long. This part of the skull (see fig. 2) is relatively more elongate than in other genera and this elongation contributes to the position of toothrows noted as the following character.
51. Toothrow relatively far forward on skull (also visible in fig. 2).
52. Palate extends about to the (back of the) last molars. Same as character 13.
53. Incisive foramina long and open and extend as far as the anterior end of maxillary toothrows or even to the middle of M1 (see fig. 2). Same as character 11.
54. Bullae not enlarged. Nor are they in other oxymycterines.
55. Mandible has a relatively low coronoid process. Correlated with general slenderness of dentary, character 19.
56. Mesopterygoid fossa broad and almost parallel sided. This fossa is narrower than in *Lenoxus* and *Blarinomys,* and broader than in *Microxus* and *Podoxymys.* See also character 16.
57. Parapterygoid fossa narrow and "fairly deep." This is true of other oxymycterines. The depth of the fossa was said to be shallow by Hershkovitz (see character 17).
58. Interparietal well developed. This is true in comparison with *Microxus, Podoxymys,* and *Blarinomys.* Interparietal is about the same relative size in *Lenoxus.* The akodont group has relatively small interparietals. Same as character 12.

Dental characters:

59. Molars relatively weak, long, and narrow. True of akodonts generally. Same as character 25. This elongation may be more extreme in *Oxymycterus* than in other genera of oxymycterines. A detailed study of the proportions of teeth to test this idea would be interesting.
60. Molar cusps high with clear traces of subsidiary ridges in the main outer folds [see fig. 4; these are illustrated as mesoloph(id) or mesostyl(id) by Hershkovitz, 1962: 79]. True of akodonts generally. See character 26 also. Teeth wear to leave a simple indented surface.
61. M3 reduced. This is relative to the somewhat elongated M1 and M2, as in character 29.
62. General tooth pattern is of *Akodont* type. This involves several characters listed separately, including 25–28, 35, 59, and 60.
63. Unworn lower molars are complex, in adults traces of subsidiary ridges are often retained in main inner and outer folds (see fig. 4 and Hershkovitz, 1962).
64. Posterointernal heels (of m1 and m2) are well developed. These are the posterolophids of Hershkovitz, 1962: 71. This is true, but seems also to be true of *Microxus, Lenoxus,* and *Akodon.* The development is less in *Podoxymys.*
65. m1 has six cusps. Same comment as for 64. *Podoxymys* has an undivided anterior cusp and thus five instead of six.
66. m2 has four cusps "as usual." True of akodonts generally.
67. m3 medium size, its pattern like that of m2. The likeness is general, but m2 is more complex. True of akodonts generally.
68. Incisors weak, slender, and ungrooved. True of oxymycterines generally, not *Oxymycterus* alone. See characters 21, 22, and 23.

DESCRIPTIONS OF TWO NEW SPECIES

Oxymycterus hiska, new species

HOLOTYPE: 171519, MVZ; skin, skull, body in alcohol of an old (see tooth wear in fig. 4) nulliparous female; obtained by James L. Patton, field number 12257, on 5 August 1985.

OTHER SPECIMENS: Five from the same locality.

TYPE LOCALITY: 14 km W of Yanahuaya, department of Puno, Peru, at 2210 m elev.; lat. 14°19'S and long. 69°21'W.

DISTRIBUTION: Known only from the type locality.

DIAGNOSIS: An *Oxymycterus* distinguishable from all previously described species by smaller size (see table 1) and pelage shorter and finer than in these larger species. See the following description of a second small species for other diagnostic differences.

COMPARISONS: Included in diagnosis and in following description.

GENERAL CHARACTERS: For size see table 1. Pelage is blackish, as are caudal scales and skin on dorsal and palmar surfaces of pes. Hairs on chin are paler than surrounding hairs (a feature present also in the following species, and more noticeably as a white spot in some *Microxus mimus*).

HABITAT AND HABITS: Specimens were taken near Abra Marracunca on the ridge separating the drainages of the Rio Huari Huari and the Rio Tambopata. The habitat is considered "bosque muy humedo montano bajo" (under the Holdridge system, Tosi, 1960), dominated by epiphyte-laden trees, cecropias, bamboos, and tree ferns. Specimens were caught in mossy runways on the ground, under logs, or around tree root masses. This area is being rapidly deforested as a result of clearing for homesteads, farm patches, and cattle grazing.

Stomach contents of two individuals contained only parts of insect exoskeletons. All specimens were obtained in late July or early August; none were in breeding condition, but adult females showed signs of recent reproductive activity, and the two subadults in the sample suggest a breeding season at the end of the rainy season (March or April). Other akodonts collected at this locality were *Microxus mimus, Akodon aerosus,* and *Lenoxus apicalis.*

ETYMOLOGY: The name *hiska* is the Aymaran word meaning "small." This language is spoken in the area in which this new small mouse was discovered.

Oxymycterus hucucha, new species

HOLOTYPE: 260583, AMNH; skin, skeleton, tissues in liquid nitrogen (NK 12028, at the University of New Mexico) of an old adult male; prepared by S. Anderson, field number 8176, on 4 September, 1984.

OTHER SPECIMENS: 119948, MVZ, and 246721, AMNH.

TYPE LOCALITY: 28 km by road W of Comarapa (Santa Cruz) but in the department of Cochabamba, Bolivia, at 2800 m elev.; lat. 17°51′S and long. 64°40′W.

DISTRIBUTION: Known only from at and near the type locality. The second specimen recognized as belonging to this species is from a locality designated as 20 mi E of Totora, which the fieldnotes of the collector, O. P. Pearson, describe as "up the hill [from Comarapa] to the summit where cloud forest is dankest on the ridge where all is forest to the north and northeast," and thus at or near the type locality. The third specimen is also from the Siberia Cloud Forest at a place (along the same road and a short distance westward from the type locality) designated as 101 km by road W of Epizana, at 2989 m (17°48′S, 64°45′W).

DIAGNOSIS: An *Oxymycterus* distinguishable from all other species by smaller size, much smaller than all except *O. hiska,* slightly smaller than *O. hiska* (see table 1); differs from *O. hiska* also in relatively narrower skull, including rostrum, interorbital constriction, and braincase; smaller teeth and bullae; longer palate (posterior margin of incisive alveoli extends less posteriorly and margin of mesopterygoid fossa extends less anteriorly); nasals flaring more noticeably upward at the very tip and projecting farther beyond the premaxillaries; parapterygoid fossa slightly narrower and more fenestrated; upper incisors less opisthodont; and zygomatic plates (see side view) less depressed ventrally.

COMPARISONS: Slightly smaller than *O. hiska,* tips of dorsal hairs more conspicuous, paler, and more reddish. In color resembling young of some *O. inca,* however, these have much larger feet. Some hairs of digits of pes reach to ends of the claws, unlike the shorter hairs of *O. hiska.*

HABITAT: The holotype was captured on the ground in the cloud forest of Siberia. The habitat of the second specimen was described by O. P. Pearson as cloud forest with "... moss covered with lots of sphagnum, orchids, fuchsias, etc. Ground in many places with lycopodia, vaccinium, etc." This description fits the type locality also. The habitat of the third specimen was noted on the skin label as "cloud forest, 6 m tree height, tree trunks covered with lichens, 100 percent ground cover of lichens, ferns, mushrooms." Other such areas are scattered in central Bolivia among a great variety of other types of climatic areas. Ridges and valleys in profusion here along the eastern flanks of the Andes interact with prevailing winds, seasonal changes, and precipitation to provide arid cactus-clad valley floors, grassland patches, scrublands, and forests of various types, often in close proximity. This region is known as "los valles" and the forested slopes between about 400 and 3000 m are known as "las yungas." Biotic diversity is certainly as complex as the topography and local climates. This fascinating diversity offers challenges for several generations of scientific naturalists.

ETYMOLOGY: The name *hucucha* is the Quechuan word for mouse. Quechuan, the language of the Inca Empire, is spoken in the area where this new species of mouse was discovered.

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APPENDIX

Specimens examined electrophoretically were:

Oxymycterus paramensis: PERU: Depto. Cusco; 55 km (by road) N of Calca, 3560 m [N = 2, Univ. Michigan Museum of Zoology].

Oxymycterus hiska: PERU: Depto. Puno; 14 km (by road) W of Yanahuaya, 2210 m [N = 3, MVZ].

Lenoxus apicalis: PERU: Depto. Puno; 14 km (by road) W of Yanahuaya, 2210 m [N = 6, MVZ].

Microxus mimus: PERU: Depto. Cusco; Agualani, 9 km N Limbani, 2840 m [N = 7, MVZ]; 14 km (by road) W of Yanahuaya, 2210 m [N = 2, MVZ].

Akodon aerosus: PERU: Depto. Cusco; 72 km (by road) NE of Paucartambo, 1460 m [N = 28, MVZ]. Depto. Puno; 14 km (by road) W of Yanahuaya, 2210 m [N = 5, MVZ].

Akodon boliviensis: PERU: Depto. Cusco; Tres Cruces, 32 km (by road) NE of Paucartambo, 3140 m [N = 10, MVZ]; 20 km (by road) N of Paucartambo, 3480 m [N = 10, MVZ]; 5 km E Huancarani, 3870 m [N = 10, MVZ]. Depto. Puno; 12 km S Santa Rosa [de Ayaviri], 3960 m [N = 25, MVZ].

Akodon torques: PERU: Depto. Cusco; Abra Malaga, 90 km (by road) SE of Quillambamba, 3560 m [N = 13, MVZ]; Tres Cruces, 32 km (by road) NE of Paucartambo, 3140 m [N = 20, MVZ].

Bolomys amoenus: PERU: Depto. Cusco; 20 km (by road) N of Paucartambo, 3580 m [N = 1, MVZ].

Specimens in figures or tables are:

Akodon varius: AMNH 260465 (drawings of skull and feet), BOLIVIA: Depto. Santa Cruz; 1 km N and 8 km W of Comarapa, 2450 m.

Lenoxus apicalis: AMNH 72607 (drawings of skull and feet), BOLIVIA: Depto. La Paz; Ñequejahuira, 2450 m.

Microxus mimus: AMNH 246709 (drawings of skull and feet), BOLIVIA: Depto. Cochabamba; 101 km by road SE of Epizana, Siberia Cloud Forest, 2989 m.

Oxymycterus hiska: MVZ 171519 (table, skull photo, teeth), holotype; MVZ 171518 (table, teeth), paratype.

Oxymycterus hucucha: AMNH 260583 (table, skull photo, teeth), holotype; AMNH 246721 (table, teeth), BOLIVIA: Depto. Cochabamba; 101 km by road SE of Epizana, Siberia Cloud Forest, 2989 m; MVZ 119948 (table), BOLIVIA: Depto. Cochabamba; 20 mi E of Totora, 2960 m.

Oxymycterus inca iris: AMNH 260604 (table, feet, and skull drawings, skull and teeth photos), BOLIVIA: Depto. Santa Cruz; Estancia Cachuela Esperanza, 300 m.

Oxymycterus paramensis paramensis: AMNH 249003 (table, feet, and skull photos), BOLIVIA: Depto. La Paz; Caracato, 2900 m.

Podoxymys roraimi: AMNH 75585 (drawings of skull and feet), BRASIL: Estado Roraima; summit of Mt. Roraima, 2800 m.