the femora piceous beneath; the prothorax and elytra sparsely ciliate at the sides, and also with scattered, shorter, semierect, yellowish-cinereous hairs, which are serially arranged on the elytra. Head coarsely granulate; prothorax nearly twice as broad as long, feebly rounded at the sides, slightly narrowed in front, the surface densely covered with small, flattened, subtriangular elevations, these being sometimes absent from a smooth narrow line on the anterior half of the disc; elytra short-oval, widest about the middle, obliquely narrowed behind, densely covered with small flattened triangular elevations, which are more raised and granular towards the apex; beneath densely granulate and sparsely pubescent.

Length $2\frac{3}{4}$ - $3\frac{1}{4}$, breadth $1\frac{2}{3}$ - $1\frac{3}{4}$ millim.

Many specimens. Closely allied to the European A. rufus, Luc. (=rugosus, Rosenh.), but duller, the elytra more obliquely narrowed behind, and with the flattened subtriangular elevations much more crowded, becoming tuberculiform towards the apex.

The other described species of the genus are A. insularis, Reitt., from Corsica, and A. dilatatus, Reitt., from

Astrachan.

LVIII.—A Preliminary Revision of the Bornean Species of the Genus Mus. By Oldfield Thomas.

Considering the great richness in rats and mice which Mr. John Whitehead's exploration of Mount Kina Balu in 1888 showed Borneo to possess, no part of the world has until recently been so badly represented by specimens in scientific collections as that island. Happily, however, in 1893 and 1894, the British Museum acquired from Mr. A. Everett two large collections of Muridæ from Kina Balu and other localities, and it is to these collections that the possibility of making even the present rough revision of the members of this group is due. Mr. Whitehead was the first discoverer, as it turns out, of the majority of the peculiar Bornean species; but the absence at the time of lowland specimens for comparison prevented my recognizing all the new forms when the paper on his collections was written *. Now, however, that Mr. Everett has obtained examples both from high up and low down on Kina Balu, besides sending good series from Labuan, the Penrisen Hills, Palawan, and elsewhere, while Mr. Hose has contributed some from Mounts Dulit and Mulu and the lowlands of Baram, I am enabled to work out the

whole series somewhat more satisfactorily.

But even now it has been found impossible to do more than give a rough synopsis of the species as yet recognized to occur in Borneo, without making any observations on the Murine fauna of the other great East-Indian Islands, where no doubt many of the same species also occur.

Similar or better series will be needed from those islands

before anything of the sort can be attempted.

The characters given in this synopsis are such as may be observed by any one on the spot, with good skins for examination, and do not need any technical knowledge for their recognition beyond the power of distinguishing adult from young specimens. Detailed technical descriptions of the

new species are, of course, appended.

Although it is hoped that the present paper marks an advance on our previous limited knowledge of these animals, yet there is clearly an enormous amount more to be learnt as regards their ranges, vertical and horizontal, their sexual and seasonal differences, and many other points, on most of which we are entirely ignorant. For this purpose we want infinitely more material and that better collected, especially in the form of skins, with perfect skulls, and with the exact localities, altitudes, and flesh-measurements carefully marked on the labels. These remarks, if true of Borneo, are much more so as regards the other great islands of the East Indies, from all of which good material is urgently needed.

Rough Synopsis of the Species of Mus known to occur in Borneo.

1. Mus infraluteus, Thos.

Size very large, form thick and heavy; hind foot about 50 millim.* Tail about equal to head and body, black, short-haired. Fur soft, but with longer harsher bristles intermixed. Colour hoary blackish grey; belly dirty greyish buff, not sharply defined. Hands and feet blackish.

Mount Kina Balu (Whitehead, Everett).

"Tankulom" of Dusuns (Everett).

2. Mus Muelleri, Jent.

Size large, form normal; hind foot about 42 millim. Tail rather longer than head and body, brown, short-haired. Fur

^{*} Measured from heel to tip of longest toe, without claw.

coarse, without spines or longer bristles. Colour coarsely lined black and yellowish. Belly whitish buff, almost or quite without slaty bases to hairs; not sharply defined. Metapodials brown, digits naked. Mammæ 2—2=8.

Metapodials brown, digits naked. Mammæ 2—2=8.

Batang Singalan *, Sumatra (Müller, Leyden Mus.); Sadong, Sarawak (Wallace); Kina Balu, Paitan, and Gomanton Cave, N. Borneo (Everett); Mount Dulit, 2000 feet (Hose); Claudetown (Hose); Labuan (Everett).

3. Mus sabanus, Thos.

Size large; hind foot about 41 millim. Tail much longer than head and body, rather more hairy than in the previous species, its colour variable, more or less bicolor. Fur thinly spinous. Colour coarsely lined rufous, clearing to bright rufous on sides. Belly pure sharply defined white or pale yellow. Centre of metapodials dark brown, their sides and whole of digits white. Mammæ 2—2=8.

Mount Kina Balu (Whitehead, Everett); Mount Dulit, 5000 feet (Hose); Niah Caves, Sarawak (Hose); Bunguran

Island, Natunas (Everett).

4. Mus rajah, sp. n.

Size medium, but feet proportionately very long, so as to be nearly as long as in the last species (circa 39 millim.). Tail about as long as the head and body, thinly haired, bicolor. Fur thickly spinous. Colour varying from isabelline to rufous, in all more rufous on sides. Under surface white, generally sharply defined; a rufous collar in some specimens. Hands and feet white. Mammæ 2—2=8.

Mount Batu Song (Everett); Paitan, N. Borneo (Everett); Kina Balu (Everett); Labuan (Low, Everett); Penrisen Hills, W. Sarawak (Everett); Bunguran Island, Natunas (Everett);

Palawan (Whitehead, Everett).

5. Mus alticola, Thos.

Size medium; hind foot about 32 millim. Tail about equal to head and body, practically naked, bicolor. Fur long, spiny. Colour uniformly bluish grey above, pale yellowish white below; line of demarcation not sharply marked. Feet whitish.

Mount Kina Balu, 8600 feet (Whitehead).

6. Mus ochraceiventer, sp. n.

Proportions and other characters as in last, but fur * The type locality is always put first.

shorter and more spiny, and colour different. Back coarsely grizzled brown and fulvous rufous; belly brilliant fulvous yellow ("ochraceous").

Mount Kina Balu, below 3000 feet (Everett).

7. Mus Whiteheadi, sp. n.

Size small; hind foot about 27 millim. Tail about length of head and body, nearly naked, bicolor. Fur spiny. Colour rufous above, but the tips of the spines wholly brown or black, ochraceous, with slaty bases, below not sharply defined. Hands and feet white; soles slate-coloured. Mammæ 2—2=8. Bullæ small; palatal foramina short. Teeth of normal size.

Kina Balu (Whitehead, Everett); Poeh Mountain (Everett); Penrisen Hills (Everett); Banguey Island (Everett).

"Ahun-Ahun" of Kian Dusuns (Everett).

8. Mus bæodon, sp. n.

Hind foot 25 or 26 millim. Proportions and characters of feet and tail much as in the last species. Fur very spiny. Colour rufous, faintly speckled with yellow; the spines, at least on flanks, with yellow terminal or subterminal rings; belly-hairs wholly whitish buff, not sharply defined. Mammæ 2—2=8. Bullæ and palatal foramina as in Whiteheadi. Teeth very small.

Mount Kina Balu (Everett).

9. Mus Jerdoni, Bly.

Size very variable, some specimens almost as large as *M. rajah* and others as small as *M. ephippium*; hind foot ranging from 25 to 30 millim. Tail very long, considerably longer than the head and body; more hairy than in other species, and finely tufted at the end; uniformly brown in some, partly or wholly bicolor in others. Fur spiny. Colour rich rufous, strongly lined with black along the centre of the back. Belly pure sharply defined white or pale yellow. Upper surfaces of hands and feet with a brown patch on the metapodials, the remainder pure white. Mammæ 2—2=8.

Sikim and other continental localities. Mount Kina Balu (Whitehead, Everett); Mount Dulit (Hose); Niah Coast (Hose); Penrisen Hills (Everett).

"Rapit" of Kian Dusuns (Everett).

[The difference in size between the various specimens re-

ferred to *M. Jerdoni*, even among series from single localities, is so great that it would at first sight appear impossible that they should all belong to one species; but the intergradation seems to be so complete that I have for the present no alternative but to include them all under one name. Larger series will, however, be necessary before a thoroughly sound conclusion can be arrived at.]

10. Mus Margarettæ, Thos.

Size very small; hind foot about 19 millim. (16 in subsp. pusillus). Tail very long, nearly twice the length of the head and body, naked, unicolor brown. Fur soft, spineless. Colour rich rufous, brighter on sides; belly pure white. Hands and feet whitish, but with brown metapodial patches; claws very small; thumb and great toe opposable. Mammæ 1—2=6.

Penrisen Hills (Everett). Subspecies pusillus, Mount Kina Balu (Everett).

11. Mus ephippium, Jent.

Size as in *M. Whiteheadi*. Tail rather longer than head and body, unicolor brown. Fur coarse, rather spiny. Colour dull grey, varying to rufous, especially in very old specimens. Spines white, tipped with dark brown. Belly dirty greyish white, the bases of the hairs grey. Hands and feet white. Mammæ 2—2=8. Bullæ large, palatal foramina long. Teeth normal.

Sumatra (Leyden Museum); Kina Balu (Whitehead, Everett); Labuan (Everett); Kayan Country, Upper Baram River (Hose); Penrisen Hills (Everett); Palawan (Everett).

[Lastly, there remains to be considered the group to which the European house-rats belong, a group which has been the bane of workers on Oriental Muridæ, and which at present, owing to want of material, it is quite impossible to bring into any sort of order. Fortunately, so far as the present paper is concerned, there is a Bornean name available, and this I propose to use for the lowland rats of the group, without expressing any opinion as to their relationship with extra-Bornean species.]

12. Mus neglectus, Jent.

Size of Mus rattus; hind foot about 35-38 millim. Tail ranging from a little shorter to a little longer than the head and body, unicolor dark brown, fairly well haired, but not

tufted. Fur short and harsh, almost or quite spineless. Colour above dark grizzled black and rufous; belly dirty grey, varying to brown, especially on the middle line of the chest. Hands and feet whitish, but their metapodials often dark brown along the centre; sometimes wholly brown. Mammæ 2—3=10 (rarely 3—3=12).

Banjer-massing, S. Borneo (S. Müller); Mount Kina Balu, about 3000 feet (Whitehead, Everett); Labuan (Everett); Mantanani Island (Everett); Baram (Hose); Simanggang, Batam Lupar, Sarawak (Everett); Balabac (Everett).

[In spite of the apparent differences involved in the wording of the above diagnosis, these specimens are all fairly uniform in appearance, and are readily distinguishable from every species hitherto referred to except *M. Muelleri*, to which they have a certain superficial resemblance. Their smaller size and possession of three inguinal pairs of mammæ will, however, always separate them from that animal.

But within the group there is a second Bornean form which I now think it necessary to describe, namely the represen-

tative of M. neglectus from the heights of Kina Balu.]

13. Mus baluensis, sp. n.

Very similar to *M. neglectus* in size, proportions, and colour, but the fur quite long and soft, and the belly of a uniform dirty buffy hue.

Mount Kina Balu, 8000 feet (Whitehead), 7000-10,000

feet (Everett).

Detailed Diagnoses of the New Species.

Mus rajah.

Size medium, but the feet proportionately long. Fur thickly intermixed with spines. No longer bristle-hairs. Colour a dull rufous clay-colour, darker along the back, where the spines are tipped with brown, paler on the sides, where they are white throughout. Belly white, the hairs white to their roots; line of demarcation on sides fairly well defined. Centre of belly in old specimens with a large discoloured patch, apparently due to some glandular exudation. Ears medium, rounded, naked; laid forwards in a spirit-specimen they reach about to the middle of the eye. Upper surface of hands and feet white; the digits almost naked; soles grey, smooth, with the usual six prominent pads; fifth hind toe reaching barely to the base of the fourth. Tail about the

length of the head and body, thinly haired, the scales large and prominent, about eight to the centimetre; bicolor slaty grey above, white below, and commonly at the end all round

for an inch or two; no terminal tuft of hairs.

Skull strongly built, with a broad heavy muzzle. Frontal region remarkably flattened, even concave in old specimens; supraorbital ledges very strongly developed, overhanging the orbits, and forming marked postorbital angles, behind which they run back to the antero-external angles of the interparietals. Anterior edge of interparietal approximately transverse. Plate of zygoma but little developed, its anterior edge vertical. Palatal foramina short, widely open, their posterior limit two or three millim. in front of m. 1.

Teeth rather small in proportion to the size of the skull.

Hind foot of the typical skin (3) 39 millim.

Dimensions of an adult male in spirit (from Paitan, N. Borneo):—

Head and body 196 millim.; tail 196; hind foot * 37.5;

ear 22×16 ; heel to front of last foot-pad 19.5.

Hab. (of type). Mount Batu Song, Baram district, Sarawak. Coll. A. H. Everett, Oct. 1891.

Type: B.M. 92.9.6.15.

M. rajah is the species which I have hitherto looked upon as M. Hellwaldi, Jent., and it is mentioned under this name both in my own papers and in Hose's 'Mammals of Borneo.' I still regard it as closely allied to M. Hellwaldi, which was described from Celebes; but, in view of the entire spinelessness of the three Celebean specimens I have seen, and the uniform spininess of the sixteen Bornean ones before me, of all ages and seasons, I am compelled to consider this character of sufficient constancy to demand the specific distinction of the latter from the former.

Some specimens of this species have a rufous or greyish collar dividing the white of the chin from that of the chest, and this is especially noticeable in immature individuals. Kina Balu examples have this collar at a maximum, but further skins are needed before the local constancy of the character can be proved. An immature specimen from the Penrisen Hills and another from Bunguran both have collars, while other examples from the same localities are without them.

^{*} Although a good typical representative of the ordinary lowland form of *M. rajah*, this specimen has unnaturally swollen and probably shortened feet. The hind foot of another spirit-specimen, from Palawan, is 40 millim.; heel to front of last foot-pad 20.

Mus ochraceiventer.

Proportions and essential characters as in M. alticola, Thos., of which it may be looked upon as the representative at the base of Kina Balu. Fur more spiny and shorter than in alticola, a dorsal spine about 10 as against 16 or 17 millim. in length. The colour above instead of being uniform dark bluish grey is a coarsely speckled fulvous and black, the tips of the spines being black or brown, while those of the hairs are fulvous. Nape and sides of neck more markedly fulvous. Whole of under surface a brilliant and most unusual ochraceous colour, almost exactly matching Ridgway's "tawny ochraceous," and wholly different from the yellowish white of M. alticola. Both spines and hairs are tipped with ochraceous, although their extreme bases are grey, which latter colour is predominant in young specimens. Hands and feet thinly covered on the metapodials with fine white or pale brown hairs; the digits naked. Tail as in alticola, practically naked, slaty grey above, white or yellowish below, the contrast specially marked terminally. Palate-ridges 3-4. Mammæ 2-2=8.

Skull apparently as in *alticola*, except that the palatal foramina are shorter and broader behind, and the anterior edge of the zygomatic plate is nearly vertical, instead of slanting backwards

backwards.

Hind foot of the typical skin (♂) 31.8 millim.

Dimensions of an adult male in spirit:-

Head and body 146 millim.; tail 153; hind foot 31.5; ear 16 × 13.5; heel to front of last foot-pad 15.

Skull: see p. 459.

Hab. Mount Kina Balu, below 3000 feet. Coll. A. Everett, Jan. 1894.

Type: B.M. 94.7.2.27.

A considerable number of this remarkable-looking species were obtained by Mr. Everett's native collectors in January 1894, and although (as in the case of the other Kina Balu specimens brought in by the same men) no trustworthy record of the altitude has been preserved, Mr. Everett informs me that it is practically certain that none of them were collected above 3500 feet.

Considering their close alliance in essential characters it is just possible that specimens intermediate between *M. alticola* and *M. ochraceiventer* will be found at intervening altitudes, in which case the latter will have to be reduced to a subspecies of the former; but until such specimens are obtained it would be impossible to allow such different-looking animals to pass under the same name.

Mus Whiteheadi.

Size small. Fur of medium length, thickly mixed with spines. General colour above tawny rufous, lined with black; the spines slaty white, with black tips. Under surface ochraceous, more or less pure according to the degree to which the slaty bases of the hair are visible. Ventral spines white-tipped. Sides paler, no sharp line of demarcation between the upper and lower colours, which are, indeed, except for the black tipping of the dorsal spines, very like each other. Ears of medium length, laid forward in a spiritspecimen they reach about to the middle of the eye; naked. Upper surfaces of hands and feet white or pale buff; palms white, soles slaty blue; fifth hind toe reaching nearly to the middle of the first phalanx of the fourth; sole-pads usually only five in number, the postero-external being suppressed in all but two of the specimens examined. Tail scarcely longer than head and body; very finely haired, practically naked, not pencilled at tip; bicolor, slate-coloured above, white below. Palate-ridges 3-5; mammæ 2-2=8.

Skull: interorbital region broad, with strong supraorbital ledges, which, after forming a sharp postorbital angle, run back along the parietals. Anterior margin of interparietal nearly directly transverse. Projecting plate of anterior zygoma-root well developed, convex above. Anterior palatine foramina just about the length of the upper molar series, but sometimes rather shorter, not quite reaching to the level of the front side of m. 1; their combined outlines forming a long

even oval.

Hind foot of the typical skin (?), moistened, 27 millim.

Dimensions of a specimen in spirit (3):

Head and body 102 millim.; tail 110; hind foot 27; ear 15.5 x 13; heel to front of last foot-pad 13.

Skull: see p. 459.

Hab. Mount Kina Balu.

Type obtained by J. B. Whitehead at 3000 feet, March 18, 1888.

This species is that referred to in my own previous papers and in Hose's 'Mammals of Borneo' as Mus Musschenbroeki, Jent.; but a renewed comparison of it with my notes on Dr. Jentink's type in the Leyden Museum shows that the Celebean species is a larger animal with, among other differences, a molar length of 6·1 millim. and a hind foot of 30 millim. The palatal foramina are also markedly longer.

Mus bæodon.

Size small, about as in *M. Whiteheadi*. Fur nearly wholly spinous, with less wool-hairs intermixed than in any of the allied species; the spines of the back about 9 millim. long. General colour rufous brown (browner on the head, more rufous on the rump), finely speckled with yellowish. Each spine is whitish basally, gradually darkening to brown terminally, but with a narrow terminal or subterminal band of yellow. Throat and chest dull rufous; belly pale buffy yellow, the hairs and spines of this colour throughout; line of demarcation on sides not sharply defined. Hands and feet white; fifth hind toe reaching nearly to the end of the first phalanx of the fourth; soles smooth, with the usual six high and prominent pads. Tail rather shorter than the head and body, practically naked; bicolor; scales about twelve to the centimetre. Palate-ridges 3—4; mammæ 2—2=8.

Skull with the usual supraorbito-parietal ridges normally developed. Anterior edge of zygomatic plate slanting backwards; palatal foramina small, well open, their posterior boundary nearly 2 millim. in front of m. 1. Molars remarkably small and delicate (see measurements), the total molar length only just equal to the least distance between the first molars of the two sides.

Dimensions of the type, an adult female in spirit:

Head and body 119 millim.; tail 111; hind foot 26; (ears destroyed); heel to front of last foot-pad 11.7.

Skull: see p. 459.

Hab. Mount Kina Balu. Coll. A. H. Everett.

Type: B.M. 94.7.2.81.

This peculiar little species may be readily recognized from all its allies by its diminutive teeth, which are smaller in proportion to the size of the skull than in any other species of *Mus* known to me.

An immature skin, also from Kina Balu, agrees with the adult in most respects, but has a larger proportion of woolhairs mixed with the spines, and the spines of the back are broadly brown-tipped, without yellowish rings.

Mus baluensis.

Size about as in *M. neglectus*. Fur quite spineless, long and soft, the dorsal wool-hairs about 17 millim in length, and the longer bristle-hairs, which are numerous, attaining about 30 or 35 millim. General colour coarsely grizzled orange and black, the resulting tone not unlike Ridgway's "raw umber." Whole of under surface, including the chin,

dirty buff, the hairs slaty grey basally, buff terminally; line of demarcation on sides not sharply defined. Ears of medium size, laid forward in a spirit-specimen they almost reach the anterior canthus; thinly haired, brown or black. Metapodials brown mesially, whitish laterally and on the digits; fifth hind toe reaching to the end of the first phalanx of the fourth. Tail rather longer than head and body, unicolor, dark brown, fairly well haired, but not tufted. Palate-ridges 3—5, the three anterior interdental, as usual in this and the ephippium group, with a sharp backwardly-directed projection in the centre. Mammæ 2—3=10.

Skull distinguished from that of *M. neglectus* by its much broader and rounder brain-case, on which the parietal ridges are more widely bowed outwards, by its broader and shorter interparietal, and by its less widely open anteorbital foramina,

of which the outer walls are less projected forwards.

Hind foot of the typical skin 33.5 millim. Dimensions of a spirit-specimen (3):—

Head and body 171 millim.; tail 194; hind foot 32; ear 20×17.

Skull: see below.

Hab. Mount Kina Balu, 8000 feet. Coll. J. Whitehead,

Feb. 4, 1888.

The specimens referred to as being soft-haired examples of Mus rattus in my original paper on Mr. Whitehead's mammals, together with two spirit-specimens sent by Mr. Everett, are those on which Mus baluensis is now founded. What its ultimate position will be, when all the group is worked out with proper material, I am unable to say; but I am convinced that, as a local form, whether species or subspecies, it is quite distinct from anything hitherto described.

Skull-measurements of the New Species above described.

Greatest length Basilar length to henselion Greatest breadth		ochraceiventer. do. 40 30.5 13	White- headi. ♂. 33.6 25.4 16	<i>bæodon.</i> ♀. 32 25 15	balu- ensis. 3. 43.2 35 20.4
Nasals, length	19 7.5	15 7.6	11.4	$\frac{12}{6}$	15:5 6:8
Interparietal, length	5·8 10	5·8 10·4	5·0 9·0	6 9.2	5·9 12·5
Length of zygomatic plate	4.2	2.9	3.2	2.3	4.5
Palate length from hen- selion	22	16.2	13.6	12	21.3
Diastema	14.5	11.2	8.9	8·9 32**	12.6

Skull-measurements (continued).

ochracei- W rajah. venter. he			
$\vec{\sigma} \cdot \vec{\sigma}$	3. 9	. 3	
	4.8 4	6 8	1
	2.6 2	2.5 3	3
	5.1 4	1 7	7
	20.2 20	28	3
aw, coronoid to		3·1 15	3
ramina, length 7.6 5.1 ,, combined of the	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	2. d 86 8 875 3 4 28	3 3

Except in the case of *Mus bæodon*, the above measurements are not taken from the skulls of the actual types, as skins have been whenever possible selected as types, and the native skinners have unfortunately always cut off the backs of the skulls during the process. These measured skulls have been extracted from spirit-specimens which have been carefully compared and found to agree with the typical skins.

LIX,—Descriptions of Two new Bats of the Genus Kerivoula. By Oldfield Thomas.

MR. JOHN WHITEHEAD'S expedition to the Northern Philippines has resulted in the discovery of one, and Mr. Charles Hose's explorations in Eastern Sarawak in that of the other, of the two following new species, which, belonging to the group comprising K. Hardwickei, K. pellucida, and K. papillosa, are clearly distinct from any of them. Of these three old species the last-named is at once distinguishable from either of the new ones by its much greater size, and K. pellucida by its longer ears, so that K. Hardwickei is the only one with which it is necessary to compare them.

Kerivoula Whiteheadi, sp. n.

Size and proportions about as in K. Hardwickei, but the ears are slightly longer and the lower legs shorter. Upper surface of wing-membranes to a line drawn from the elbow to the foot, whole of interfemoral membrane except the terminal half-inch, and surface of lower limbs to feet thinly but distinctly clothed with long orange-coloured hairs, these parts in K. Hardwickei being practically naked. Forearm, carpus, and index also thinly clothed. Hinder edge of interfemoral with a few short hairs along it, scarcely forming a fringe. Colour above rufous-orange, the slaty bases to the hairs



Thomas, Oldfield. 1894. "LVIII.—A preliminary revision of the Bornean species of the genus Mus." *The Annals and magazine of natural history; zoology, botany, and geology* 14, 449–460. https://doi.org/10.1080/00222939408677833.

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