AN ACCOUNT OF THE RATS OF CALCUTTA, WITH SOME REMARKS ON THE EXISTING CLASSIFICATION OF THE GENERA *MUS* AND *NESOKIA*.

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INTRODUCTORY

The present inquiry as to the rats occurring in Calcutta, their relative numbers and habits, started originally in a very humble way, as the result of a suggestion made by Colonel Leslie, Sanitary Commissioner to the Government of India. In a discussion as to the part played by the fleas of rats in the dissemination of plague, he suggested that the comparative mildness of the recent epidemics in Calcutta as compared with Bombay, Poona and the towns and cities of Upper India, was due to the fact that in these latter *Mus rattus*, the long-tailed Black Rat, was the predominant one, whereas in Calcutta the predominant rat was *Mus decumanus*, the Brown or "Norwegian" Rat, a species which from its habits is brought into much less intimate contact with man. The distinctions given as sufficient to separate the two varieties were as follows :—

Mus decumanus, a large, heavy-bodied rat with a blunt round head, tail shorter than the head and body, and the ears small and round, so that when laid forward on the head they fail to reach the eyes; *Mus rattus*, a slender long-tailed rat with tail longer than the head and body, long ears, so that when laid forward they cover the eyes. At the time this suggestion was made conditions were extremely favourable for collecting evidence on any point connected with rats, as rewards were being paid for living rats, and large numbers, up to about two hundred a day, were being brought into all the District Offices including District II, which is under my charge. A few attempts at differential counts soon made it clear that the distinctions given were quite insufficient, that tails were met with showing every gradation from 70 to 150 per cent. of the length of the head and body, and that the difference in the relation of ear to eye, though correct in a general way, was very unreliable. So I had recourse to the authorities at the Indian Museum in the hope that a thorough examination of a few type-specimens would enable me to settle the question in point; but my hopes were rudely dashed to the ground when I learned that the subject of Indian rats was in a state of great confusion, that there were only two or three men in the world who could tell with certainty the genus and variety of any given rat, and these, only if they had before them skin, skull and spirit specimens, and then, only if they had at hand existing types with which to compare their specimens.

However, along with this came a suggestion that the subject was in such a state that any contribution would be of value, particularly when such unlimited material was at hand. Accompanying the suggestion came instructions how to carry it out, the requisite measurements to be taken and points to be noted. I must here express my deep indebtedness to Colonel Alcock, I.M.S., and to Dr. Annandale for the encouragement and the assistance they have given me, putting all the facilities of the Museum at my disposal. My thanks are also due to Mr. I. H. Burkill and his brother and to Colonel Bingham for the great trouble they have taken over the reproduction of the plates illustrating this paper.

I have now recorded the measurements of over 200 rats, and must have roughly examined the external characteristics of some 2,000. When I began to work I was entirely ignorant of the subject, and could only group my observations vaguely, according to such external characteristics as size, colour, the proportionate length of the foot or the tail, the colour of the tail, and the like. It was gratifying to find later that a detailed examination of the skulls and dentition confirmed the validity of the grouping; without knowing what rats I was dealing with, I had separated them correctly.

HISTORICAL.

A brief note on the history of the study of the Indian Murinæ may be of some use, at least to the beginner, as an indication of the existence of three main epochs in the history of the subject. The first epoch is that in which species were named in the most loose and unsystematic manner, vitiated by imperfect description and examination of a very limited number of specimens, with the result that complete confusion ensued. This epoch may be said to have closed in 1863, when Blyth wrote his Memoir on the Rats and Mice of India.[1] In this a complete collection was made of all references to all Indian species, but practically nothing was done to systematise the some fifty species regarding which references were collected. Dr. Jerdon accepted Blyth's work, adding little to it, and except for Dr. Anderson's able and exhaustive paper on the subject of the subgenus *Nesokia*,[2] nothing was done till Thomas in 1881 wrote his epoch-making memoir on the Indian species of *Mus*. This work was based on an examination in England of 450 Indian specimens, of which no less than 180 had been preserved in spirit.

The main feature of Thomas's invaluable work was the reduction of a crude collection of 90 names into a co-ordinated system containing only 19 valid species, so that from the synopsis it was easy to dentify a specimen. Outstanding facts in the paper are the demonstration from a series of skulls of *M. alexandrinus* var. *nitidus* that the proportionate length of the nasals is a character so liable to individual variation as to be useless as a specific character, and that the same is the case with the presence or absence of spines in the fur. At one time this latter character was made

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[1] *Journ. Asiat. Soc. Bengal*, vol. xxxii, p. 327.

[2] *Journ. Asiat. Soc. Bengal*, 1878, vol. xlvii, part ii, p. 214. [3] *Proc. Zool. Soc.*, 1882, p. 257.

not only of specific but even of subgeneric and generic value, but after what Thomas has to say on the matter, it seems pretty clear that it is simply, in the main part, a seasonal variation, spines taking the place of hairs to a greater or less extent in all tropical rats in the hot season. With reference to the relations of *Mus alexandrinus*, *Mus rufescens*, and *Mus nitidus*, he arrives at the definite conclusion that they are three intergrading varieties of the same rat, *alexandrinus* typically found in Kashmir and North-West India, *rufescens* in Southern India, *nitidus* in the Nepalese District, while the skulls of all three show no difference except in size. With regard to the relationship of this little group of varieties to the European *Mus rattus* he is by no means so clear, but he tends to the opinion that they will be found eventually to belong to the same species.

We now come to the third epoch, one characterized unfortunately by more or less the same state of confusion as prevailed during the first. Since Thomas did his work the boundaries of India have been enlarged to include Burma, the rats of which are linked up with those of Borneo and the Malay Archipelago, Formosa, Java and Celebes. From all the countries named a vast number of new species have been described, the specific differences between which are often minute, so minute in fact that no description can convey them, and comparison with existing types is absolutely necessary.

Some observers seem to have gone on the principle that every island should have its own named rat, a point on which I shall say more, when considering local variations. The result is that in a recent conspectus of some of the Oriental Rats, Mr. Lewis Bonhote has collected 8 groups, 10 subgroups and 95 species.[1] The distinctions drawn between the groups and subgroups are sufficiently unsatisfactory; but to find included such names as *M asiaticus*, *M decumanoides*, *M sladeni*, *M caudatior*, etc., is more than disappointing. They were extinguished by Mr. Thomas more than twenty years ago, on the ground of identity with other species of incomplete description, or, in the most extreme instances, of complete absence of description. No less than fifteen such extinguished varieties have to be marked off Bonhote's list; five of them extinguished not only by Thomas, but also by Sclater after examination of the types in the Indian Museum; they were made mere synonyms of *M rufescens*. It is impossible to pass over the paper of Mr. Bonhote without calling attention to certain slips which are liable to cause needless difficulties. Thus he makes *M bukit* similar to *M. cremoriventer* but distinguished by being larger, being 12·1 cm. in length of head and body. But *M cremoriventer*, according to Miller, is 14·6 cm. in length of head and body.

M. jalorensis he distinguishes from *M. rufescens* by its colour and its short tail; but in the contrasted measurements he records, *M jalorensis* has a tail 113 per cent. of its body-length (14·5 cm.), while *M. rufescens* has a tail only 108 per cent. of its body-length (17 cm.). Though the latter is defined as a short-tailed rat, the type has a tail of 122 per cent. of its body-length, measuring 14·4 cm.

[1] In Annandale and Robinson, *Fasciculi Malayensis*, *Zoology*, part i, Oct. 1903.

Mr. Bonhote admits that a series of *M bukit* agreed exactly with a series sent home by Mr. Lyle from Assam and recorded by Mr. Bonhote himself as *M jerdoni*. Nevertheless, not only does he retain the name of *M bukit*, but he places it in a different subgroup from *M jerdoni*, namely, that of *M griseiventer*. *M pellax* is practically a prototype of *M jerdoni*, but he separates them. Thomas found *M pyctoris* to be identical with *M nitidus*, but they are here placed in separate subgroups, the latter being placed in that of *M griseiventer* although it has been specially noted that the *pyctoris* subgroup represents the *nitidus* group of Thomas.

THE CAUSES OF CONFUSION.

It is difficult for one who is an absolute tyro like myself to discuss, however superficially, the causes that have led to the present confusion. It is only the great practical importance of the subject and the knowledge that many of those who are working at rats in connection with plague have no pretensions to be trained zoologists, that emboldens me to touch on it at all. The leading fault seems to be one that is all too common in many branches of zoology, namely, an undue tendency to manufacture new species out of the most trifling deviations from type, accompanied by neglect to give due weight to the following factors of variation :—

1. Local variations due to environment.
2. Developmental variations.
3. Normal variations and sports.

Local Variations.—In recent literature the most instructive instance of this factor is that of the *Mus musculus* (House Mouse) of North Bull, an island in Dublin Bay. It is less than a century since this island was cut off from the mainland, but already a large proportion of individuals have developed a pale sand-coloured coat with light buff or yellowish belly to harmonize with the environment of sandhills. In St. Kilda and the Faroes, in both of which it is known that the time available for variation is short, specialization has gone much further and types have been produced differing immensely from the parent type in general size and the relatively much increased hind foot, in addition to exhibiting comparatively minor variations in colour. How far those local variations can carry the enthusiastic species-maker is seen in Captain Barrett-Hamilton's paper on the variations of the Long-tailed Field Mouse, in which most detailed descriptions are given of 16 subspecies. Judging from these instances we must expect to find slight variations in all island forms, so that the present policy of giving each of these a new specific name opens up a vista full of the direst complexity.

Developmental Variations.—Immature specimens, particularly where they do not form part of a series, are liable to be made into new species, as the variations are sometimes extreme. If this major error is avoided, a source of great confusion remains in the erroneous and misleading measurements that may be recorded. I shall not deal with the subject at present, as it will be taken up at length later on.

Normal Variations.—As has already been indicated, these are too frequently neglected altogether. There is already a considerable amount of literature dealing

with the colour variations of the Black Rat, its tendency to white breast patches, albinism, etc. Further on I shall show, as has already been noted in Bombay by Liston, that an extreme range of colour is found in the *Mus rattus* of the large cities of India, from black through brown to yellow and white. Size is another characteristic that is very variable, as has been already noted in the case of *M jerdoni* and *M alexandrinus;* this also will be gone into fully in the case of *M rattus.* With regard to minute variations in skulls, such as the shape and size of the bullæ, the shape of the interparietal, the form of the coronoid suture and the like, one can only come to the conclusion that they are frequently unworthy of consideration. The faintest variations, such as "bullæ a shade flatter," "nasals rather narrower," "incisive foramina rather narrower," are made specific. Fortunately many observers are becoming convinced of the futility of these minute differentiations.

SKIN MEASUREMENTS.—There is a very considerable error in attempting to estimate the size of an animal from a skin. Invariably, whether there has been stretching of the skin or not in drying, it will be found that its dimensions have greatly increased, while the tail, if without the vertebræ, has shrunk correspondingly. There is a stuffed skin of *Nesokia bengalensis* in the Indian Museum which measures 27·5 cm. in length of head and body; judging from the size of the hind foot (3·5 cm.), it probably measured when fresh only about 20 cm. Similar instances might be multiplied, but the fallacy of skin measurements is too well recognized to necessitate more. Nevertheless, one still finds descriptions of new species and genera where the only measurements given are those of dried skins. The errors arising from accepting the measurements of spirit specimens may be considerable. Thus Blanford notes that in the case of three specimens of *Golunda ellioti*, the Indian Bush Rat, there was a shrinkage of no less than 20 per cent. in the length of the head and body after they had been kept four months in spirit.

CHANGE OF COLOUR IN SPECIMENS.—In comparing with type skins and specimens, it must be remembered that specimens in alcohol, or specimens exposed to light or even kept for very long in a drawer, change colour. Anderson has noted the tendency to become rufous in *Nesokia,* and Barrett-Hamilton notes the same in the case of *Mus sylvaticus.* It is very marked in many of the skins of the Indian Museum, particularly in those of *Nesokia* and *M decumanus.* Though agreeing in all other respects with the stock descriptions, they have developed a general rufous foxy tint all over. In spirit specimens minor colour variations become extremely ill-marked in a very short time, so that a white tip to the tail or a white breast spot may become almost unnoticeable in the space of a month or two.

From what has been said it is evident that some more rational system of classification is required. This is rather an urgent matter considering the extreme practical importance of the subject in connection with plague. It is now twenty-five years since Mr. Oldfield Thomas reduced chaos to order, earning the thanks of every worker who has approached the subject. Is it too much to hope that he will again take it up, brush away the accretions of a quarter of a century, and give us a classification free from the redundancies and overlappings that at present exist?

GUIDE TO INDIAN RATS CONNECTED WITH PLAGUE.

Of the 95 references given by Bonhote I have succeeded in finding no less than 68, the majority of them in the library of the Indian Museum, and a few in the library of the Asiatic Society of Bengal. The most important of the references which I have not been able to obtain are Miller's papers, in the Proceedings of the Washington Academy of Science, dealing with the rats found in the islands off the coasts of Java and Sumatra such as *M. tambelanicus*, *M lingensis*, *M. anambæ*, etc. The greater number of Bonhote's references are to rats found in Borneo, Sumatra, Java, Celebes, the islands off the coast of Siam, and generally the islands of the East Indian Archipelago, while rats from the Philippines are included, and even from islands off the coast of China. Now, the rats of Luzon in the Philippines, as described by Thomas in his very interesting paper on Mr. Whitehead's collection,[1] form a group which, so far as is known, have little connection with the forms found in India proper, but which, on the other hand, show a distinct affinity to the Muridæ of Celebes and Australia. So characteristic is the group that 5 new genera and 7 new species have had to be framed to cover the new and strange forms found. It is clear then that from the point of view of those who wish to take up the rats of India and their connection with plague, much time would be wasted if they were to attempt to familiarize themselves with the rats named in Bonhote's list. A still more serious objection to using it as a basis for such work lies in the fact that the references apply solely to the genus *Mus*, whereas the rats that are of practical interest to the Indian worker may apparently belong to other genera. Thus I have already shown that the rat most concerned with plague in Calcutta belongs to the genus *Nesokia*, namely *Nesokia bengalensis*[2] ; and possibly as our knowledge of the subject increases, similar instances will be found of rats, which though originally field rats, have become parasitic on man and so have become liable to become carriers of plague. There must be many ready to investigate the practical problem conveyed in the words " the rats of India and their connection with plague," who would shrink from the much wider and more difficult task involved in attempting to grasp the subtle differences and distinctions of such a widely diffused and comprehensive group as the Oriental species and varieties of the genus *Mus*. For the benefit of such it may be said that practically nothing has been added to the list of Indian Murinæ since Blanford wrote his Fauna of India in 1891. In the twelve years that elapsed between the publication of this and the appearance of the paper in *Fasciculi Malayensis*, so far as I know, only one new rat has been added to the Indian list, *Mus vicerex*, Bonhote; and this, as will be shown later, is probably only a synonym of *Mus nitidus*, or *Mus pyctoris* as it is named by Bonhote. That the rats of India are still by no means worked out is indicated by my note on the *Nesokia* from Jagdispur (*postea*, p. 43), but all the species so far named will be found in Blanford's work, with the exception above given, namely *M vicerex*. As noted by Bonhote, the most important papers in connection with the *Mus rattus* group are :—

[1] *Trans. Zool. Soc.*, vol. xiv, 1895-1896, p. 377.

[2] *Calcutta Plague Report*, 1905-1906.

Oldfield Thomas, *Proc. Zool. Soc.*, 1881, p. 521.
W. L. Sclater, *Proc. Zool. Soc.*, 1890, p. 523.
,, ,, *Cat. Mamm. Ind. Mus.*, p. 62 (1891).

Anderson (*loc. antea cit.*) is the leading authority on *Nesokia*, and exhaustive papers by Blanford on *Golunda ellioti* and *Mus metada* will be found in the *Journ. Asiat. Soc. Bengal*, part ii, vol. xlv, p. 165 (1876), and vol. xlvi, p. 288 (1877), respectively. Of the family Muridæ the only subfamily likely to be found of importance as a diffuser of plague is that of the Murinæ, and of the seven genera composing it probably the only two of importance are *Mus* and *Nesokia*. Of the 22 Indian species of the genus *Mus* 10 are rats, 12 are mice. Mice, though I have as a rare exception known them to die of plague, are of no practical importance; so only the ten species of rats remain to be considered. If the number of specimens recorded is any guide, then the following five species are very rare and of no practical importance: *M. fulvescens*, *M bowersi*, *M berdmorei*, *M. blanfordi*, *M chiropus*. This leaves in addition to the two described in my paper, namely *M rattus* and *M. decumanus*, only the three, *M concolor*, the common little House Rat of Burma, *M. jerdoni*, a small Himalayan rat distinguished by its bicoloured long tail with lower surface white, and *M niveiventer*, also a small Himalayan hill rat, but distinguished from the previous one by its tail being shorter, almost the same length as the body. Of the genus *Nesokia* it is unnecessary to give details, as full measurements of skulls and bodies of all species are given in the table at the end of this paper, and most of them are discussed. The above is only a forecast, and subsequent observations may prove it incorrect. If so, it will have fulfilled its purpose, which is merely that of attempting to define the present limits of our knowledge, in order that subsequently the gaps may be filled. The following are general references which cover all references not included in Bonhote's list and include some which will be of value rather to the beginner than to the ordinary student of the Muridæ:—

1. *Proc. Camb. Phil. Soc.*, vol. xiii, part iv, p. 215, 1905: L. Doncaster, "An Experimental Investigation of the Colour Variation of Rats."
2. *Journ. Linn. Soc. Zool.*, vi (1862), p. 71: S. J A. Salter, "Interbreeding of *Mus decumanus*, *rattus* and *alexandrinus*."
3. *Proc. Zool. Soc.*, 1900: Barrett-Hamilton, G. E. H., "Variations of *Mus*."
4. *Proc. Roy. Phys. Soc.*, ed. 1904: Clarke, W. E., "Forms of *Mus musculus*."
5. *Proc. Zool. Soc.*, 1903, ii, p. 72: Bateson, "Pigment in Mice."
6. Tomes' *Dental Anatomy*.
7. *Nomenclature of Colors for Naturalists*, Ridgway.
8. *Mammals Living and Extinct*, Flower and Lyddeker.

THE CHARACTERISTICS OF IMMATURITY IN RATS.

I have been bold enough to make the heading of this section apply to rats in general, though I have examined the young of only 2 genera and 5 species, for the reason that the distinctions to be described are common to many, if not most, of the mammalia, and are very marked in man and the anthropoid apes. In the young of mammals it is found that in early immaturity the cranium is globular and large in proportion to the facial part of the skull, also that the feet and ears tend to be large compared to the general body dimensions. In the rat, as will be shown, those characteristics are very definitely displayed, and in addition the pelage of the young is very distinct from that of the mature rat. The importance of clearly defining the marks of youth is brought home to one when one comes across a description of a new rat founded perhaps on the examination of a single specimen. Let me quote the instance of *Mus blanfordi* as an example, where the type was an immature one having only 68 per cent. of an adult length. Had the value of proportional measurements then been recognized, Thomas would at once have seen that the specimen was immature and would not afterwards have had to alter the drawing of the skull and his original description, admitting that the slope of the anterior zygoma root was simply a character of immaturity, not a specific character as at first laid down. That twenty-five years later the same factor of error is still given full play will be seen from a subsequent note on a so-called specimen of *Nesokia bengalensis* from Kilakarai, G. of Manaar. I will first lay down the law of proportional body measurements.

If the length of the hind foot is as much as 30 *per cent. of the total body-length, then the rat is immature, is just cutting, or has just cut, its third upper molar, and has (approximately) only* 50 *to* 60 *per cent. of its ultimate body-length.*

The foot of a mature rat is only about 20 per cent. of the body-length and may, in a very large and old rat, fall as low as 16 per cent. The ear is a more variable character, so that it is more difficult to lay down a general law; but it will be found that there is a difference of nearly 5 per cent. between the ear of a rat of the age indicated and that of a mature one. The tail is a still more variable character, but even in it the tendency is for the proportions of youth to exceed those of maturity. The following is a table of typical instances from each species, including *Mus blanfordi* from Thomas's description :—

Table contrasting the body measurements of immaturity and adult life.

	Total length of body in centimetres.	Percentage of body length.		
		Tail.	Hind foot.	Ear.
N. bengalensis	10·2	81·37	22·54	15·68
Do.	9·3	80·46	24·73	16·12
Do.	9	77·77	25·55	15·55
Do., adult	18·16	81	17	10·7
M. decumanus	11·5	95·6	28·7	15·6
Do.	11·3	97	28	15·8
Do.	11·5	85	30	16·5
Do., adult	22·6	89	18	8·2
M. rattus ..	10	145	29	19
Do.	9·5	147·3	31·5	18·9
Do.	10·5	128·5	27·6	16·1
Do , adult	17·3	121	19·1	12·1
N. bandicota	17·5	88·5	26	14·5
Do., adult	26·9	94·5	19·18	10·2
M. blanfordi	10·25	148	29·2	17
Do., adult	15	130	22·1	

As regards cranial measurements it will be seen that the table bears out the general statement already made, that in early youth the proportional cranial measurements tend to be larger, while the facial measurements tend to be smaller. This is shown particularly in the measurements of the nasals, the cranial breadth, both maximum and interorbital, and the length of the zygomatic plate and the diastema, while the most marked characteristic of all is the enormously increased relative dimension of the molar series. This is due to the fact that the molars, even before they have cut the gum, are already practically full grown, as far as length and breadth go, having to increase in depth only. The third upper molar, the only one I have observed uncut, occupies practically the same area as a full-grown tooth at a stage at which it is still merely a plate of dentine showing no more than an indication of tubercular ridges and only the rudiments of the large posterior fang. From the two measurements that show the greatest divergence, the following law may be laid down :—

A skull which has a maximum cranial breadth of 50 *per cent. of the total skull-length and an upper molar series of* 22 *per cent. of the skull-length is that of a rat which is cutting or has just cut its third upper molar, has attained only* 50 *to* 60 *per cent. of its full body-length, and possesses a skull that is only about* 70 *per cent. of its full length.*

The relative proportions in the adult vary of course according to the species, being greater in the broad-skulled *Nesokia* than in the long-skulled *M rattus*, but it may roughly be laid down that in the adult the corresponding percentage measurements are 37 % and 17 % against 50 % and 22 %. In *M decumanus* the cranial breadth sinks to 33·6 %, while the molar series is as low as 14·9 %, probably owing to the fact that the series from which the measurements were made were rather specially selected as full grown. This is borne out by the series of maximum sized *M rattus*, where these measurements fall to 35·58 % and 16·24 % respectively. These figures apparently do not hold good for some of the *Nesokiæ*, owing to the excessive breadth of the cranium and the relatively large size of the teeth; but the data on which to form a conclusion are at present deficient. Apart from actual measurements there are general characteristics of a young skull sufficiently well marked to enable one at once to form an opinion as to its age. The globularity of the cranium is very distinct, and gives the posterior aspect a very characteristic shape, as is very well shown in the plates accompanying this paper. The occipital, instead of being a sloping or perpendicular plate, is a segment of a sphere, and the part of the skull which projects most posteriorly is the centre of the occiput, instead of being the occipital ridge or the condyles according as the occiput is vertical or sloping. Again, the bony ridges for muscular attachments such as the occipital and supraorbital are hardly developed at all, so that, instead of forming bold contour lines which may in the adult give the cranium a rectangular character rather than a globular one, they do not break the smooth globularity of the cranium.

In its undeveloped condition the zygoma tends to slope forwards and downwards instead of being boldly perpendicular. This forward slope has already been referred to in the case of *Mus blanfordi*. It is distinctly shown in *Mus rattus*, occasionally in *Nesokia bengalensis*, and only in one out of several young *M. decumanus*. My single specimen of the young *Nesokia bandicota* shows it distinctly, and the doubtful young Kilakarai skull shows it very clearly indeed, the slope being over 30° from the perpendicular.

The characters of immature teeth will be dealt with when discussing the different species, as the extra cusps and ridges or rudiments of them, which are so well shown in a young tooth, vary so much in the different forms.

The fur in young rats is soft, thick and mole-like, with dense grey underfur. The longer hairs, the projecting tips of which determine the colour of the mature rat, are very sparse and hardly break the general surface of the fur, so that the colour tends to be grey more than brown. This is particularly so on the underparts, which are coloured almost entirely by the underfur, so that the belly is dark grey with hardly any lightening of colour. This applies to the young of all the rats I have examined.

Table contrasting the skull measurements of immature with those of adult rats.

	Length of skull in millimetres.	Percentage of total length of skull.					
		Length of nasals.	Cranial breadth.	Interorbital breadth.	Length of zygomatic plate.	Diastema.	Length of upper molar series.
M. decumanus	34	33·8	43·3	16·9	11	26·4	22
Do.	33	34·6	45·4	16·6	10·6	27·2	21·2
Do.	35	32·8	44·2	17·1	11·4	27·2	21·4
Do., adult.	51·0	38·7	33·6	14·1	13·7	29·4	14·9
N. bengalensis	29	27·5	50	17·2	13·7	27·5	24·1
Do.	28·5	25·4	49·1	18·4	14·03	28·07	24·5
Do.	28	28·5	50	17·8	14·2	27·67	23·2
Do., adult ..	39·6	29·4	42·0	15·81	16·16	31·06	18·05
M. rattus	28	33·9	50	19·6	8·9	25	25
Do ..	31	32·2	48·3	17·7	9·6	25·8	21·7
Do.	31	32·5	50	16·1	10·4	25·8	22·5
Do., adult of 17 cm. length ..	41·5	35·7	37·4	13·9	12·4	27·5	17·1
N. bandicota	44	31·1	40·9	15·9	13·6	29·7	22·7
Do., adult ..	63·6	36·3	34·8	13·97	17·1	31·43	18·69

KEY TO THE RATS OF CALCUTTA.

A. LONG-TAILED, *i.e.*, tail = 125 to 135 per cent. of length of head and body.

1. Small to medium sized; slender body; ears long and wide and stand out from head; eyes very large and prominent; feet slender, white but sometimes dark; median pads of hind foot cordiform, external pad generally with small extra tubercle; tail uniformly dark. House rat.—*Mus rattus* (*alexandrinus*): the Black Rat.

B. SHORT- OR MEDIUM-TAILED, *i.e.*, tail = 90 per cent. of length of head and body.

2. Heavy-bodied rat, with large, heavy tail which is generally white or distinctly light in lower half; eyes small; distinguished from *N bengalensis* by feet which are large, heavy and flesh-coloured with cordiform median pads like *rattus*; jowl heavy

and broad, though head is long ; no long piles or bristles ; molars tritubercular. A house and drain rat ; does not spit or bristle when caged. —*Mus decumanus* : the Brown Rat.

3. Heavy-bodied, of moderate size, like a small *M decumanus*, but has long piles or bristles on back ; tail tapers suddenly and is about 70 cent. of the length of the head and body ; uniformly black and nearly naked ; pads of hind foot small and nearly circular, not cordiform, proximo-external pad very small, and in 2 per cent. of specimens wanting ; feet and nose light purplish, not flesh-coloured, proportionately small ; fur thin and bristly, giving drowned specimens a half-naked appearance ; molars with transverse laminæ. Burrowing, grainstoring, stable, and grainshop rat ; erects its bristles and spits when caged.—*Nesokia bengalensis* : the Indian Mole Rat.

4. Extremely large and heavy-bodied ; muzzle greyhound-like compared with *decumanus*, deep and narrow ; tail almost equal in length to head and body ; ears long ; very long black piles 5 to 6 cm. in length ; feet extremely large, atreous, with six round pads as in *N. bengalensis*, tail generally black and more naked than in large specimens of *decumanus ;* burrowing, grainstoring, frequenting gardens but is captured in houses ; molars with transverse laminæ. Erects its bristles and spits when caged.—*Nesokia bandicota* var. *nemorivagus* : the Lesser Bandicoot.

SPECIES OF RATS IN CALCUTTA AND THEIR RELATIVE FREQUENCY

Four species of rats were found, the first two equally common and predominant, the third not so common, and the fourth very rare :—

1. *Mus decumanus*, 26 %.
2. *Nesokia bengalensis*, 60 %.
3. *Mus rattus*, 14 %.
4. *Nesokia bandicota* var. *nemorivagus*, rare.

The figures of relative frequency tend to be rather unsatisfactory from various causes. In the first place pressure of plague work made it impossible for me to make accurate recorded counts of any but a small proportion of the rats I examined. In the second place it was only late in my investigation that I could accurately distinguish the different varieties. In the third place experience has shown me that the proportions vary in different parts of the city ; in the north, where grain-stores and huts abound, *N bengalensis* is the common rat, accounting for 50 % to 60 % of the total ; while in the central and European parts *Mus decumanus* is almost equally predominant. The Bandicoot is found mainly in gardens in the suburbs on the banks of tanks, but it is comparatively very rare. My colleague, Dr. Crake, counted 1,000 rats but only distinguished long-tailed rats, *i.e.*, *Mus rattus*, from all other species, making the former 11·2 per cent. of the total.

Later figures based on the rats collected at the Head Office from August to December 1906, show strikingly the difference between the rat populations of the northern native city to which the first count refers and the central European portion in the heart of which the Head Office is situated. The figures are as follows :—

1.	*Mus decumanus*	2012 = 51·1 %
2.	*Nesokia bengalensis*	1450 = 37·3 %
3.	*Mus rattus*	373 = 9·8 %
4.	*Nesokia bandicota*[1] var. *nemorivagus*	38 = 1 %
	Total	3,883

MUS RATTUS.

THE INDIAN HOUSE RAT.

(Synonymy after Blanford.)

Mus rattus, Linn. Syst. Nat., 1, p. 83 (1766); Blyth, Cat., p. 113; W. Sclater, P. Z. S., 1890, p. 523.

Mus alexandrinus, Geoff., Desc. De l'Egypte, Hist. Nat., ii, p. 733; Atlas, pl. v, fig. 1 (1812); Scully, P. Z. S., 1881, p. 204; Thomas, P. Z. S., 1881, p. 533.

Mus indicus, Geoff., Desm. Mam., p. 299 (1822), *nec* Beckstein.

Mus rufescens and *asiaticus*, Gray, Charlesworth's Mag. N. H., i, p. 585 (1837).

Mus rattus and *flavescens* (*nec* Waterhouse), Elliot, Mad. Jour. L. S., x, pp. 212-214.

Mus brunneusculus, *rattoides*, *nitidus* and *horeites*, Hodgson, A. M. N. H. (I), xv, pp. 267, 268 (1845).

Mus nemoralis, Blyth, J A. S. B., xx, p. 168; *id.* Cat., p. 114.

Mus kandianus, Kelaart, Blyth, *Ibid.*, p. 169.

Mus rattus, *ceylonus*, *flavescens*, *nemoralis* and *asiaticus*, Kelaart, Prod., pp. 58, 61-63.

Mus robustulus, Blyth, J A. S. B., xxviii, p. 294 (1859); *id.* Cat., p. 114; *id.* Mam. Birds Burma, p. 39.

Mus crassipes, Blyth, J A. S. B., xxviii, p. 295.

Mus (*Leggada*) *andamanensis*, Blyth, J A. S. B., xxix, p. 103 (1890); *id.* Cat., p. 114.

Mus rattus, *andamanensis*, *nemoralis*, *rufescens*, *robustulus*, *nitidus*, *horeites* and *æquicaudalis*, Blyth, J A. S. B., xxxii, pp. 338-344.

Mus infralineatus, Blyth, Cat., p. 116 (no description).

Mus rattus, *infralineatus*, *brunneus*, *rufescens* and *nitidus*, Jerdon, Mam., pp. 194, 197-201.

Mus palmarum, Zelebor, Novarareise Säugeth, p. 26, Pl. 3.

Mus sladeni and *yunnanensis*, Anderson, Ann. Zool Res., pp. 305, 306.

Mus rattus, *rufescens*, Thomas, P. Z. S., 1881, p. 57-71.

Chuha, *Musa*, H.; *Gachua-indur*, Beng.; *Kart yelli*, Tam.; *Ghasmiyo*, Cing.

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[1] These Bandicoots were almost all sent to me specially from other districts, having been captured for the most part in gardens in the suburbs.

I feel that some apology is required for venturing on a subject that is still in such a tangle of confusion as the varieties of *Mus rattus* (or *alexandrinus* as Thomas has named it). Thomas's invaluable work in showing that the three varieties, *alexandrinus*, *rufescens* and *nitidus* are intergrading varieties with no skull differences and separated only by size, cleared up matters very considerably. One gathers, however, that there is still considerable doubt as to what exactly is the typical *Mus rattus* of India and what variations from the type are sufficiently distinct to warrant names, from the following passage in the same author's review (1894) of the Bornean species of *Mus* : "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 the Oriental Muridæ, and which at present owing to want of material 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." The name is not given, however, and no further mention is made of the group. Similar sentiments are conveyed more tersely in a footnote to Miller's key to the rats of Trong, Lower Siam, which simply states that *Mus alexandrinus* has been excluded. As to the house rats of India generally, I have nothing to say; but I have hopes that my comparatively extensive work on the house rats of Calcutta will afford material which, in experienced hands, may aid in attacking the general question of the varieties of the Oriental *M. rattus*, particularly in reducing vague varieties and sub-varieties to a common denominator.[1] For I shall try to demonstrate that *M. rattus*, as found in Calcutta, shows the greatest possible variation in coat, colour and size; so much so as to render it absurd to give a new name to every slight variation found in each new locality investigated, as is the tendency at present. Thomas has already shown that the presence or absence of spines is valueless as a mark of specific difference, and that the length of the nasals is variable, though some doubt is cast on this latter observation by the measurements I have collected. I shall try to establish that differences of size have to be regarded with great suspicion, while white-tipped tails and white underparts and colour variations generally, and even, in the matter of skulls, differences which at present are made to have specific value, are liable to be nothing more than normal individual variations. The material which I have to go upon consists of fresh measurements of over 90 specimens, skull measurements of 46 of these, and the rough examination of some 300, examined in the months of February, March and April, with only a few in May.

The first point to settle was whether there were two distinct size varieties, *alexandrinus* and *rufescens*. These Thomas describes as larger and smaller, but he gives the measurements as follows :—

	Body.	Tail.	Hind foot.	
M alexandrinus	15·6	17·5	3·6	From spirit specimens.
M. rufescens	13·3	16·5	3·6	
M nitidus	16·5	16·7	3·5	(A hill variety not found in Calcutta.)

[1] See note on Millais' description of the rats of Great Britain at the end of this paper.

The law of age variation, which I have already laid down, enabled me to settle this definitely. If, as seemed probable, differing sizes were due simply to age, then by arranging them in series according to size one would expect to find that as the size increased the relative proportions of the hind foot and ear would regularly decrease. How completely the result justifies the anticipation will be seen from the following table, where the gradation of the percentage of the length of the hind foot and the ear is perfect.

Table showing gradation of measurements in different sizes (i.e., *ages*) *of* Mus rattus.

Total length of body in centimetres	Percentage of body-length.		
	Tail.	Hind foot.	Ear.
13—15	135·1	22·8	13·7
15—16	125·8	20·1	12·7
16—17	123·5	19·9	12·6
17—18	125·0	19·2	12·1
18—19	120·1	18·2	11·9
19—20	124·4	18·1	11·8

An examination of the skulls of the series confirms the result of the body measurements, and almost equally strongly indicates that the gradation of size is simply one of age. There are one or two slight discrepancies in the case of some of the measurements, particularly that of the interorbital breadth, a very small measurement in which an error of $\frac{1}{50}$ of an inch is an error of over 1 per cent. in relation to the total length of the skull, and 8 per cent. of the actual measurement. In the most important measurement, however, that of the breadth of the cranium, the gradation is perfect, ranging from 40·4 per cent. for rats of only 13 to 15 cm. in length to 35·5 cm. for the largest sized rats from 19 to 20 cm. in length. It will be remembered that in the young rats 9-10 cm. long the cranial breadth was as much as 50 per cent.

Table showing gradation of cranial measurements in different sizes (i.e., *ages*) *of* Mus rattus.

Length of head and body.	Number examined.	Average length of skull in millimetres.	Percentage of total length of skull.					
			Length of nasals.	Cranial breadth.	Interorbital breadth.	Length of zygomatic plate.	Diastema.	Length of upper molar series.
13—15 cm.	10	37·97	35·1	40·4	15·0	11·5	26·3	18·0
15—16 cm.	8	38·9	34·0	39·5	14·4	11·7	26·6	17·8
16—17 cm.	8	40·93	35·4	38·6	13·7	12·2	27·1	16·8
17—18 cm.	11	41·5	35·7	37·4	13·9	12·4	27·5	17·1
18—19 cm.	4	43·87	36·7	36·6	14·1	12·5	27·6	16·6
19—20 cm.	5	45·25	37·5	35·5	14·2	12·59	28·8	16·2
Total	46							

These tables of measurements establish beyond a doubt that age and size are the only factors in the grouping of the different series, and that the existence of two constant races is impossible. The variation in size is very considerable, for many of the smallest rats, only 14-15 cm. in length, were already mature, to judge from the development of the testes, though still young as shown by the teeth. On two occasions I have found rats of this size pregnant.

Colour.—The very wide range of colour is most striking, and at first most strongly suggested that I must be dealing with at least two species, but further investigation soon showed that every colour may be found in every size of rat, and that very divergent colours are linked together by intermediate examples. This is not by any means the only instance in the genus *Mus* of a great range of colour being noted. Swinhoe in his description of *Mus coninga* gives no less than five colour varieties "so linked together by intermediate forms that there is no drawing a line between them." Other members of the subfamily Murinæ which show the same great range of colour, are *Crateromys* and *Phlœomys; Crateromys schadenbergi*, the beautiful squirrel-like rat of the mountains of Luzon, is found black, grey and piebald; *Phlœomys cumingi* is almost as variable as the guinea pig and no less than seven types have been figured, exemplifying every degree of skewbald and piebald coloration.[1] Whereas in Bombay the black type of *M rattus* is the most common, *i.e.*, 30 per cent., here in Calcutta it is so rare that I have only got eight specimens in all, half of which have been specially sent to me from other districts.

Of the variations of *M rattus* as found in Bombay, Liston writes as follows:—

"Colour, in Indian species, usually brown, more or less rufous or occasionally yellowish-brown; more rarely blackish-brown or black; below generally white,

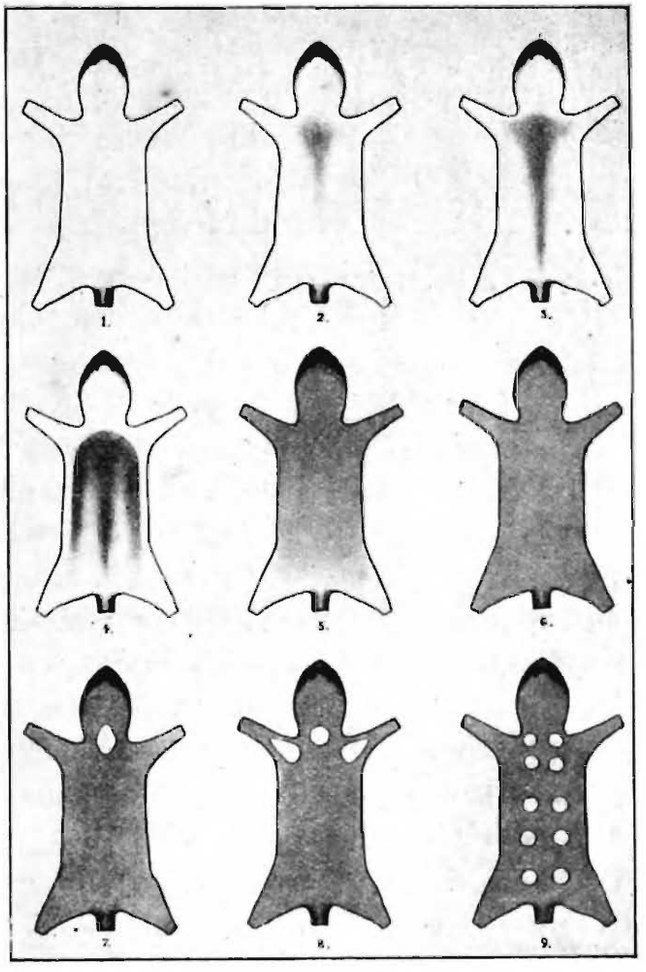
[1] *Abh. über Zool. Mus. Dresden*, 1896-97.

frequently sullied, sometimes brown or grey and occasionally with a white, fulvous or grey median band. Tail uniformly brown throughout.

"In Bombay at least one-third of the rats are typical *Mus rattus*, *i.e.*, black, but in other parts of India this does not appear to be the case.

"It must be remembered, however, that this rat is often far from being black, varying from brown to almost white."[1]

The colour usually found in Calcutta is a rather light-brown with a clearly defined yellow-white belly, white tinged with lemon yellow extending to the throat and the inside of the limbs. A very pretty variation is sometimes seen in which the white of the belly is separated from the upper brown parts by a narrow line of burnt sienna. The brown of the upper parts varies from a dull vandyke brown to a distinctly rufescent or sienna-tinted brown. Again, rarely, the brown may be so pale as to become almost a yellow, *i.e.*, a faint cinnamon brown. The middle line of the back, as in most rats, is much darker than the rest. Whereas in about 50 per cent. of individuals the yellow-white belly is found, in the remainder the belly is grey or orange-grey, a curious tawny mixture, produced by orange or ochraceous tips mixed with grey. Between the white and the grey or orange-grey belly every possible combination is found, from a white belly with a single spot or streak of grey under the throat to one where the streak has spread out into a great breastplate of grey that leaves only a margin of white. Where the whole belly is grey, the only trace of intrusive white may be a white spot or star under the throat or small circular patches round the nipples. As showing how endless are the combinations and variations of these different belly colourings, the figure in the text may be referred to, showing the different variations found in nine specimens of *M rattus*, which represented the total bag for one day. Only two out of the nine rats showed the same pattern, one being a very large adult, the other a small one. The skin with the grey breast stripe did not occur in this particular batch, but it is included in the drawing as being a common type of colouration. Where the fur of the belly is white the skin is also white instead of being bluish-grey as it normally is on belly back and sides. If the fur of the belly is grey the skin is also found to be grey.



Black Form.—A comparison of the black form with skins from Oxford in the

[1] *Plague, Rats, and Fleas*, Liston, Captain, I.M.S., *Journ. Bombay. Nat. Hist. Soc.*, vol. xvi, p. 253.

Indian Museum shows that externally the black form is identical with the old Black Rat of England.[1] The belly is a very dark grey or greyish-black ; the feet are covered with short black or brown hair and are atreous throughout, including the soles. A few grey hairs may be found mixed with the black on the sides. Except that none of the 8 specimens exceed 16·5 cm. in length, there is nothing in either the body or the cranial measurements to distinguish them from normally coloured rats, for the fact that the tail is a little below the average is probably accidental and of no importance. The underfur instead of being grey may be nearly black. In the belly it may have a few orange ochraceous tips, giving rise to a greenish tint in combination with the dark blue-grey of the underfur, just as is sometimes seen in the back of the rat of ordinary colour, particularly when wet. I am at present trying to breed from a female, which is interesting as being intermediate between the extreme melanotic type and what is much more common, the rat that is simply slightly darker than usual and more pigmented all over. Though at a first glance this rat seemed black all over, a closer inspection showed that the sides were brown owing to an admixture of the black with yellow and ochraceous rufous tips. The belly and throat were very dark-grey and the feet were atreous. The most notable thing in the colouring was a jet black patch under the throat, stretching from ramus to ramus.

Unpigmented Forms.—Just the converse of the melanotic forms are the sports which are occasionally come across showing lack of pigment all through the skin as well as the hair. The most extreme case has been admirably figured and needs no detailed description. It is a very good specimen of partial albinism, where pigment has been retained in the eye and in the dorsal stripe, but elsewhere is lost. One other instance has been met with in which there were only sufficient white hairs to give the rat a light greyish tint. A more interesting form was one in which it was less a case of pigment being wanting than of its being very faint. The skin it is true was unpigmented upon the dorsal as well as the ventral aspect, but the fine fur of the back was brown, so light in colour as to be almost yellow, *i.e.*, a pale cinnamon colour. Unfortunately the skull of this specimen was lost before being examined ; the general dimensions and appearance of the specimen agreed closely with the description of *Mus fulvescens*[2] or *cinnamoneus*, a rat about the specific identity of which I am rather doubtful.

Fur.—From the preceding section it will be evident that to attempt to express in terms of fur the extreme variations of colour found, would be impossible. The fur varies greatly in consistency, being sometimes comparatively soft and fine and quite free from spines, while in others a good many spines will be found taking the place of the intermediate elements. In none of the skins do spines form the predominant element of the covering ; as a rule they are rather few and scattered. The usual three elements are found—

1. Dark-grey fine underfur about ·75 cm. long.—In the white-bellied forms

[1] See, however, note at end of paper.

[2] Some of the Indian Museum specimens of *M. fulvescens* have the zygomatic plate sloped forward but others have it perpendicular.

this is white on the belly, but occasionally it is only the tips that are white. On the body the grey underfur is frequently tipped with pale yellow or ochraceous buff. The underfur varies with the general degree of pigmentation, and in dark rats is a very dark blue-grey and in black rats may be almost black.

2. Hairs of 1–1·25 cm. long, as a rule grey below with the brown or black upper part terminating in a tip of ochraceous orange. Other hairs have no brown or black in the upper part. It is the predominance of these ochraceous or orange hairs which determine the lightness of colour and rufescence of the rat. These are the hairs which are often replaced by whitish or grey spines with black or brown tips.

3. Long black hairs in the dorsal region, particularly over the rump.—These vary from 2·25 to 2·5 cm. in length but are comparatively fine and need not be mistaken for the huge coarse bristles of *Nesokia*. Occasionally they are much longer than stated, and may run up to 3 to 4 cm. in very large coarsely furred specimens.[1]

Tail.—The tail is long and slender, averaging about 125 per cent. of the body-length; the artist has made it rather thicker than it should be. It varies, however, within considerable limits, and shows a tendency to be longer in the smaller rats, so that the true average line slopes from 135 for rats under 15 cm., down to 120 for large rats of 19 cm. and over, with extreme limits of 152 and 106 per cent. The tail is uniformly tapered and very regularly annulated, the rings averaging in the centre of the tail 10 to the centimetre. The tail is scantily clad with brown or black hairs as long as the depth of two rings. Towards the tip the hairs are longer, but they do not form a brush. In colour it is generally uniform blackish brown, but if the rat is a light-coloured or rufescent one, the tail may be pale madder-brown. Thomas and Blanford make it faintly lighter below. I find as a rule that it is absolutely uniform and only very occasionally does one get a faint trace of lightening underneath.

White tips.—Four times I have found white-tipped tails, in addition to noticing on two or three occasions that the four or five longer terminal hairs were white. In three instances the effect was marked as both skin and hairs were white; in two of these the tip was 2 cm., but in the third it was only 0·2 cm. long. In the fourth instance the last 5 cm. of the tail were covered with white hairs, but the skin was brown, so that the general appearance was as if the end of the tail had been dusted with flour. This white tip was noted as a sport in *Nesokia bengalensis* also.

Whiskers.—These are very long, longer than the head and ear combined. The lower two or three vibrissæ as a rule are white, the rest black. The tips are frequently lighter. Two, or sometimes more, very long cilia spring from the supraorbital region.

Feet.—Both fore and hind feet are, as a rule, covered with short, white hairs, and their sides are flesh-coloured. In dark rats the middle of the hind foot will be light

[1] I have attempted as far as possible to describe the hair colour by comparison with Ridgway's scale of colours, but I find it a most unsatisfactory process, as a single hair may require half a dozen long and unfamiliar names to describe it. Take a long black hair which shades down to white or almost white at the base. From black one works through two or three varieties of brown, next through two or three shades of drab, passing through isabelline to delicate changes of grey before white is finally reached.

brown, whereas in black rats it is dark greyish-brown or nearly black. The sole is generally flesh-coloured but in a dark rat is slightly atreous, and in a black one distinctly so. The manus shows the usual five pads and a rudimentary tubercular pollex bearing a nail. All the other digits bear claws, which are white, hooked, and sharp. The hind foot is long and narrow; it shows the usual 6 plantar pads, the mesial ones of which are markedly cordiform and generally show a supernumerary tubercle, as is pictured in the foot of *M decumanus*.

Ears.—The ears are very large, wide, and prominent, standing clearly out from the head. They are scantily clad above with short, brown hairs, but below are nearly naked.

Mammæ.—Two pectoral pairs and three inguinal, with little tendency to vary.

Habits.—The typical abiding place of *Mus rattus* is the thatch and crannies of the roof, roof tiles, holes in the floor and such-like places. Unfortunately for it, the structure of the average Calcutta house does not lend itself to providing such hiding places, as the roofs are flat and built of masonry laid on beams, nowadays generally of iron. In fact the modern house affords such a very small foot-hold to *Mus rattus* that this may be the explanation of the comparative rarity of the species in Calcutta. On the other hand, there are still large areas of tiled huts in the city. Though many of the rats brought to me came from the upper stories of "pukka" (masonry) houses, most came from huts, and generally from the cook-rooms of the huts. They climb with great facility, scampering upside down along the wire roof of the large cage in which I have some confined. Once or twice when in small cages, I have seen the tail used as a support and point d'appui in climbing about. Twice I have had captured rats litter immediately after being caught, and on each occasion the litter was three, but 6 to 8 is the number normally found in pregnant females. At birth they are pink, naked, with eyes and ears closed, and measure 5 cm., the tail being only 2 cm. long, less than half the body-length. The tip of the ear conch is directed downwards and forwards under the skin. Even at the end of 10 days the conch is simply a little tag with no external meatus. The meatus is represented by a small quadriradiate furrow. I have now kept records of all rats found pregnant for a year from February to February, and can state definitely that as far as observed in cities there is no breeding season. At the Zoological Gardens they live to a great extent in the palm trees. Mr. Sanyal, the Superintendent of the gardens, informs me that at one time he kept rats taken from nests in the trees, and bred them in a masonry pit. He noted the curious fact that in a few generations they lost their bright rufous colour and became very dark brown, assimilating themselves to the ground in which they burrowed.

Distribution.—Almost world-wide, doubtless from being introduced. Probably indigenous in India and found throughout the country, also in Burma and Ceylon, from the sea level to an elevation of at least 8,000 feet (after Blanford).

Teeth.—It is rather difficult to describe the tooth of *Mus rattus* accurately, owing to the impossibility of drawing a sharp line between what constitutes a rudimentary cusp and what constitutes a rudimentary lamina. It may simplify matters to state that the molars of this species consist of a varying number of sinuously-waved trans-

verse laminæ overlapping each other obliquely from before backwards. The essential difference between these laminæ and those found in the genus *Nesokia* is that the former are much more sinuous and tend to break up into definite cusps, three in the upper molars (a large central anterior one, flanked by a smaller one on each side which is slightly posterior) and two only in the lower molars. This sinuous arrangement of the cusps is well shown in the figure of the unworn tooth of *Mus rattus* (plate i, fig. 10), while the sharp way in which the cusp stands out from the lamina is better displayed in the figure of the unworn tooth of *Mus decumanus* (fig. 25).

The upper incisors are orange in colour, with a comparatively flattened anterior surface which shows fine longitudinal parallel markings just as in *Nesokia*, though Thomas and Blanford make the incisors smooth as against the "sculptured" surface seen in the same teeth in *Nesokia*. The pair of lower incisors are much paler, rather a faint yellow-ochre than orange, and at times may be white. The upper molars show the following structure:—

The 1st molar consists of three tricuspid laminæ as above described, the tubercles or cusps forming three longitudinal rows.

The 2nd molar consists of three laminæ, of which only the middle one is fully and typically developed. The anterior one is only rudimentary and is represented by the inside cusp. The posterior one is also not fully developed and is represented mainly by the central tubercle, and less distinctly by the outside cusp, the inner being altogether wanting.

The 3rd molar is like the second, but the middle lamina is less distinctly marked off into three cusps or tubercles, while the posterior one is very small and shows only the central tubercle.

I have had to go into this question rather in detail, as in some specimens the laminar division of the tooth is more distinctly marked than the tricuspid or tritubercular division of the lamina. The main characteristic, however, of the fully developed unworn tooth is the division of the lamina into distinct tubercles or cusps, though it must be admitted that in the early development of the tooth the lamina appears with very little sign of subdivision, approximating to the condition typical of the Nesokian tooth.

The laminæ in the lower molars are divided into two tubercles, giving a double row of cusps separated by a median furrow. The first molar consists of three of those laminæ, with a rudimentary fourth one behind mesially, *vide* fig. 12*a*.

In addition it may show an extra cusp between the second and third laminæ on the outside of the tooth, *vide* fig. 12*b*.

It is noteworthy that additional laminæ or cusps in the upper molars are found on the inside, whereas in the lower they are on the outside. The second molar consists of two fully developed laminæ, with a median rudimentary one behind. In addition there are found on the outside the following additional rudiments: a rudimentary lamina in front of and outside the first laminæ, and an extra cusp joined in between the first and second laminæ.

The third lower molar consists of two laminæ, the second of which is poorly developed. An additional mesial rudimentary lamina is present posteriorly, and between the first and second laminæ is an additional rudimentary cusp. The posterior mesial rudimentary lamina is very clearly seen in the second molar at a stage at which the third is still simply a flattened plate, which does not hide or interfere with it in any way.

In the worn tooth of both upper and lower jaw, these traces and rudiments disappear, so that there remains simply a flat surface of dentine marked by a sinuous black line, which is all that remains to show the separation of the laminæ or tubercular ridges, *vide* fig. 7.

Skull.—The distinguishing feature in the skull is that it is an elongated oval with all its lines and ridges flowing in easy curves and with elongated narrow nasals which give to the whole as it were an aquiline expression. The cranium is slightly domed, with a shallow depression separating its contour from the paired eminences that mark the termination of the supraorbital ridges. The lower portion of the anterior edge of the zygomatic plate is vertical, or slants a little upward and forwards to curve backwards to a deep emargination. The lower part of the infraorbital foramen is narrow, with a swelling in front on the maxillary bone. The palatine foramen is equal in length to the upper molar series, and extends posteriorly to just beyond the anterior root of the first molar. The nasals project markedly beyond the gnathion or most projecting point of the premaxilla. The occipital bone is vertical, the occipital crest and the condyles being in the same plane. The coronoid suture generally forms a flattened crescent, but is very variable. The interparietal is generally oval, bounded by a curved line posteriorly and two curved lines coming to a point anteriorly.

Variations.—I have been rather surprised to find that the variation of the nasals is so slight compared with the range of from 49 to 69 per cent. described by Thomas as occurring in *Mus nitidus*. The extreme range is only from 32·5 to 38·9 per cent. The general average is 35·2 per cent., and in half of the specimens the measurements fall within the limits 34 to 37 per cent., with the remainder almost equally divided above and below the limits given. These figures are based on *M. rattus* taken as a whole, including all sizes. Thomas in his series of 12 skulls of *Mus nitidus* from Darjeeling, apparently not collected by himself, found as has been said very wide variations in the length of the nasals. On the other hand I find that the length of the nasal is almost constant, not only in the *M rattus* series of skulls but in all the Calcutta species which I have examined, as will be seen from the figures given below. In addition to being constant I find the average measurement is much smaller than given by Thomas, about 36 per cent. of the skull length sinking down to 27 per cent. in *Nesokia bengalensis*. Possibly the explanation of the discrepancy is that Thomas has reckoned his percentage on the basal length, whereas mine is reckoned on the total length. The following are details giving the maximum above and below the average percentage in the case of each rat, reckoning each size of *rattus* separately: *N. bandicota* var. *nemorivagus*—practically nil; *Mus rattus*—2+2; *M. rattus* var. *nitidus*—2+2; *N. bengalensis*—1+2·5; *M. decumanus*—2+3·4. Two quite exceptional

instances have been excluded in making up these figures, first a *N. bengalensis* skull with nasals 10 per cent. below the average, and a smallest size *M. rattus* skull 6 per cent. above the average. The coronoid suture shows a considerable amount of variation A simple flattened curve is common, but it is still more common to find that the curve is like a bracket owing to a posteriorly projecting point on the frontal. In 6 out of 62 skulls examined on this point it was angular, the two limbs forming an angle of 120° This condition is almost always found in immature skulls ; it is not quite sufficiently marked in the young skull as figured in fig. 5. In four specimens the posterior projection of the frontal was very marked. Number 259 had a zygomatic plate that sloped slightly forward and downward instead of being perpendicular. This sloping, non-developed condition of the plate is marked in very young skulls with the third molar not yet developed. Number 182 showed the right anterior palatine foramen ·75 mm. longer than the left. Close to the coronoid suture there is a projection of the supraorbital ridge, from which a vertical ridge runs down the posterior wall of the orbit; in No. 284 this is almost completely absent. The interparietal, on which much stress is laid as a means of differentiation, varies very much in shape. It is commonly an oval with pointed ends. The anterior curve is generally bracket-shaped owing to an anterior projection ; the posterior curve may be similarly modified by a posterior projection. Lastly, the ends of the oval may be truncated so that the bone has lateral boundaries and tends to be five-sided. As a rule the posterior suture is clear of the occipital ridge, but sometimes it is not, so that the interparietal has a considerable share in the formation of the ridge, *vide* fig. 31.

The occipital in Nos. 91 and 132 instead of being vertical, slopes slightly backwards and downwards, though not to the same extent as in *Mus decumanus*. Occasionally the occipital ridge projects posteriorly beyond the vertical plane.

Dimensions.—It is not necessary to say anything as to the measurements of the body and the cranium, as the tables given at the end have been broken up into groups which indicate clearly what are the average normals and what are above or below these. The two smallest sizes have not been taken into account in making up the averages of body and skull measurements given in the tables of comparative measurements at the end of this paper.

MUS RATTUS var. NITIDUS.

Thomas finds the skull in no way different from that of *M alexandrinus* or *M rufescens* and makes it an intergrading variety—the hill variety of *M alexandrinus*. From an examination of a very limited number of specimens in Darjeeling, it seems to me to be a distinct variety clearly marked off by the proportionate length of the tail. In two adults this was 97·3 of the length of the head and body, and in two three-quarter grown rats 105·7 per cent. The tail is distinctly lighter below, unlike that of *M. rattus* as found in Calcutta. Blanford makes the tail of *M rattus* generally the same colour throughout, but sometimes paler beneath, and states that some specimens from Simla have the undersurface of the tail quite white. Possibly the real explanation

of this statement is that the *M nitidus* of Simla has been confused with *alexandrinus*. The fur is longer, darker, and thicker than in the *M. rattus* of the plains; the underfur on the belly is 7·5 mm. long and on the back 12·5 mm., the same length as the black and yellow-tipped hairs. The long, black hairs of the back are from 30 to 35 mm. in length. The belly is a dirty grey which, with the tail light coloured underneath, gives the general effect rather of a young *M. decumanus* than of *M. rattus*. The tail is rather attenuated at the end. The large and prominent eye distinguishes it from *M decumanus*. The feet are white above, and have the soles slightly atreous, though not more so than is found in a dark specimen of the ordinary *M. rattus*. Blanford makes the soles of the feet white.

The following are the principal measurements of fresh specimens; the crania of the immature ones were not measured. The only point of difference between these crania and those of Calcutta *rattus* was very slight, the occipital bone was not quite so vertical, though presenting nothing like the slope seen in *M decumanus*. On none of the specimens examined was a single flea found, but a minute mite was always found in large numbers. One sickly rat swarmed with them.[1]

Body Measurements of Darjeeling Mus rattus *var.* nitidus.

No.	Sex.	Date.	Head and body.	Tail.	Hind foot.	Ears.	Relation of ear to eye.
1	♂	12-6-06	18 100		3·7 21·11	2·1 11·66	Half covers.
2	—	14-6-06	13 100	13·5 103·8	3·3 25·38	2 15·38	,, ,,
3	—	14-6-06	13 100	14 107·6	3·2 24·61	2 15·38	,, ,,
4	♂	18-6-06	19·5 100	18·5 94·8	3·6 18·46	2·2 11·28	Covers.
5	♂	18-6-06	18·5 100	18·5 100	3·5 18·85	2·2 11·88	Half covers.

Mus vicerex from Simla described by Bonhote (*loc. cit. antea*) seems identical with the *Mus nitidus* of Darjeeling in every particular save that the former is said to have the ear fringed with a line of short, white hairs, probably an unimportant local variation.

[1] Specimens of a similar mite obtained from *Nesokia bengalensis* and *Mus decumanus* have been identified by Mr. Warburton as a species of *Hæmagamasus*.

Darjeeling Mus rattus *var.* nitidus.

Principal skull measurements.

No.	Sex.	G.L.	B.L.	G.B.	N.L.	Io. B.	Cranial Breadth	Zg. Pl.	Palat. length.	Pal. For.	Pal. For. Br.	Diastema.	Up. L. Molars.	Br. of Up. Mol.	L. J. C to Inc.	L. J. Cor. to Angle.
1	♂	44	38	21	17·5	6	17	5·5	22·5	8·5	3	12·5	7	2	29·5	13
		100	86·35	47·72	39·77	13·63	38·63	12·5	50·13	19·31	6·81	28·45	15·8	4·54	67·04	29·54
5	♂	45	38	22	18·5	6·5	17	5·5	22·5	8·5	3·5	13	8	2	30	14·5
		100	84·4	48·8	41·1	14·4	37·7	12·2	50·0	18·8	7·7	28·8	17·7	4·4	66·6	32·2
4	♂	45·5	38·5	21·5	17	6	17	5·5	22	8	3·5	13	7·5	2	30·5	14
		100	84·61	47·2	37·3	13·1	37·3	12·0	48·7	17·5	7·6	28·5	16·4	4·3	67·0	30·7
Total figures		134·5	114·5	64·5	53·0	18·5	5·1	16·5	67·0	25	10	38·5	22·5	6	90·0	41·5
Average figures		44·8	38·1	21·5	17·6	6·1	17	5·5	23·3	8·3	3·3	1 ·8	7·5	2	30	13·8
Average percentage			84·8	47·2	39·3	13·6	37·9	12·2	49·7	18·5	7·3	28·6	16·7	4·4	67·0	30·8

MUS DECUMANUS.

This description is based on full measurements in the flesh of 75 specimens, many of them immature, and a cursory examination of a very large series of some hundreds at least, all trapped in Calcutta.

General Characters.—It is a very large, not unhandsome, thickly-furred rat, with large, heavy, flesh-coloured feet, a tail averaging 90 per cent. of the body-length, white or light coloured below. The pads are large, prominent, and the middle ones are cordiform. Ears and eyes are small. The head is long, with broad heavy muzzle and cheeks very full. The tail is heavy and uniformly tapered.

Fur.—The fur is composed of the usual three elements :—

1. Long, black hairs found all over the back, projecting above the general surface of the fur. These only average 2·5 cm. long, and are different from the long, stout, prominent piles of *Nesokia*, which are nearly twice as long.

2. Stout hairs about 1·25 c.m. These vary much in colour and show every gradation of colour from pale ochre or burnt-sienna to brown and blackish-brown. Some are black or brown with yellow tips, while some are yellow with brown or black tips. On the underparts these hairs are mainly white.

3. Thick underfur composed of lanuginous hairs ·5–·75 cm. long, mostly grey, but some pale ochre or very pale brown. These latter may have a grey base. They are very much finer than in *Nesokia bengalensis*.

Colour.—The general effect is a brown rat a little darker over the middle line of the back, with the colour getting lighter towards the lower part owing to the predominant tips being pale yellow or dirty white. The shade of brown varies considerably, from a moderately rich brown to a rather pale yellowish-brown. There is sometimes a rufous [1] effect from sienna-coloured tips, but this is never marked.

The undersurface varies considerably, but it is generally a dirty greyish-white, fading gradually into the lighter tones of the lower parts of the side. It may be hoary-grey all over or whitey-brown, and at times may be an almost clear yellowish-white rather sharply defined, extending over the throat and inner sides of limbs. The occasional sport of a white-tipped tail, noted in *Nesokia bengalensis* and *Mus rattus*, has not been observed in this species.

The whiskers are black, but the hairs lowest on the muzzle are white throughout.

Tail.—Blanford makes the tail brown all over, and in consequence I was at first very puzzled as to what this *decumanus*-like rat with a distinctly bi-coloured tail could be. However, I find in the Indian Museum series that five specimens show the bi-coloured tail distinctly, *viz.*, skins Nos. j.f.l. and p. collected in Calcutta by O. N. Fraser and one (A) collected in Bushire, Persia, by Blanford. Two skins from Gilgit show it slightly, while in three specimens from Saingooting, Assam, and three from the Andamans, the tail is uniformly brown. The fact that the lighter colour of the lower surface may occasionally be so slightly marked as to be easily overlooked, explains the error of previous observers. Out of one particular series of 43 very carefully examined as to the coloration of the tail, three showed a tail at first sight brown all over with short, black hairs; but on careful examination it was seen that the tail was distinctly lighter below, the hairs being light brown there instead of black; in 10 the lower surface was markedly lighter due to a mixture of light-brown and white hairs; in 30 distinctly white below, with white hairs and most commonly white scales. The last two figures are rather arbitrary as every gradation of shade was found, obtained in every possible way, according to the predominance of the scales or hairs in the lightening. Typically, the scales are brown above and horny white below, the rings averaging 6 to 8 to the centimetre, with a limit of 10 to the centimetre. But the lower scales may be found in every shade up to the darkest brown, in which case the hairs will be white. The hairs, on the other hand, may be black, but the scales will then be white. In one instance the scales were white both above and below, the hairs were black above and below, but the lightening of the lower surface was secured by the black hairs being white-tipped below. But no matter what the shade, white, brown or atreous, it will generally be found that scales and hairs vary inversely in depth of colour, and the tail is always distinctly bi-coloured. It is very common to find the scales patchy, little islands of horny white scales occurring in the middle of the brown or *vice versâ*.

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[1] "Rufous" is used as a convenient and generally understood term, signifying reddish, foxy red. Strictly speaking it is an incorrect term, as according to Ridgway it is obtained by the use of the pigment "light red," a colour never seen in a rat.

Manus.—Covered with short, light brown or dirty white hairs. Pollex tubercular with nail. The other digits show strong, horny white claws, by no means always worn and blunted as sometimes described. The palm, which is flesh coloured, shows five pads.

Pes.—Flesh-coloured, thinly covered with short, white hairs, which, on the outer margin of the foot, are sometimes brownish. All the digits are armed with stout, horny white claws, surmounted by a little tuft of longer white hairs. The sole of the foot is flesh coloured and shows six prominent fleshy pads. The median ones are cordiform, and that at the base of the fifth digit frequently shows an attached tubercular pad, which in *Mus rattus* is nearly constant. The proximo-external pad is large and fleshy, unlike the small rudimentary one found in *Nesokia bengalensis.* Next to the tail the pads form the most reliable distinction between these two rats as far as external characters go, though the relative proportions of the length of the foot are very distinctive also.

Ears.—Short and rounded, nearly naked, and of a brownish flesh colour ; covered with very minute hairs ; lower part of the posterior surface nearly naked. When laid forward in 42 per cent. of individuals they came short of the eye, the interval varying from ·2 cm. to 1 cm. In 26 per cent. the ear reached the eye. In 14 per cent. it half covered the eye ; in 4 per cent it covered the eye, and in 14 per cent. the relation of ear to eye was not noted. It will be noted how very unsatisfactory is this point as a diagnostic test, particularly as it is very difficult to apply it in a constant manner.

Mammæ.—These characteristically number three pairs pectoral and three pairs inguinal but are rather variable as this distribution was found in only 11 out of 19 specimens.

In four instances $\frac{2}{3}$ was the formula, in one case $\frac{1}{3}$, in one case $\frac{4}{3}$, and twice they were found unsymmetrical $\frac{3}{2}$ $\frac{3}{3}$ and $\frac{3}{4}$ $\frac{3}{3}$.

Habits.—This rat is essentially parasitic in its habits, frequenting sewers, drains, cellars and generally the basements of houses, and burrowing there. Even where the upper stories are composed solely of masonry and iron, as is generally found in houses of modern construction in Calcutta, these rats are frequently trapped upstairs at night, gaining access by waste-water pipes and the like. I have watched them come out from a drain in a courtyard, enter the outlet of an iron pipe, and presently appear in an upper verandah where they skirmished about for food. With my companion I watched them for a considerable time playing about between the drain and the upper verandah. When caged their demeanour is quite different from *Nesokia bengalensis ;* they take things quite quietly and philosophically and never dash wildly about. They never erect their fur and gnash their teeth. The figures given in my preliminary note as to the relative frequency of *M. decumanus*, were collected in Districts I and II where grain godowns abound, and *Nesokia* is in consequence the predominant rat. In District III, which collects rats caught in and about the Municipal Market and the surrounding quarters, *M. decumanus* accounts for half of the rats sent in.

Dimensions of M. decumanus.

	Head and body.	Tail.	Hind foot.	Ear.
Rough average	22·6	20·2	4·15	19·7
Average large	24			
Average small	21			
Maximum	27·4	24·5	4·8	2·2
Minimum	19	16·5	3·8	1·5
Rough average percentage	100	89	18	
Large Do.	100		19·5	
Small Do.	100		17	..
Maximum percentage	100	100	21	
Minimum Do.	100	80	16	

The two largest rats met with, of a total body-length of 27 and 27·5 cm., were both males, but the next two largest, 25·6 and 25, were both females. Though practically every proportion of tail from 80 to 100 per cent. of total body-length was met with, 82 per cent. of the total fall within the limits 85 to 95 per. cent. The percentage length of the hind foot is a rather important measurement as it is an extremely valuable indication of the age of the specimen. The four rats which have as small a measurement as 16 per cent., are all very large and old rats with a body-length of 27·5, 27, 25·7, 25·25 cm. On the other hand the two with a maximum of 21 per cent. are barely full grown, measuring only 19 and 19·5 cm. in body-length. With half-grown rats about 11 cm. in length, the foot is 28 to 30 per cent. of the body-length.

Skull.—The most striking characteristic is the flatness of the antero-posterior curve and the general appearance of squareness shown by the cranium. The upper cranial surface, which in *Mus rattus* is pyriform, is here rather rectangular, the massive supraorbital ridges running back almost straight to join a very well-defined occipital ridge. The occipital bone is set obliquely instead of vertically, so that the condyles project most posteriorly of any part of the occiput. The anterior edge of the zygomatic plate sweeps boldly upwards and forwards to recurve to a deep emargination. This is not very well shown in the figures as the anterior curve should be much bolder. The nasals only just project beyond the gnathion or most prominent point of the premaxilla, so that they are much less prominent than in *Mus rattus*. The interparietal is generally three-sided with a well-marked anterior spike, but this may be suppressed so that the bone is an oval as is normally found in the young skull, *vide* fig. 18. The same variability of the posterior suture as regards its position relative to the occipital

ridge is found, as has been already described in connection with *Mus rattus*. Where the occipital ridge is very well developed it may give the occiput the appearance of being vertical, but there is always some slope. The zygomatic plate may rarely be nearly perpendicular, but even in the young skull it hardly ever slopes downwards and forwards as it does in young *M. rattus*.

Teeth.—After the very full description given of the teeth of *Mus rattus*, there is very little to be said; those of *Mus decumanus* are identical except for a slight difference in size, being slightly larger, particularly the incisors. Figure 20 shows well a tooth that is extremely worn so that it has become a mere block of dentine with only a trace of laminar division left, and not even a trace of cusps. The young teeth show the same tendency to be furnished with additional cusps and laminæ as is seen in *M. rattus*, and figure 27 shows particularly well the central additional rudimentary laminæ of the lower molars. In addition to the antero-internal supplementary lamina or cusp normally present in the second and third molar in *M. rattus*, there is occasionally found a trace of an antero-external cusp, indicating a tendency of the extra lamina to extend completely across the tooth. This has already been noted by Miller in his description of *Mus validus*, in which the external cusp is normally present even in the worn tooth and is generally joined to the internal one, completing the additional lamina in the second molar, whereas in the third molar the elements are said to be less distinct: in the figure the two extra cusps are shown quite separate, with no indication of a junction. In four out of twelve young *M decumanus* skulls I have found this trace of an antero-external cusp, whereas in *Mus rattus* I have seen it once only.

NESOKIA BENGALENSIS.

THE INDIAN MOLE-RAT.

(Synonymy after Blanford.)

Arvicola bengalensis, Gray and Hardw., Ill. Ind. Zool., ii, pl. 21 (1833-34).

Mus kok, Gray, Charlesworth's Mag. N. H., i, p. 585 (1837).

Mus (Neotoma) providens, Elliot, Mad. Jour. L. S., x, p. 209 (1839).

Nesokia hardwickii, Kelaart, Prod., p. 65, nec Gray.

Nesokia kok, Kelaart, *ibid.*, p. 66.

Mus daccaensis, Tytler, A. M. N. H. (2), xiv, p. 173 (1854).

Mus tarayensis, *plurimammis*, and *morungensis*, Hodgson, Horsfield, A. M. N. H. (2), xvi, p. 112 (1885).

Nesokia indica, Blyth, J A. S. B. xxxii, p. 328; Jerdon Mam., p. 187; Theobald, P. A. S. B., 1866, p. 239; Blyth, Mam. Birds, Burma, p. 38.

Mus (Nesokia) indicus, Blyth, Cat., p. 112, partim.

Mus (Nesokia) blythianus, *barclayanus*, and *providens*, Anderson, J A. S. B., xlvii, pt. 2, pp. 225-231, pl. xiii.

Nesokia barclayana, Blanford, Yark. Miss. Mam., p. 46, pl. x*a*, fig. 1 (skull).

Mus (*Nesokia*) *bengalensis*, Thomas, P. Z. S., 1881, p. 526; Anderson, Fauna Mergui Archip., 1, p. 341.

Yenkrai, Beng.; *Kok*, Can.; *Golatta koku*, Tel. of Yanadis; *Rekywek*, Burmese.

This is the commonest rat in Calcutta and probably the one most concerned in the dissemination of plague, being the predominant species in grain godowns, which have, in Calcutta and elsewhere, notoriously been the centres from which plague has spread. Major Leonard Rogers, I.M.S., has kindly examined for me sick specimens and has found them suffering from plague.[1] Its general characters will be found described in the key. It has apparently been much confused with *M decumanus* in the past, but the character of the footpads, the relatively small foot, the tail, bristles, and colour of the feet and muzzle, will always distinguish it, while the broad, short, arvicoline head is also characteristic. The fur is coarse and thin, so that when the rat bristles when enraged, the naked skin can often be seen; when drowned the animal frequently looks half naked, with the large teats in the female very prominent. The fur is composed of three elements, as follows: (*a*) Underfur pale, grey, coarse, scanty, found all over except on the upper surface of the feet and the anterior lower surface of the throat. (*b*) Coarse, pointed hairs, 1·25–1·5 cm. long, most of which are black below with straw coloured or cream buff tips, sometimes surmounted by an extreme tip of black. Mixed with these, are similar hairs rather longer and coarser, black throughout; both these kinds of hair may have pale grey or isabelline bases. Towards the underparts the yellow tips get paler till on the belly and throat dirty white or white hairs are found mixed with the black. (*c*) Long, black piles, 4-5 cm. long. These are very characteristic; they are found all down the back and partly down the sides, but are most marked on the rump.

Whiskers.—These are black, mostly tipped with pale sienna or ochraceous buff.

Colour.—The general colouring is very similar to that of *M. decumanus*, but the effect is a colder, greyer brown. Down the middle line of the back, the mixture of black tips with ochraceous buff gives a fairly rich brown, but as the sienna tips grow paler down the sides, a greyish grizzled-brown results, getting dirty greyish-white on the underparts. Just under the throat and on the inside upper surface of both feet, and the inside of the legs, dirty white is found; but not enough to affect the general undercolour, which is grizzled greyish. The muzzle is a rather livid flesh colour, as are also the feet, markedly darker than the flesh colour of *M. decumanus*, the feet being faintly atreous. Anderson makes the feet and muzzle in *N. blythianus* flesh coloured, but in *N. providens* dark flesh coloured. *N providens* is, according to him, a Southern Indian or Ceylon rat, while *N. blythianus* is common in Calcutta. As a pure field rat the former tends to be lighter in colour and occasionally rufous.

Tail.—The tail is rather characteristic in shape; it is very thick at the base and tapers suddenly, so that the extremity looks attenuated compared with the heavy uniformly tapering tail of *M. decumanus*. It is irregularly, but very distinctly, annulated, the rings averaging in the centre about 12 to the cm. The scales are

[1] *Calcutta Plague Report*, 1905-06, p. ii, Appendix A.

square with rounded corners; black pointed hairs about one and a half to two rings deep are set under the scales. Under the base of the tail these are longer, and occasionally a few of them are white. The scales generally overlap, but sometimes the rings are separated by a dark, flesh coloured interval, giving the tail a brown appearance rather than black. Twice I have come across a white tip to the tail, both scales and hair being white; this tip extended only 0·5 cm.[1]

Feet.—The feet are dark flesh coloured, or faintly atreous, and with their small, round pads are quite characteristic. The fore foot has the usual five pads, and the hind the usual six, but the proximo-external is so very small that it is easily overlooked. So small is it that it is occasionally absent altogether or it may be absent on one side and only faintly present on the other. The following is the result of an examination of a series of 160 individuals on this point :—

Normal.	Almost absent.	Absent one side.	Absent both sides.	Rather large.
147	3	2	3	5

In the five noted as having rather large pads, there was a tendency for the pads to be cordiform as in *M. decumanus*. The manus shows a rudimentary pollex with a nail, while all the other digits are armed with sharp, white, strong claws. The short hairs covering the feet are dark, except on the inside where they are white; a few long, white hairs project over the claws.

Mammæ.—The mammæ are numerous, large, and easily counted; generally 14, 4 pectoral and 3 inguinal pairs. When large the series is continuous and cannot be properly broken up into pectoral and inguinal. The following is the result of 16 observations recorded :—

				Rt.	Lt.
$\frac{4}{3}$	$\frac{3}{4}$	$\frac{4}{4}$	$\frac{5}{4}$	$\frac{4}{4}$	$\frac{3}{4}$
5 times	4 times	3 times	3 times	once	

Ears.—The ears are brownish flesh coloured, practically naked, and quite naked on the lower half of the dorsal surface. Their relation to the eye as in all the other Calcutta rats examined, is very variable. Though the ear is short, the head is so short and blunt that in 46 per cent. it reaches or covers the eye. Fifty individuals were examined as regards this point, with the following results :—

Covers.	Half covers.	Reaches.	Short.	Unspecified.	Total.
9	7	12	14	8	50

Habits.—This rat was originally a burrowing, grainstoring field rat, but in Calcutta it has become markedly parasitic on man, infesting stables and grain godowns. It honeycombs solid brick walls, and I have seen it at midday waiting in its hole three feet up the wall for the horse's stall to be replenished. Recently in our own stables I have found a pile of rubbish 6 ft. × 4 ft. × 9 in. thrown out

[1] Since this went to press I have obtained two black-eyed albinoes identical in colouring with the albino *M. rattus* which is figured.

by this species, containing large lumps of brick. At the same time a brick drain got totally blocked owing to their burrowing in the foundations. Their swimming and diving habits have been noted by Blanford, Anderson, and Blyth; the last author also refers to their fierceness and habit of bristling their coat. Personally I have noted that when brought in a cage they snarl and bristle at one, their snouts are bleeding from their violent dashes against the bars, while the whole cage is in a constant ferment of savage attack and counterattack. When the cage is submerged they swim up, down and round with ease and unconcern, and it is only when asphyxia is coming on that they begin to exhibit alarm or to struggle. In huts where grain is stored and in godowns, the whole yard and the plinths of the surrounding huts are found riddled with their burrows, as also are the clay walls of the huts. The native has devised a simple but effective method of keeping them down. Under the huge sack granaries in which the grain is stored, they place sheets of corrugated iron; periodically the sacks are shifted, the sheets removed, and with a few strokes of the *kodali* (hoe), burrows, rats' nests and young are exposed, and a holocaust ensues.

These rats are frequently brought into the depots alive in enormous batches; for instance I have seen as many as seventy in one gunny bag, all caught by hand in one flour-mill. Whenever a batch is particularly large, it always turns out that instead of being trapped they have been caught by hand. The favourite method is for the rat-catcher to take up a position after dark by a favourite run, generally a small ungrated opening in the wall through which waste water runs off into the large open sewer, drain or ditch by the side of the road such as is still found in Entally and the outskirts of the city. A candle is generally used, and the hand is protected by being loosely wrapped in a cloth. I have been told of one particularly expert rat-killer who was blind, but who could locate the rats so exactly by ear that it was seldom that his stick missed. A common method of hand catching is to stop up all the holes except one or two, flood the run with water and secure the rats in sacks or by hand as they bolt

One particularly successful rat-catcher whose hut adjoins a small native flour mill has shown me a particularly effective method of using an ordinary "Wonder" trap. A hole large enough to contain the trap is dug in the floor of the hut across one of the runs. Grain is strewn in the bottom of it and the top covered with a stone or board. In two or three nights the hole becomes the chief resort of the rats, which take it apparently for the central storage chamber of their run. The cage will then be found crowded every morning.

Distribution.—The greater part of the Indian Peninsula from the base of the Himalayas to Cape Comorin, and from Lower Sind to Cachar, and, I believe, Assam; more common in damp alluvial tracts, but ascending to the tops of the Nilgiris and other hills. Found also in Ceylon and in the valley of Kashmir, and apparently throughout Burma to the Mergui Archipelago. (After Blanford.)

Teeth.—Thomas gives as the characteristics of the subgenus *Nesokia*, molars composed of transverse laminæ and incisors very broad, finely sculptured in front as compared with the narrow and smooth incisors of *Mus* proper. Blanford follows Thomas,

but Anderson, who originally worked out the genus, says nothing about this character in his description of the incisors, while Gray, who laid the foundations for Anderson's work, says definitely that in his type, *Nesokia* (*Mus*) *hardwickii*, the incisors are flat and smooth. Personally I have found the incisors covered with fine, irregularly parallel markings, but these are not more marked in *Nesokia* than in *M. decumanus* or any other form of *Mus* examined, whether in my own or in the Indian Museum collection.

Gray made the transverse lamination of the molars the principal generic difference, but Anderson makes the cranial characters of greater importance, on the ground that in the young *Nesokia* skull the characters of the molars approximate to *Mus*. The fact is that although the adult worn teeth of *Nesokia* are very clearly distinguished from those of *Mus* by their larger size and bulk, and the possession of straight instead of sinuous laminæ, the young unworn tooth is very similarly constituted in both. As will be seen in figure 52, the cusps of an unworn lamina may be nearly as distinct in *Nesokia* as in *Mus*. The cusps are, however, very soon lost, and then the transverse laminæ become very distinct, so distinct that they are never lost, even in a very much worn tooth. It escapes the stage often seen in an old *M decumanus* of being reduced to a featureless surface of dentine.

Additional rudimentary laminæ or cusps.—Whereas in *Mus* as typified in *M rattus* and *M. decumanus*, additional cusps or laminæ are habitually found, in *N. bengalensis* they are frequently absent altogether, or are represented only by a minute trace, and that sometimes only on the teeth of one side. In fig. 52 the inside cusp, representing a third lamina in the second and third molar, is very well marked, but it is frequently represented by a trace so small that it is difficult to represent it in an illustration. In eight immature skulls examined, the second upper molar showed a well marked, additional rudimentary lamina on both sides in four instances, in two instances there was a trace of it on the right side only, and in two instances there was no trace at all. The third molar in the same series showed it well marked on both sides only in one instance. In two there were traces on both sides, and in one a trace on the left side only, while half of them showed no trace of it at all. In mature skulls it is practically lost altogether in the third molar, only one, out of twenty examined, showing it at all. It can still be made out in the second molar in five out of twenty. In five there was only a faint trace of it, sometimes on one side only, and in ten no trace could be found at all.

Lower molars.—Occasionally there is found in the second lower molar a third rudimentary lamina or a trace of one, but it is notable that it is always found on the external side of the tooth as against the inside of the upper molars. The mesial additional laminæ found in *Mus* are not found in this *Nesokia*, though present in the only young specimen of Bandicoot which I have obtained.

Skull.—The skull is very different in general appearance from that of *Mus*. It is a very broad, heavy, blunt-nosed skull with a globular cranium, while the whole skull shows a depth and solidity that are never found in *Mus*. The pterygoids are very thin and high, and the pterygoid fossæ deep (broken in skull figured). The auditory

bullæ are nearly twice as large as in *Mus*, smooth, round and prominent; Blanford describes the infraorbital foramen as typical; the lower portion very narrow, the outer portion slanting forward from the base, then broadly rounded and deeply sinuate. The zygoma tends to be angular in its sweep outwards and downwards, and is heavy and solid. The nasals instead of projecting over the gnathion as in *Mus*, fall 2 mm. short of it. The occipital bone slopes backwards and downwards, but less markedly than in *M. decumanus*.

Variations.—The posterior border of the interparietal is, as a rule, straight, giving the posterior end of the cranium a very square appearance, but in 25 per cent. of skulls it projects backwards in a point running to meet the occipital crest. In two instances, out of 25 skulls examined, the posterior border was actually slightly concave forwards, so that the bone was crescentic with the horns pointing back rather than forwards, *vide* fig. 54. The coronoid suture is generally curved as shown in fig. 54, but it may be angular, the limbs being 120° apart. This was seen twice. In one skull the curve, instead of being represented by one angle, was broken into two by a backward projection of the frontal, which was truncated.

The anterior palatine foramen is very narrow, particularly posteriorly, where it becomes slit-like. It is very slightly longer than the upper molar series, being 7·6 mm. against 7·1 mm.

The nasals show practically no variation except in one instance, No. 127, in which they are only 7·5 mm. against an average of 11·6 mm., or 18·75 per cent. against 29·4 per cent. of the total skull length.

In addition to the measurements of 20 skulls, a table is given comparing the measurements of my own series with those of the Indian Museum series and a few skulls of *Mus* (*Nesokia*) *kok*, the slightly smaller, sometimes redder southern variety. The Museum series, from different parts of India, averages larger than mine, though the one specimen collected in Calcutta agrees with my average. The Museum series are old skulls. The smaller *N. kok* series, on the other hand, are fairly young; three out of the six show a marked supernumerary cusp or lamina in the second molar, and two show traces, while in only one has it disappeared.

Skull Measurements in Millimetres.

	Extreme length.	Zygomatic breadth.	Length of Up. Molar Series.	Breadth of Up. Molar Series.	Length Ant. Pal. For.
Average of—					
6 *Nesokia kok* (Ind. Mus.)	36·6	22·4	7·2	2·54	7·3
20 ,, *beng.* (Hoss. Coll.).	40·2	23·8	7·14	2·6	7·1
10 ,, ,, (Ind. Mus.)	42·2	26	8	3	7·8
Maximum of—					
6 *Nesokia kok* (Ind. Mus.)	?	24	7·5	2·75	8
20 ,, *beng.* (Hoss. Coll.).	44	25·7	8	3	8·5
10 ,, ,, (Ind. Mus.)	47	28	9	3·2	10·5
Minimum of—					
6 *Nesokia kok* (Ind. Mus.)	35·5	21·5	7	2·5	7
20 ,, *beng.* (Hoss. Coll.)	37	22·5	6·5	2·3	6·5
10 ,, ,, (Ind. Mus.) ..	39	23·5	7	3	7

Interbreeding of Nesokia bengalensis *with* Mus decumanus.

Anderson records a very striking observation as to the interbreeding of *Nesokia blythianus* (i.e., *bengalensis*) with *Mus decumanus*, which had better be reproduced in his own words :—

" Among males found among the native huts I have observed two types of skulls, " one larger than the typical form, but the animals were in other respects identical " with other males conforming to the ordinary type of skull. I have never observed " these more elongated skulls in females, but, if they do occur, I would be disposed " to make the variation due to interbreeding with Decumanus."[1]

I am able to confirm this observation more or less, for I have come across one very large specimen, No. 328, which in some points of the skull suggested an admixture with *M. decumanus*, though I must admit that on the indication given by the smallness of the foot, the thinness of the fur and the general appearance, there was nothing against it being an exceptionally large specimen of unmixed *Nesokia bengalensis*. The following is a detailed description :—

Cross bred (?) *Nesokia bengalensis*, No. 328.

Head and body.	Tail.	Hind foot	Ear.
25·5	19	3·5	2·45

[1] Anderson, *loc. ante cit.*, p. 228.

In general appearance the rat is like a Bandicoot, but the foot is very small and the head is short, bluff and arvicoline, the typical head of *Nesokia bengalensis*. The pads are small and circular; the ears are round and relatively short. The eye is very small, ·6 cm. long and only ·4 cm. wide. As regards colour the throat and cheeks are yellowish-white, while the belly is yellowish-grey, not sharply marked off from the sides and bears an ill-marked grey central stripe. The nose is flesh coloured; the ears are pinkish-brown and nearly naked. The back is more rufous than usual, as ochraceous buff or pale tawny tips are numerous, particularly about the head and ears. The limbs are grizzled brown outside, white inside. The underfur is very scanty indeed 5 cm.—·7 cm. long, pale grey or isabelline in colour. On the belly are short, stiff hairs 1 cm.—1·7 cm. in length, with grey or isabelline bases and pale tawny or ochraceous tips, sometimes surmounted by an ultimate tip of black. Other hairs are brown or black throughout, or black with a tawny tip. The long black piles of the back are 5 cm.—5·5 cm. in length. The tail is short and thick and tapers suddenly to a point; the rings in the centre average 10—11 per cm., the hairs above are 1½ rings deep and black in colour. The scales are greyish-brown. The hairs below are brown, not black, but the lightening of the lower surface is almost imperceptible. The scrotum is of medium size relatively. The skull is rather elongated, 25 per cent. above the average but otherwise is more or less Nesokian in character. It is possible that the diminution of cranial breadth may be due simply to the excessive age of the skull.[1]

This is not the only reference I have found as to the possibilities of cross breeding, for Mr. S. J A. Salter, in a rather loose description of the "snake rat," in which he identifies it with *Mus alexandrinus*, describes the interbreeding of *Mus alexandrinus* and *Mus decumanus*. The passage is as follows :—

"Undoubtedly characteristic specimens of *M rattus*, *decumanus* and *alexandrinus* may be obtained, but there are intermediate forms in endless variety as may be seen by looking at the cages of a rat-catcher after visiting docks. This suggests interbreeding.

"Some specimens of *M. alexandrinus*, which had been sent from Alexandria, got loose in the gardens (Zoological) some years since, and for a long time afterwards the keepers frequently caught cross bred rats, at first half breds, and afterwards with less and less of the character of the snake rat, till at length all traces of it disappeared. In the language of horse trainers the new strain was 'bred out.' The capacity for interbreeding appears to be endless and indefinite. Newman has suggested that these cosmopolitan rodents are, in their differences, not so many species, but mere geographical races. If interbreeding and a resultant fertile offspring determine the specific identity of varying individuals, there is an end of the question. The different rats do breed and their progeny are fruitful for any length of time and any number of generations."[2]

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[1] For measurements of the skull see table at the end.

[2] *Journ. Linn. Soc.*, vi, *Zool.* (1862), p. 71.

Analysis of measurements of Nesokia bengalensis.

	Length of head and body.	Length of tail.	Length of hind foot.	Tip of ear to meatus.
Rough average	18·18[1]	14·8	3·2	1·94
Average large	19·5			
Average small ..	17·2			
Maximum	20·5		3·8	2·2
Minimum	15		3	1·8
Average percentage of head and body-length	100	81[2]	17	10·7
Average long do.	100	82		
Average short do. ..	100	77		
Maximum do.	100	94	21	
Minimum do.	100	69	15	

NOTE ON A RAT FROM KILAKARAI ON THE GULF OF MANAAR.

In 1905 Dr. Annandale collected in Kilakarai, G. of Manaar, a rat (Reg. No. 8078 of the Indian Museum) which was sent home to the British Museum for identification, and which has been named by Mr. Wroughton,[3] in the list of mammals appended to Dr. Annandale's "Notes on the Fauna of a Desert Tract in Southern India," *Nesokia bengalensis*. This rat at first put me considerably astray, as it was so totally different in many respects from the series which I was beginning to identify as *Nesokia bengalensis*. Its dimensions, fresh, were as follows, compared with those of an immature specimen of *Nesokia bandicota* :—

	Head and body.	Tail.	Hind foot.	Ear.
Rat from Kilakarai	17·5	17·5	4·4	2·4
Immature *N. bandicota*	17·5	15·5	4·4	2·6

The tail seemed rather long, 100 per cent. of the body-length, as compared with an average in my series of 79, with only two instances out of fifty above 90, namely, 95 and 91. The foot measurement was, however, much more striking, being no less than 26 per cent. of the total length, a proportion which I have already shown is found only

[1] 86 per cent. have a length between 17 and 19·5 cm.

[2] 76 per cent. of the tails are found between 75 –85 per cent. of head and body-length.

[3] *Mem. Asiat. Soc. Bengal*, vol. i.

in immature rats. The normal proportion is 17·4 per cent. with extreme variations of 15 to 21 according to the age, though in *Nesokia scullyi* it is said to be 26 even in the adult. The ear, too, is like the foot, abnormally large, 2 cm. over the maximum which is found only in very large specimens about 20 cm. long ; it is 13·2 per cent. of the body-length against an average of 10·7. The idea suggested by the external proportions that the rat was immature, was fully confirmed by an examination of the teeth, as they are quite unworn and show very clearly the rudimentary extra laminæ in the second and third upper molar. The upper molar series, moreover, is much too large to be that of *Nesokia bengalensis*, being 10 × 3 mm. against an average of 7 × 2·6, with a maximum of 8 × 3. The characters of the skin are quite unlike those of *Nesokia bengalensis ;* the general colour is lustrous steely grey with deep brown along the back. The undersurface is dark grey, with only a trace of white-tipped hairs ; long piles are present, but closer set and finer than in *Nesokia bengalensis*, and rich brown rather than black in colour. There is thick grey underfur. Altogether it is rather a handsome rat, very different from the rusty, coarse-coated rat with which it has been confused. The tail also is too finely and regularly annulated ; the feet are covered with fine brown hair. The skull is larger than that of *Nesokia bengalensis*, 43 × 28 mm. against an average of 40 × 23·8 in my series ; in the Indian Museum it is true there are skulls of this size, but these are very old skulls as shown by the worn down teeth and the greatly developed muscular ridges. The skull in dispute shows much larger teeth, and all the characters of an immature skull. If, on the other hand, we compare it with the skull of the immature *N. bandicota* whose body dimensions have already been given,—No. 222 of my series,—it will be found that the dimensions are almost similar. Altogether I can only come to the conclusion that instead of being an adult *N bengalensis* it is an immature specimen of *Nesokia bandicota*, though to which variety it belongs I am not in a position to say. There is the possibility that it may be a new species characterized by the same exceptional breadth of the cranium and size of the foot as is shown by the recorded measurements of *Nesokia scullyi*, but the material so far collected as to the measurement of the different members of this genus is so scanty that much will have to be done before the identity of this and the Jagdispur specimens can be definitely settled. A note on the Jagdispur rats will be found later on.

Comparison of skull measurements of Kilakarai skull with that of immature N. bandicota, *No.* 222.

	G.L.	Basal L.	G.B.	N.L.	Io. B.	C.B.	Zg. Pl.	Pal. L.	Diast.	Pal. For.	Pal. F.B.	Up. M.L.	Up. M.B.	Lower C. to I.	Jaw C. to A.
Immature *N. bandicota.*	44 100			14·75 33·5	7 15·9	17·5 39·7	6·25 14·2	25 56·8	13 29·5	8 18·1	3·5 7·9	10·5 23·8	3·5 7·9	31 70·4	15 34
Kilakarai skull.	43·5 100	40 91·9	24 55·2	16 36·7	8 18·3	18 41·3	5 11·4	24 55·1	13 29·8	8·5 19·5	3 6·8	10·25 23·5	3·5 8·0	.. .	

NESOKIA BANDICOTA var. NEMORIVAGUS.

(Synonymy after Blanford.)

(?) *Mus setifer*, Horsfield, Res. Java (1824); Cantor, J. A. S. B., xv, p. 254; Blyth, J A. S. B., xxiv, p. 712, xxxii, p. 334.

Mus (rattus) nemorivagus, Hodgson, J A. S. B., v, p. 234 (1836), id. A. M. N. H., xv, p. 226 (1845).

(?) *Mus macropus*, Hodgson, A. M. N. H., xv, p. 268 (1845).

Mus bandicota, Blyth, J A. S. B., xxxii, p. 333, partim; id. Mam. Birds Burma, p. 39; Jerdon, Mam., p. 193, partim nec Bechstein.

Mus (Nesokia) elliotanus, Anderson, J A. S. B., xlvii, pt. 2, p. 231, pl. xiv, figs. *e-h* (1878).

Mus (Nesokia) nemorivagus, Thomas, P. Z. S., 1881, p. 529.

(*Nesokia nemorivaga*, Blanford, Fauna Brit. Ind. Mam., p. 426 (1888-91).

General characters.—This is the smaller or Northern Indian type of Bandicoot, characterized by its great size, rough bristly coat, very large black feet, long deep narrow snout, long ears and savage behaviour.

Fur.—The fur is very coarse and bristly, so that, as in *Nesokia bengalensis*, when the animal erects its piles the skin can frequently be seen. It may be described as consisting of four elements in place of the usual three.

Underfur.—This is rather scanty, but fine and lanuginous compared with that of *Nesokia bengalensis*. It is very pale grey in colour, sometimes rather a washed-out brown rather than grey, and averages 1 cm. in length. It tends to be paler towards the tips.

2. Fine hairs about 2 cm. in length, grey or pale-brown in the lower half, and the upper half pale straw or brown, so light sometimes as to be almost white.

3. Intermixed with the above are coarse, strong, black hairs 2–3 cm. in length with the tips generally coloured pale ochre or ochraceous buff in the top half. Many, however, are black or brown-black all through. Sienna or buff tips are more predominant about the head, shoulders and back, and below they are paler.

4. All down the back but particularly about the rump, are long black piles 7–8 cm. long; for their length they are not particularly coarse.

Whiskers.—These are black, generally tipped with ochraceous buff; supraciliary bristles are wanting.

Colour.—It is unnecessary to go into detail in describing the colour, as it is practically identical with that of *Nesokia bengalensis*; so many light and pale tips are mixed with the black, and the distinctly sienna or ochraceous buff tinted ones are so few, that the general effect is that of a cold greyish-brown, getting greyer and lighter down the sides. The throat, belly, and inside of the limbs are a hoary dirty greyish-white. The feet are covered with grizzled brown short hairs, and the sides and the soles are atreous, so that the general effect of the feet is black.

Tail.—The tail, nearly equal in length to the head and body, is very thick at the

base and tapers gradually to a very fine point. It is generally of an almost uniform brownish-black, but the fact that pale-brown shows between the rings emphasizes the rings and makes them very distinct, giving a smooth and regular appearance as against the rough and irregular tail of *decumanus*. The rings average 8 to the cm.; from the base of the scales issue pointed, black or dark-brown hairs 2–2½ rings depth in length. In two out of the 11 observed, the tail was as it may be in *M decumanus*, with the scales white or rather pale horny colour, and the hairs black. The colouring of the tail is always uniform, and I have never seen a white tip.

Feet.—The feet are very characteristic owing to their excessive size, atreous with the footpads round just as in *Nesokia bengalensis*. Numbers 184, 212 and 215 showed the small circular postero-external pad just as in *Nesokia bengalensis*, but the median pads were cordiform as in *M. decumanus* or *M rattus*. The colour of the feet is brown to black, but a few long, white hairs may be found over the roots of the claws. These are horny, white, strong, and curved, except in the pollex which is tubercular and bears a nail. The "lines of the hand" are very marked in the sole of the hind foot. In the coloured plate the artist has made the foot rather large, as the specimen was not quite full grown and the drawing was enlarged to full size.

Ears.—The ears are long and large, averaging 2·7 cm. In four instances out of 11 they only reach the eyes; in two they half cover, in two they are ·3 and ·4 cm. short of the eyes, and in three the relative position is unspecified. The colour is brown, covered with fine, short hair, except inside and in the lower part of the dorsal surface.

Mammæ.—Blanford gives six pairs, but does not allocate them. In the two instances where I have noted it, the formula is $\frac{5}{5}$ and $\frac{2}{3}$. In the male the scrotum is very small and insignificant, particularly compared with the enormous protrusion generally so noticeable in the other rats I have described. In two instances the scrotum at first seemed empty, and only very small and shrivelled-looking testes were found in section. Even when the scrotum is apparently well filled, the testes are less than the size of a hazel nut.

THE SPECIFIC DISTINCTION BETWEEN *N. BANDICOTA* AND *N NEMORIVAGUS*.

Anderson makes the difference in external appearance one of size, but lays down very definitely the skull differences, namely, that *N. elliotanus* (i.e., *nemorivagus*) is less elongated, has a shorter muzzle and less breadth between the lachrymal foramina, while the nasals are much shorter and not so broad. He had rather a limited series of *N elliotanus* to deal with, consisting apparently of one from Purnea, two from Calcutta, one from Sibsagar, Assam, and one from the Khasi Hills. In my own series of eight adult skulls, all from Calcutta, I failed to make out the differences described, after a close comparison with the Indian Museum series of *N. bandicota*. On the other hand there is a very considerable amount of variation in this latter series, *i.e.*, that of *N. bandicota*. The skulls from Manbhoom and Guna differ considerably from the two from Ceylon. Anderson noted this and remarks: "Although these Guna rats and the bandicoot

" from the south of the Godavery are the exact counterpart in external appearance " of the Ceylon rats, the skulls of the latter have remarkably different nasals from " the rats of Guna and Manbhoom, being much narrower and more posteriorly pointed, " and, moreover, the muzzle is narrower and not so long. Allowance, however, must " be made for variation, especially in insular examples, and I am, therefore, disposed " to regard the foregoing differences, observable in the species of the Ceylon bandicoots, " in this light." By reducing all the skull measurements to percentages it is possible to make an exact comparision. It will be found that the difference between the proportions of my *nemorivagus* series and the Indian Museum *bandicota* series, is quite trifling and very much less marked than the difference between the Ceylon skull and the rest of the *bandicota* series. The nasals of my series are 2·4 per cent. shorter, and the other differences are practically insignificant. The Ceylon skull, however, is rather distinctive, being a rather long and narrow skull with short, broad nasals 4·9 per cent. shorter than that of the average *bandicota*, and 6·5 per cent. shorter than that of the Madras *bandicota*; moreover the supraorbital ridges anteriorly are very closely approximated. The palate is also a trifle shorter, 2·7 per cent. less than the Madras *bandicota*.

CHIEF DIFFERENCES COMPARED.

	N.L.	Io.B.	Cr. B.	Pal. L.
Average *bandicota* compared with *nemorivagus*	+2·4 %		−1·2 %	+2·1 %
Average *bandicota* compared with Ceylon skulls	+4·9 %	+1·9 %	+1·3 %	−1·2 %
Madras *bandicota* compared with Ceylon skull	+6·5 %	+2·2 %	+1·5 %	+2·7 %

With so little material—one of the two skulls in the Museum is too broken to measure—it is impossible to come to a definite conclusion regarding the Ceylon Bandicoot, but it is possible that it may be found to be a very well marked variety. With regard to *N. nemorivagus* I have shown that in Calcutta it is marked off from *N. bandicota* only by absolute size, not by any proportional differences. Even the size difference is rather discounted by the fact that the largest *N. nemorivagus*, No. 175, with a total length of 63 mm., is as large as the average *N. bandicota*. I therefore draw the conclusion that there is only one species of *Nesokia bandicota* and that *N. nemorivagus*, so far from being a distinct species, is a mere variety characterized by smaller size. Judging from the skulls, it would probably be found on examining an extended series that the larger specimens of the one variety and the smaller of the other would bridge the gap that now exists between their recorded measurements.[1]

Habits.—It is a burrowing rat, found in gardens and compounds, particularly in the banks of tanks, but all the specimens I have secured were trapped in houses, generally about the cook-room. Anderson relates that one of his specimens was said to

[1] Since this was written I have measured an old male from Calcutta whose chief measurements were 30 body, 30 tail, 5·6 foot, 2·6 ear, *i.e.*, exactly 2 feet in total length, *i.e.*, practically the standard size for Ceylon Bandicoots.

be captured in a palm tree but refuses to guarantee the truth of this statement. In the middle of August I found two pregnant females, each containing two half-grown fœtuses. Blanford records it from Bengal (Purnea and Calcutta, where it is rare); Eastern Himalayas, Assam (Sibsagar); and the Khasi Hills; also Formosa. The species probably extends to Burma and Malay countries. I am credibly informed that it is common in the rice-fields all over Lower Bengal and that the ryots (peasants) when the rice has been cut and harvested habitually pillage its grain store. As much as two or three pounds of rice or grain is said to be not an uncommon amount in a burrow.

Skull.—The general characters of the skull are not so truly Nesokian as in the smaller and more typical species such as *hardwickii* and *bengalensis*. Except that the zygomatic arches are expanded, giving a big total breadth to the skull, 53·9 per cent. against 49·5, and the greater development of the zygomatic plate, 17·1 per cent. against 13·7, in its general contour and appearance it is not so very unlike a large *M. decumanus* skull. The anterior palatine foramina, however, are narrower and more closed, the zygomatic plate is longer and more massive, the palate is characteristic. From the two anterior palatine foramina run back over the surface of the palate two rather pronounced longitudinal furrows. These grooves, near their hinder extremities, have the posterior palatine foramina lying in their course, and beyond them they are prolonged over the posterior margin of the palatines, where they nearly constitute a closed canal by the inward projection of the inner palatine border of the maxilla and the somewhat thickened and anteriorly recurved posterior margin of the palatines. The grooving is very feebly shown in *Mus*, and thickening of the hinder margin of the palatines is, as a rule, wanting. In *M decumanus* skulls, however, it is occasionally found to a slight degree. The tympanic bullæ are relatively larger, being 18·8 per cent. in length against 17·2 per cent. in *M. decumanus*. These characters are characters common to all the *Nesokiæ*. The supraorbital and other ridges are very marked. The cranial upper surface is broadest anteriorly instead of posteriorly as in *M. decumanus*. The swelling, due to the root of the upper incisors immediately behind the premaxillary junction, is very marked, so that the lower part of the infraorbital foramen is almost closed, it is so narrowed. The occiput slopes downwards and backwards so that the condyles are the most projecting point posteriorly. The anterior palatine foramina are narrow and equal in length to the molar series. The nasals, in relation to the gnathion, are short, projecting beyond it only 2 mm., but relatively to the skull are of average length, 36·3, about the same as is found in *M. rattus* and *M decumanus*, whereas in the smaller and more typical *Nesokia* the nasal percentage is as low as 28 and 30.

The sutures generally are very serrated and irregular. The coronoid suture as usual is variable; most commonly it is semicircularly convex backwards, but it may be markedly angular, and in one instance showed two angles so as to have the posterior end of the frontal cut off square, as already described in *N. bengalensis*.

The interparietal is very variable and is frequently asymmetrical, as is figured in Anderson's types of this and typical *N. bandicota*. It is commonly roughly pentagonal

with the posterior line curved slightly backwards. It may have a prominent projecting point anteriorly, flanked by a smaller forward projection on each side. It may, again, be roughly hexagonal, with a slight projection forward from the anterior side.

Teeth.—These require little description. The incisors are very broad, deep orange in colour, both upper and lower. The upper molar series is 11·85 mm. × 3 mm. or expressed in percentages 18·69 × 5·11, proportionately smaller than in smaller and more typical *Nesokiæ*. The laminæ are slightly more sinuous, though markedly transverse; the enamel pattern is very clear. Only two of eight specimens showed inside extra laminæ or cusps on the second and third upper molar, while none of the lower molars showed any trace at all, except the young skull already described in connection with the Kilakarai rat. The lower molars in this show very distinctly supplementary mesial laminæ, *vide* fig. 41.

NOTE ON A NEW VARIETY OF NESOKIA FROM JAGDISPUR, BIHAR, WITH SOME REMARKS ON THE PRESENT CLASSIFICATION OF NESOKIA.

There were recently sent to the Museum for examination by Captain King, I.M.S., from Jagdispur, Bihar, a couple of female rats which manifestly are very closely allied to the form *N. hardwickii* but which agree in character with none of the described varieties, being very sharply separated by the length of the anterior palatine foramina. As will be seen from the description, they have all the external characters of *N. hardwickii*, but instead of the very small foramina almost completely closed, and only 11·7 per cent. of the skull in length (13·6 in *N. huttoni*), have them no less than 22·3 per cent. of the skull in length and comparatively open in front though closed to a slit behind. The large foot and general characters of the fur and dimensions generally agree with those of the variety *huttoni*, but instead of a very short tail (67·8 per cent.), the tail is comparatively long (91·8 per cent.), while the ear instead of 7·5 is 11·6 per cent. Judging from the skulls neither rat is full grown; the cranial measurements given in table are taken from the skull of No. 8102, that of No. 8099 being too damaged to measure accurately.

	Length of head and body.	Tail.	Hind foot.	Ear.
No. 8102 Ind. Mus.	14·5	13·5	3·4	1·7
No. 8099 do.	16	14·5	3·4	1·85

The bluff arvicoline aspect is well marked. The fur is long and fine in both specimens, intermediate between the rather harsher fur of typical *N. hardwickii* and the silky fur of high-living *N. huttoni*. The smaller skin is rather dark, brown above and hoary in the belly. The feet are covered with fine hair of greyish-brown, but the inside of the dorsum is white. The tail is almost naked, black, finely and regularly ringed. There are no long piles. The sienna tips on the back are not sufficient to lighten the colour but only give the effect of a dark rich brown, and so again on the belly the tendency is more to grey than white.

No. 8099 has the belly, throat and inside of the limbs quite white. The feet are almost entirely white ; the tail is bi-coloured, being lighter below. This is faintly indicated, too, in the black tail of the dark coloured specimen.

It is impossible, as has been shown, to assign these rats to any of the varieties of the species *hardwickii*, while *bengalensis* is equally negatived by the largeness of the feet and the character of the fur. At the same time it would be a mistake to attempt to give the form a name and definite place in the scheme of *Nesokia* as long as our knowledge of that genus remains as unsatisfactory as at present.

The figures of the skulls of Anderson's types are so markedly different that one accepts with some reserve Thomas' reduction of Anderson's seven species to four. Possibly a full examination of more material would re-establish some of these extinguished varieties and show that some of the intergrading steps are sufficiently defined to require recognition. Next plague season, if the system of rat-collection is as widely resorted to as it was last year, it should be possible for the Government of India to secure such a series from all parts of India as to settle this and other doubtful questions once and for all.

NOTE ON MEASUREMENTS OF RATS AND PRECAUTIONS TO BE TAKEN IN DESPATCHING SPECIMENS.

A few notes on measurements may be of some use to those who wish to take up the subject without previous experience of similar work. The following body measurements are usually recorded : (1) Length of head and body combined ; taken from tip of the nose, excluding hairs, to centre of anus. If *rigor mortis* is present, the body must be straightened but not stretched. Callipers are recommended, but a steel tape will do if following the contours of the body be avoided. (2) Length of tail ; from centre of anus to tip, excluding hairs. (3) Length of hind foot ; from the point of the heel to tip of longest toe, excluding claw. (4) Length of forearm and hand, excluding claws. Thomas notes that this is a most useful measurement for showing the comparative length of the fore and hind limbs, that of the hand only being extremely difficult to take with accuracy. This measurement is, however, rarely recorded. (5) Length of ear. In my own measurements this has been taken from the lower edge of the meatus, but Thomas recommends that it should be taken from the external root of the conch as the skin shifts so much on the head that the measuring from the meatus is very unsatisfactory. In addition to the above, which are those in ordinary use, Thomas advises that the length of the head should be given, measured from the tip of the nose to the inside of the auditory meatus, one point being placed in the meatus as far as it will go without hurting the skull. " This should always be given, being almost the only measurement that can be relied upon for perfect accuracy in showing the general size of the animal." Probably this was so at a time when nearly all measurements were those of spirit specimens, but even Thomas himself does not record it in his later articles. Other measurements, occasionally recorded, are the breadth of the ear, the length of the last pad of the hind foot, and the distance between the front of this pad and the heel.

Skull measurements.—This subject caused me some difficulty, and as I am uncertain that my measurements were taken in the standard fashion, it seems best to give a brief description of my methods.

1. Greatest length = G.L.—Taken with sliding callipers. The anterior point is very variable, being the tip of the nasals in *Mus decumanus*, and the front of the incisors in short-nosed *N. bengalensis*. The latter point of measurement is almost identical with what would be the most desirable one, namely, the most projecting point of the premaxilla. The posterior point is equally variable, being sometimes the supra-occipital ridge, sometimes the inion, sometimes the opisthion, sometimes the condyles.

2. Basilar length to henselion = Basil. L.—Taken with curved, fine-pointed callipers reversed, from the pit behind the two incisors to the basion or anterior border of the occipital foramen. This is unsatisfactory owing to the penetration of the callipers into the pit depending on the closeness with which the incisors are approximated. The callipers have to be excessively fine to get properly home in small *M. rattus* skulls.

3. Greatest breadth = G.B.—From zygoma to zygoma, with sliding callipers.

4. Nasal length = N.L.—From extreme point to extreme point, avoiding the central notch where it is present.

5. Interorbital breadth = Io.B.—The point of minimum breadth between the orbits. The minimum point is a little below the edge of the orbit so that the callipers have to be slightly opened in order to pass over the edges of the orbits. It is difficult to take very accurately unless care is taken to slide the callipers off at the point where the orbital edges are most close together.

6. Cranial breadth = Cr.B.—Taken with callipers at the point of maximum breadth, *i.e.*, from a little pit just above the centre of the posterior root of the zygoma. In *M. rattus* the maximum is found a little posterior to this pit.

7. Length of zygomatic plate = Zy.Pl.—Taken with callipers antero-posteriorly from the deepest part of the posterior concavity to the most projecting point of the anterior convexity.

8. Palate length from henselion = Pal. L.—As in basilar length.

9. Diastema, with callipers from most anterior point of edge of socket of first molar to most posterior point of socket of incisor.

10. Palatine foramina, length = Pal. For. L.—The anterior palatine foramina are sometimes longer on one side than the other; if so, take the mean of the two. Whereas in the case of *Nesokia* the foramen narrows to a slit posteriorly, it may be difficult to define that end of the foramen.

11. Palatine foramina, breadth = Pal. For. B.—This is the width of the two foramina combined. This measurement is very difficult to get accurately where the foramina are very narrow, as the side walls of the foramen converge making an edge-to-edge measurement much too large. In such cases I get the point of the dividers inside the walls of the foramen and adjust them as accurately as possible to the maximum width of the black opening seen.

12. Length of upper molar series = Up. Mol. L.—From edge of tooth socket to edge of tooth socket.

13. Breadth of upper molar series = Up. Mol. B.—I used callipers for this, reading them off on a steel scale graduated to half millimetres. It is a very unsatisfactory method as the margin of error is so large compared to the actual measurement. To get accurate results one would require a fine, automatic outside gauge, reading up to, say, one-tenth of a millimetre.

14. Lower jaw, condyle to incisor tip = Lower Jaw C. to I. from the condyle to the tip of the incisor. Coronoid to Angle = C. to A. From the angle to the most elevated point of the coronoid process.

In these measurements I have followed Thomas as best I knew how, except that for his length and breadth of the interparietal I have substituted the maximum cranial breadth. The interparietal is so variable in shape that its measurements are not of great importance.

Miller, in addition to basilar length, gives also (1) basal length, but without defining the phrase; and also adds the following: (2) least width of palate between anterior molars; (3) combined breadth of nasals; (4) mastoid breadth of cranium; (5) occipital depth at front of basioccipital; (6) fronto-palatal depth at posterior extremity of nasals; (7) least depth of rostrum immediately behind incisors; a total of 21 measurements.

Whether these measurements are worth the time and trouble they take is open to grave question; to be of any use they must all be reduced to percentages, and if the idea be to give a metric picture of a skull on the lines of anthropometry, then numerous as they are, they are still too few. For diameters must be placed definitely by means of longitudinal measurements. As showing the fallacy of cranial indices let me quote an unpublished example from my own experience. I measured two friends, A, a fair, short, bullet-headed Saxon, B, a dark, narrow-headed, Celt to find to my astonishment that they had practically the same cephalic index $\frac{15 \text{ c.m.}}{19{\cdot}8 \text{ c.m.}}$ and $\frac{15 \text{ c.m.}}{20 \text{ c.m.}}$ 75·3 and 75 respective indices. To indicate in figures the marked difference between the skulls I found it necessary to compare the maximum anterior cephalic diameter taken in vertical line above the middle of a line joining the orbit and the meatus; these were respectively 15 cm. and 13·5 cm. The fact is that three good illustrations of the different aspects of the skull are worth three pages of description.

Wherever possible a label with the fresh measurements should be attached to every rat before placing it in spirit, if it is to be sent for examination. Rats putrefy in India with extreme rapidity, so that they should be placed in spirit immediately they are killed, and the precaution should be taken of opening the abdomen or putrefaction may proceed even in the spirit. Sex and locality, elevation if a hill rat, and date of capture, should all be recorded on the label, which should be written in pencil not in ink. Formalin should be avoided, as in India at least it is an utterly unreliable preservative for mammals. As the result of receiving from Darjeeling consignments that should have been of rats preserved in formalin, but which were more like tins of formalin rat-soup, I carried out a series of experiments. These showed that even for small rats 8 per cent. was required, and that for large thick-skinned rats even 12 per cent. was insufficient to prevent putrefaction.

BIBLIOGRAPHY (after Bonhote).

JERDONI GROUP.

Subgroup Edwardsi.

Mus edwardsi, Thos., P. Z. S., 1882, p. 587	W. Fokien, China.
Mus siporanus, Thos., Ann. Mus. Civ. Genoa, xxxiv, p. 11 (1895).	Isle of Sipora, Sumatra.
Mus ciliatus, Bonhote, P. Z. S., 1900, p. 879	Gunung Inas, Perak.

Subgroup Sabanus.

Mus sabanus, Thos., Ann. Mag. Nat. Hist. (5), xx, p. 270 (1887).	Kina Balu, Borneo.
Mus vociferans, Mill., Proc. Biol. Soc. Wash., xiii, p. 138 (1900)	Trang, Lower Siam.
Mus lancavensis, Mill., Proc. Biol. Soc. Wash., xiii, p. 188 (1900)	Pulau Lankawi, S. China Sea.
Mus strepitans, Mill., Proc. Wash. Acad. Sci., ii, p. 207 (1900)	Anambas Island.
Mus fremens, Mill., Proc. Acad. Nat. Sci. Philad., 1902, p. 154	Sinkep Island.

Subgroup Jerdoni.

Mus pellax, Mill., Proc. Biol. Soc. Wash., xiii, p. 147 (1900)	Trang, Lower Siam.
Mus fulvescens, Gray, Cat. Hodgs. Coll., p. 18 (1846)	Nepal.
[*Mus caudatior*],[1] Hodgs., Ann. Mag. Nat. Hist. (2), iii, p. 203 (1849).	Nepal.
Mus jerdoni, Blyth, J A. S. B., xxxii, p. 350 (1863)	Sikkim.
Mus coninga,[2] Swinhoe, P. Z. S., 1864, p. 185 .	Formosa.
Mus rapit, Bonhote, Ann. Mag. Nat. Hist. (7), xi, p. 123 (1903)	Kina Balu, Borneo.

Subgroup Niveiventer.

Mus bukit, Bonhote, Ann. Mag. Nat. Hist. (7), xi, p. 125 (1903)	Jalor, Malay Peninsula.
Mus niveiventer, Hodgs., J. A. S. B., v, p. 234 (1836)	Nepal.
Mus confucianus, M. Edw., Nouv. Arch. Mus., vii, p. 93 (1871)	Moupin, China.

Subgroup Rajah.

Mus rajah, Thos., Ann. Mag. Nat. Hist. (6), xiv, p. 451 (1894)	Borneo
Mus hellwaldi, Jentink, Notes Leyden Mus., p. 11 (1879)	Celebes.
Mus anambae, Mill., Proc. Wash Acad. Sci., ii, p. 205 (1900)	Anambas Island.
Mus lingensis, Mill., Proc. Wash. Acad. Sci., ii, p. 206 (1900)	Linga Island.

[1] When a name is enclosed in brackets either it was reduced to a mere synonym by Thomas twenty years ago, or else there is no satisfactory description corresponding to the name.

[2] Misprinted *coxingi* in the original of Bonhote.

Mus surifer, Mill., Proc. Biol. Soc. Wash., xiii, p. 148 (1900)	Trang, Lower Siam.
Mus flavidulus, Mill., Proc. Biol. Soc. Wash., xiii, p. 189 (1900)	Pulau Lankawi.
Mus butangensis, Mill., Proc. Biol. Soc. Wash., xiii., p. 190 (1900)	Butang.

Subgroup Cremoriventer.

Mus cremoriventer, Mill., Proc. Biol. Soc. Wash., xiii, p. 144 (1900).	Trang, Lower Siam.
Mus flaviventer, Mill., Proc. Wash. Acad. Sci., ii, p. 204 (1900)	Anambas Island.
Mus kina, Bonhote, Ann. Mag. Nat. Hist. (7), xi, p. 124 (1903)	Kina Balu, Borneo.

WHITEHEADI GROUP.

Mus whiteheadi, Thos., Ann. Mag. Nat. Hist. (6), xiv, p. 452 (1894).	Kina Balu, Borneo.
Mus ochraceiventer, Thos., Ann. Mag. Nat. Hist. (6), xiv, p. 451 (1894).	Kina Balu, Borneo.
Mus musschenbroeki, Jentink, Notes Leyden Mus., p. 19 (1879)	Celebes.
Mus alticola, Thos., Ann. Mag. Nat. Hist. (6), ii, p. 408 (1888)	Kina Balu, Borneo.
Mus bæodon, Thos., Ann. Mag. Nat. Hist. (6), xiv, p. 452 (1894)	Kina Balu, Borneo.
Mus asper, Mill., Proc. Biol. Soc. Wash., xiii, p. 145 (1900)	Trang, Lower Siam.

BOWERSI GROUP.

Mus bowersi, Anders., Zool. Res. Yunnan, p. 304 (1879)	Yunnan.
Mus latouchei, Thos., Ann. Mag. Nat. Hist. (6), xx, p. 113 (1897)	Kuatun, China.
Mus ferrocanus, Mill., Proc. Biol. Soc. Wash., xiii, p. 140 (1900)	Trang, Lower Siam.
Mus berdmorei, Blyth, J A. S. B., xx, p. 173 (1851)	Mergui.

XANTHURUS GROUP.

Mus xanthurus, Gray, P. Z. S., 1867, p. 598	Celebes.
Mus celebensis, Gray, P. Z. S., 1867, p. 598	Celebes.
Mus meyeri,[1] Jentink, Notes Leyden Mus., i, p. 12 (1879)	Celebes.
Mus everetti, Gunth., P. Z. S., 1879, p. 75	Luzon, Philippines.
Mus macleari, Thos., P. Z. S., 1887, p. 511.	Xmas Island.
Mus luzonicus, Thos., Ann. Mag. Nat. Hist. (6), xvi, 163 (1895)	Luzon, Philippines.

MUELLERI GROUP.

Mus muelleri, Jentink, Notes Leyden Mus., p. 16 (1879)	Sumatra.
Mus palmarum, Zelebor, Reise der: Ost Fregat. Novara, Zool, i, p. 26 (1869).	Nicobars.
Mus validus, Mill., Proc. Biol. Soc. Wash., xiii, p. 141 (1900)	Trang, Lower Siam.
Mus integer, Mill., Proc. Wash. Acad. Sci., iii, p. 111 (1901)	Sirhassen Island.

[1] Now placed by Thomas in genus *Lenomys*.

Mus firmus, Mill., Proc. Acad. Nat. Sci. Philad., 1902, p. 155.	Linga Island.
Mus stoicus, Mill., Proc. U. S. Nat. Mus., xxiv, p. 759 (1902)	Henry Laurence Island, Andamans.
Mus taciturnus, Mill., Proc. U. S. Nat. Mus., xxiv, p. 762 (1902).	S. Andaman Island.

INFRALUTEUS GROUP.

Mus infraluteus, Thos., Ann. Mag. Nat. Hist. (6), ii, p. 409 (1888).	Kina Balu, Borneo.

RATTUS GROUP.

Subgroup Rufescens.

Mus rufescens, Gray, Charlesw. Mag. Nat. Hist., i, p. 585 (1837).	India.
[*Mus flavescens*],[1] Elliot, Madr. Journ., x, p. 214 (1839)	Madras.
[*Mus brunneusculus*],[1] Hodgs., Ann. Mag. Nat. Hist., xv, p. 267 (1845).	Nepal.
[*Mus tetragonurus*],[1] Kelaart, Prodromus (1850)	Ceylon.
[*Mus nemoralis*],[2] Blyth, J A. S. B., xx, p. 168 (1851)	Ceylon.
[*Mus robustulus*],[2] Blyth, J A. S. B., xxviii, p. 294 (1859)	Tenasserim.
Mus andamanensis, Blyth, J A. S. B., xxix, 103 (1860)	Andamans.
Mus flavipectus, M. Edw., Nouv. Arch. Mus., vii, p. 93 (1871).	Moupin, China.
[*Mus sladeni*],[2] Anders., Zool. Res. Yunnan, p. 305 (1879)	Yunnan.
[*Mus yunnanensis*],[2] Anders., Res. Yunnan, p. 306 (1879)	Yunnan.
Mus vicerex, Bonhote, Ann. Mag. Nat. Hist. (7), xi, p. 473 (1903).	Simla.

Subgroup Pyctoris.

(The *nitidus* group of Thomas, Sclater, and other authors.)

[*Mus pyctoris*],[1] Hodgs., Ann. Mag. Nat. Hist., xv, p. 267 (1845).	Nepal.
[*Mus equicaudalis*],[1] Hodgs., Ann. Mag. Nat. Hist. (2), iii, p. 203 (1849).	Nepal.
Mus rubricosa, Anders., Zool. Res. Yunnan, p. 306 (1879)	Yunnan.
Mus neglectus, Jentink, Notes Leyden Mus., 1879, p. 14	Borneo.
Mus tiomanicus, Mill., Proc. Wash. Acad. Sci., iii, p. 209 (1900).	Tioman Island.
Mus jalorensis, Bonhote, Fasciculi Malayensis, i, p. 29	Jalor.

Subgroup Griseiventer.

[*Mus indicus*],[1] Desm. (nec. Bechst), Mamm., ii, p. 299 (1822).	Pondicherry.
[*Mus asiaticus*],[1] Gray, Charlesworth's Mag. Nat. Hist., i, p. 585 (1837).	India.

[1] When a name is enclosed in brackets either it was reduced to a mere synonym by Thomas twenty years ago or else there is no satisfactory description corresponding to the name.

[2] Signifies that Mr. W. L. Sclater, after examining the type in the Indian Museum, agreed with Thomas in making it a mere synonym of *Mus rattus rufescens*.

[*Mus rattoides*],[1] Hodgs., Ann. Mag. Nat. Hist., xv, p. 267 (1845).	Nepal.
Mus nitidus, Hodgs., Ann. Mag. Nat. Hist., xv, p. 267 (1845).	Nepal.
[*Mus kandianus*],[1] Kelaart, Prodromus (1850)	Ceylon.
Mus germaini, M. Edw., Rech. Mamm., p. 289 (1874)	Pulau Condor.
Mus pannosus, Mill., Proc. Biol. Soc. Wash., xiii, p. 190 (1900).	Butang.
Mus tambelanicus, Mill., Proc. Wash. Acad. Sci., ii, p. 212 (1900).	Big Tambelan Island.
Mus siantanicus, Mill., Proc. Wash. Acad. Sci., ii, p. 210 (1900).	Pulau Siantan.
Mus atratus, Mill., Proc. U. S. Nat. Mus., xxiv, p. 767 (1902)	Barren Island, Andamans.
Mus flebilis, Mill., Proc. U. S. Nat. Mus., xxiv, p. 762 (1902)	Henry Laurence Island, Andamans.
Mus pulliventer, Mill., Proc. U. S. Nat. Mus., xxiv, p. 765 (1902)	Great Nicobar Island.
Mus griseiventer, Bonhote, Fasciculi Malayensis, i, p. 30	Perak.

Mr. Bonhote completes his list by mentioning that he has been unable to refer the following to any of the three subgroups of *Mus rattus* :—

[*Mus decumanoides*],[1] Hodgs., J A. S. B., x, p. 915 (1841).
[*Mus ceylonus*],[1] Kelaart Prodomus (1850).
[*Mus infralineatus*],[1] Elliot, Blyth, J A. S. B., xxxii, p. 348 (1863).

CHRYSOCOMUS GROUP.

Mus chrysocomus, Hoffm., Abh. Mus. Dresd., iii, p. 20 (1887)	Celebes.
Mus ruber, Jentinck, Notes Leyden Mus., ii, p. 18 (1879) .	New Guinea.
Mus baluensis, Thos., Ann. Mag. Nat. Hist. (6), xiv, p. 454 (1881).	S. India.
Mus fratrorum, Thos., Ann. Mag. Nat. Hist. (6), xviii, p. 246 (1896).	Rurukan, Celebes.
Mus datae, Meyer, Abh. Mus. Dresd., vii, p. 25 (1899)	Philippines.

The following six species are described as very distinct from all those that have gone before as well as from each other. They are merely noted to show that they have been taken into consideration when making out the above list :—

Mus mettada, Gray, Charlesw. Mag. Nat. Hist., i, p. 586 (1837).	Madras.
Mus gleadowi, Murray, P. Z. S., 1885, p. 805 pl. li	W. India.

[1] When a name is enclosed in brackets either it was reduced to a mere synonym by Thomas twenty years ago or else there is no satisfactory description corresponding to the name.

Mus blanfordi, Thos., Ann. Mag. Nat. Hist. (5), vii, p. 24 (1881).	India.
Mus humei, Thos., P. Z. S., 1886, p. 63, pl. v	Manipur.
Mus annandalei, Bonhote, Fasciculi Malayensis, i, p. 30.	S. Perak.
Mus coelestis, Thos., Ann. Mag. Nat. Hist. (6), xviii, p. 248 (1896).	S. Celebes.

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TO

TABLES OF MEASUREMENTS.

MUS RATTUS. *Below* 15 *cm. head and body.*

No.	Ser. No.	Sex.	Head and body.		Tail.		Hind foot.		Ear.		REMARKS.
1	54	♀	13·2	100	20·2	153	3·5	26·5	1·8	13·6	Y.W.B.
2	65	♀	14	100	18·8	134·2	3·4	24·2	2·1	15	Do.
3	66	♂	13·5	100	18·2	134·8	3	22·2	1·8	13·3	Do.
4	67	♀	13·5	100	18·5	137	3·1	22·9	1·8	13·3	Do.
5	70	♂	13·5	100	18	133·3	3	22·2	2	14·8	Black rat.
6	85	♂	13 7	100	17·7	129·1	3·1	22·6	1·9	13·8	Y.W.B.
7	87	..	13·5	100	18	133·3	3·1	22·8	1·7	12·5	Do.
8	157	♀	13·8	100	19	137·6	3·1	22·4	1·7	12·3	Do.
9	164	♀	14	100	20·5	146·7	3·1	22·1	2	14·2	Do.
10	147	♀	14	100	18·5	132·1	3·1	22·1			Do.
11	260	♂	14·2	100	19·5	129·4	3·1	21·8			Y.G.B.
12	86	♂	14·8	100	19	128·3	3·2	21·5	2·1	14·1	Y.W.B.
13	273	..	14	100	17·5	125	3·2	22·8	1·9	13·5	
14	274		14·7	100	16	108·9	3·2	21·7	2·1	14·2	
15	256	♂	14·2	100	16·5	116·1	3·1	21·8	2	14·08	Cinnamon rat with Y.W.B.
16	292	♀	14	100	18	128·5	3·1	22·1	1·9	13·5	Y.W.B. edged with isabelline.
17	294	♂	13	100	17	130·7	3·1	23·8	1·8	13·8	Grey breast spot; white tip to tail.
18	295	♀	13	100	18·5	142·3	3·2	24·6	1·8	13·8	G.W.B.
19	296	♂	14	100	16	114·2	3·3	23·5	1·9	13·5	Y.W.B.
20	301	♂	13·5	100	17·5	129·6	3·2	23·7	2	14·8	G. breast stripe.
21	302	♀	14	100	18·7	133·5	3·1	22·1	1·9	13·5	G.W.B.
Total figures			290·1		381·6		66·3		36·2		
Average figures			13·81		18·17		3·15		1·9	13·76	
Average percentage				100		135·12		22·82		13·76	

Y.W.B.=yellowish white belly. G.=grey. G.W.=greyish white. O.G.=orange grey.

These young rats were mostly collected early in my investigation when I did not note particularly the presence or absence of spots and stripes on the belly.

The large figures in the second column under each heading represent the percentage of the length of the head and body. The serial number refers to the numbering in my collection.

MUS RATTUS. *Above* 15 *cm.*

No.	Ser. No.	Sex.	Head and body.		Tail.		Hind foot.		Ear.		REMARKS.
1	42	♂	15	100	19·5	130	3·2	21·3	1·9	12·6	Y.W.B.
2	45	♂	15·6	100	20	128·2	3·1	19·8	2·1	13·	Do.
3	55	♀	15	100	20	133·3	3·4	22·6	1·9	12·6	Do. White tip to tail.
4	78	♀	15	100	19·5	130	3·2	21·3	1·8	12	Do.
5	105	♂	15·5	100	20·5	132·2	3·2	20·6	2·1	13·5	Do.
6	160	♀	15·5	100	18	116·1			2	12·9	Black rat.
7	224	♀	15	100	18	120	3·1	20·6	1·9	12·6	Y.W.B.
8	264	♂	15·5	100	21·2	136·7	3·4	21·9	2	12·5	Black rat.
9	271	♂	15	100	17·2	114·6	3·2	21·3	1·8	12	Y.G.B.
10	272	..	15·9	100	19	119·4	3·3	20·7	1·9	11·9	
11	275	..	15	100	20·3	135·3	3·2	21·3	1·9	12·9	G. B. White spots on breast and belly.
12	280	♀	15·5	100	19	122·5	3·1	20	1·9	12·6	Rufous rat. Y.W.B.
13	284	♀	15·5	100	20	129·03	3·2	20·6	2	12·2	G.B. White teat spots.
14	287	♂	15·5	100	20	129·03	2·1	13·5	2	12·9	O.G.B.
15	291	♀	15·5	100	21	135·4	3·1	20	2·1	12·9	Do.
16	299	♂	15·5	100	17	109·6	3	19·3	1·9	13·5	
17	300	..	15·2	100	17	111·8	3·1	21·05	2	12·2	O.G.B.
18	305	♂	15·5	100	20·4	131·6	3·3	21·2	2·1	13·1	Black rat figured in plate.
Total figures			276·2		347·6		53·3		35·3	..	
Average figures			15·34		19·31		3·13		1·96	..	
Average percentage				100		125·82		20·19		127·3	

MUS RATTUS. *Above* 16 *cm.*

No.	Ser. No.	Sex.	Head and body.		Tail.		Hind foot.		Ear.		REMARKS.
1	68	♂	16	100	22	137·5	3·3	20·6	2	12·5	Y.W.B.
2	74	♀	16·3	100	17·3	106	3	18·4	2·2	13·4	Black rat.
3	132	♂	16·5	100	21·5	130·3	3·4	20·6	2	12·1	Y.W.B.
4	133	♀	16·5	100	22	133·3	3·2	19·3	2·4	14·5	G.B.
5	136	♂	16·2	100	18·5	114·1	3·2	19·7	2·1	12·9	O.G.B.
6	159	♀	16	100	19·5	121·8	3·1	19·3	1·9	11·8	Black rat.
7	182	♀	16·5	100	21	127·2	3·1	18·7	2·1	12·7	G.B. White throat patch.
8	251	♂	16	100	19	118·7	3·3	20·6	2	12·5	Y.G.B.
9	252	♀	16	100	19·5	121·8	3·1	19·3	2·1	13·1	Y.W.B. Grey breast spot.
10	277	..	16·2	100	21·5	132·7	3·3	20·3	2	12·3	G.B.
11	278	♂	16	100	19·3	120·6	3·3	20·6	2	12·5	Black rat.
12	288	♂	16·8	100	21	125	3·3	19·6	2·2	13·09	Y.W.G.B.
13	289	♀	16·5	100	20·7	125·4	3·3	20	2·1	12·7	G.B.
14	304	♀	16	100	20	125	3·4	21·2	2	12·5	Y.W.B.
15	309	♂	16·5	100	19·5	118·1	3·4	20·6	2	12·1	Black rat.
16	312	♀	16·5	100	19·7	119·3	3·4	20·6	1·9	11·5	Y.W.B.
Total figures			260·5		322		52·1		33		
Average figures			16·28		20·12		3·25		2·06		
Average percentage				100		123·55		19·96		12·63	

MUS RATTUS. *Above 17 cm.*

No.	Ser. No.	Sex.	Head and body.		Tail.		Hind foot.		Ear.		REMARKS.
1	56	♀	17	100	21	123·5	3·4	20	2	11·7	Y.W.B.
2	82	♂	17·2	100	20·5	119·1	3·4	19·7	2·1	12·2	Y.W.B. Rufous rat
3	106	♂	17	100	22	129·4	3·4	20	2·1	12·3	Y.G.B.
4	107	♀	17·5	100	22	125·7	3·4	19·4	2·1	12	Do.
5	108	♀	17	100	22	129·4	3·2	18·8	2·2	12·9	Do
6	184	♀	17	100	20	117·6	3·2	18·8	2·1	12·3	Y.W.B.
7	221	♀	17	100	20·5	120·5	3·4	20	2	11·7	G. with white throat patch.
8	144	♀	17·3	100			3·2	18·4	2·3	13·2	Y.W.B.
9	145	♂	17	100	20	117·6	3·1	18·2	2·2	12·9	Do.
10	253	♀	17	100	22	129·4	3·2	18·8	2	11·7	Grey breast spot spreads over chest and belly.
11	254	♀	17·5	100	22·5	128·5	3·2	18·2	2·2	12·5	Do.
12	259	♀	17·5	100	24	137·1	3·1	17·7	2·1	12	O.G.B.
13	261	♀	17·5	100	22	129·4	3·4	20	2	11·7	Do.
14	279	♀	17	100	22·5	132·3	3·4	20	2	11·7	Whitish brown rat.
15	282	♀	17	100	22	129·4	3·5	20·5	2	11·7	Y.W.B. Hairs at tip of tail white.
16	283	♂	17·5	100	19·5	111·4	3·6	20·5	2	11·4	Rufous G.W.B.
17	290	♂	17	100	21	123·5	3·1	18·2	2·1	12·3	Rufous. O.G.B.
18	297	♀	17·5	100	20	114·2	3	17·1	2·1	12	Hairs at tip of tail white.
19	308	♂	17	100	23	135·2	3·4	20	2·2	12·9	O.G.B.
20	311	♀	17·2	100	21·5	125	3·4	19·7	2·1	12·2	Y.W.B.
Total figures			343·2		408		66		41·9		
Average figures			12·16		20·4		3·3		2·09		
Average percentage				100		125·08		19·20		12·16	

MUS RATTUS. *Above* 18 *cm.*

No.	Ser. No.	Sex.	Head and body.		Tail.		Hind foot.		Ear.		REMARKS.
1	91		18	100	21·5	119·4	3·1	17·2	2	11·1	Chestnut Y.W.B.
2	130	♂	18·5	100	22·4	121	3 3	17·8	2·1	11·3	Tawny O.B.
3	131	♂	18·5	100	22	118·9	3·3	17·8	2	10·8	Y.W.B.
4	134	♂	18·5	100	21·5	116·2	3·4	20·6	2·1	12·1	Do.
5	135	♂	18·2	100	21·2	116·4	3·3	18·1	2·3	12·6	Do.
6	174		18	100	23	127·7	3·3	18·3	2·5	13·9	Do.
7	146	♂	18·5	100	23·2	125·4	3·5	18·9	2·3	12·4	Do.
8	148	♂	18	100	21	116·6	3·3	18·3	2·3	12·7	Do.
9	225	♀	18	100	21·5	119·4	3·4	18·8	2·1	11·6	Do.
Total figures			164·2		197·3		29·9		19·7		
Average figures			18·24		21·92		3·32		2·18		
Average percentage				100	120·1	..	18·2		11·9		

MUS RATTUS. *Above* 19 *cm.*

No.	Ser. No.	Sex.	Head and body.		Tail.		Hind foot.		Ear.		REMARKS.
1	1 4	♂	19·2	100	24·3	126·5	3·6	18·7	2·3	11 9	O.G.B.
2	209	♂	19·5	100	24	123	3·6	18·4	2·4	12·3	
3	210	♀	19	100	24	126·3	3·3	17·3	2·2	11·5	
4	222	♀	19	100	22·5	118·4	3·3	17·3	2·1	11	Y.W.B.
5	270		19	100	24	126·3	3·6	18·9			G.W.B.
6	286	♀	19	100	23·5	123·6	3·5	18·4	2·4	12·6	G.B. White teat spots.
Total figures			114·7		142·3		20·9		11·4		
Average figures			19·11		23·71		3·48		2·28		
Average percentage				100		124·4		18·1		11·88	

Principal measurements of skulls of Calcutta Mus rattus *under* 15 *cm. head and body.*

No.	Serial No.	Sex.	Greatest length.	Basal length.	Greatest breadth.	Nasal length.	Interorbital breadth.	Cranial breadth.	Zygomatic plate.	Palate length.	Diastema.	Length of palatine foramen.	Breadth of palatine foramen.	Length of upper molar series.	Breadth of upper molar series.	Length of lower jaw.	Depth of lower jaw.	
1	65	♀	39·5	32·5	19·5	13·5	6·5	16	5	18·5	10·75	6·5	3	7	2·5	..	..	
			100	82·2	49·3	34·17	16·4	40·5	12·6	46·8	27·2	16·4	7·5	17·7	6·3	..	..	
2	66	♂	36·5	29	19	15	6	16·5	4·5	17·5	9·5	7	2·5	6·75	2	24	10	
			100	79·4	52·5	41·09	16·4	45·2	12·3	47·9	26·02	19·1	6·8	18·4	5·4	65·7	27·3	
3	67	♂	36·75	30	18·25	13	5·5	14·5	4·5	17	9·5	7	2·5	7	2	21·5	9	
			100	81·6	49·6	35·3	14·9	39·4	12·2	46·5	25·8	19·04	6·8	19·04	5·4	58·5	24·4	
4	70	..	39	31·5	19	13·5	6	15	4·5	18	10	7	3	7	2	24	11·5	Black.
			100	80·7	48·7	34·6	15·3	38·4	11·5	46·1	25·6	17·9	7·69	17·9	5·1	61·5	29·4	
5	85	♂	37·5	29·5	13	13	6	14·5	4	18	9·5	7·25	2·5	7	2	..	..	
			100	78·6	48	34·6	16	38·6	10·6	48	25·3	19·3	6·6	18·6	5·3	..	..	
6	86	♂	38	30·5	..	13·75	5	15·5	4 5	18·5	10·25	7·5	2·75	7	2·25	24·25	10·5	
			100	80·2	..	36·1	13·1	40·7	11·8	48·6	26·9	19·7	7·2	18·4	5·9	63·8	27·6	
7	157	♀	37	30·5	18·5	13·5	5	15	4·5	17·5	10	6·75	2·75	6·5	2	..	..	
			100	82·1	50	36·4	13·5	40·5	12·1	47·2	27·02	18·2	7·4	17·5	5·4	..	..	
8	164	♀	37·5	31·5	..	13	5	15·5	4	18·5	10·5	6·5	3	6·5	2	..	..	
			100	84	..	34·6	13·3	41·3	10·6	49·3	28	17·3	8	17·3	5·3	..	..	
9	260	♂	40	32	19	14	6·25	16	4·5	18·5	10	6·5	2·75	7	2	..	..	
			100	80	47·5	35	15·6	40	11·25	46·25	25	16·25	6·8	17·5	5	..	..	
10	274	..	38	30	17·5	13	6	15	4	18	10	7	2·75	7	2·25	23·5	10·5	
			100	78·9	48·6	34·2	15·8	39·4	10·5	47·3	26·3	18·4	7·2	18·4	5·9	61·8	27·6	
Total		..	379·75	307	185·9	135·25	57·25	153·5	44	179	100	69	28	68·75	21	117·25	51·5	
Average measurement			37·97	30·7	18·59	13·52	5·72	15·35	4·4	17·9	10	6·9	2·8	6·87	2·1	23·45	10·3	
Average percentage			100	80·85	48·95	35·10	15·06	40·42	11·58	47·14	26·33	18·17	7·42	18·08	5·52	61·73	27·12	

The lower series of figures referring to each specimen gives the percentage of the greatest length of the skull.

Principal measurements of skulls of Calcutta Mus rattus 15 *cm. and under* 16 *cm.*

No.	Serial No.	Sex.	G. L.	Basal L.	G. B.	N. L.	Io.B.	C. B.	Zy. Pl.	Pl. L.	Diastema.	Pal. For.	P.F.B.	Up. M.L.	Up. M.B.	Length of lower jaw.	Depth of lower jaw.
1	78	♀	38·5 100	32 83·1	18·5 48	13 33·7	5·5 14·2	15·25 39·6	4·5 11·6	19 49·3	10·5 27·2	7·5 19·4	2·5 6·3	7 18·1	2 5·1	.	.
2	105	♂	41·5 100	33·25 80·1	19·5 46·9	13·5 32·5	5·5 13·2	16 38·5	4·5 10·8	19·5 46·9	10·5 25·3	7·75 18·6	2·5 6	7·25 17·4	2 4·8	24·5 59	11 26·5
3	160	♀	39·5 100	32·5 82·2	19·5 49·3	14 35·4	6 15·1	15·5 39·2	4·75 12	20 50·6	11 27·8	7·5 18·9	2·5 6·3	7 17·7	2 5		
4	271	♂	37·5 100	31 82·6		12·5 33·3	5·5 14·6	15 40	4·25 11·3	18 48	9·5 25·5	7·5 20	2·5 6·6	7 18·6	2 5·3	..	..
5	275			..	17·5	12·5	5·5	15	4·5	18	10	7	2·5	6·5	2	23	10
6	280	♀	38·5 100	32·5 84·4	19·75 51·2	13 33·7	5·5 14·2	15·25 39·6	4·5 11·6	18·5 48·05	10·5 27·2	7·5 19·4	2·75 7·1	7 18·1	2 5·1	25 64·9	12 31·1
7	284	♀	38 100	31 81·5	19·5 51·3	13·5 35·5	5·75 15·1	16 42·1	5 13·1	18 47·3	10·5 27·6	7·5 19·7	2·5 6·5	7 18·4	2 5·2		..
Total figs.			233·5	192·25	114·25	92	39·25	108	32	131	72·5	52·25	17·75	48·75	14	72·5	33
Average measurement			38·9	32·04	19·04	13·14	5·6	15·4	4·57	18·71	10·35	7·46	2·53	6·96	2	24·16	11
Average percentage.			100	82·4	48·9	34	14·4	39·5	11·7	48·1	26·6	19·1	6·5	17·8	5·1	62·1	28·4

Principal measurements of skulls of Calcutta Mus rattus 16 *cm. and under* 17 *cm.*

No.	Serial No.	Sex.	G.L.	Basal length.	G.B.	N.L.	Inter-orbital length.	C.B.	Zy. Pl.	Palate length.	Diastema.	Pal. For.	P.F.B.	Up. M.L.	Up. M.B.	Length of lower jaw.	Depth of lower jaw.
1	136	♂	43	35		16	6	15·75	5·25	20·75	12	8	3	7	2	27	13
			100	81·39		37·2	13·95	36·62	12·2	48·25	27·9	18·6	6·97	16·27	4·65	62·79	30·23
2	159	♀	39	33	19·5	14·5	5·5	15·5	5	19	11	7·5	2·5	7	2	22·5	13
			100	84·61	50	37·17	14·1	39·74	12·82	48·71	28·2	19·23	6·41	17·94	5·12	57·69	33·3
3	132	♀	43	36·5		16	5·5	..	5	21	11	7·5	2·5	7	2		
			100	84·88		37·2	12·79		11·62	48·83	25·58	17·44	5·81	16·27	4·65		
4	182	♀	41	35		14	5·5	15·5	5	20	11	8·5	3	7	2		
			100	85·36		33·3	13·41	38·8	12·19	48·78	26·82	20·73	7·31	17·07	4·87		
5	277	..	41·5	34·5	20	14	5·5	15	5	20	11·5	8	3·5	7	2	21	12
			100	83·13	48·19	33·73	13·25	36·14	12·04	48·19	27·71	19·27	8·43	16·8	4·81	50·6	28·9
6	278	♂	40·5	33·25	20·5	14	6	16	5	19·5	11·5	8	3	7	2	25	12
			100	82·09	50·61	34·56	14·81	39·5	12·34	48·14	28·39	19·75	7·4	17·28	4·93	61·72	29·62
7	289	♀	38·5	32·5	19·5	13·5	5·5	15·75	5	18·5	10	7·5	3·75	7	2		
			100	84·41	50·64	35·06	14·28	40·9	12·98	48·05	25·97	19·48	9·7	18·1	5·19		
8	309		41	32		14·5	6	16	5		11·25	7·5	3	6·5	1·75	27	12·5
			100	78·04		35·36	14·63	39·02	12·19		27·43	18·29	7·31	15·85	4·2	65·85	30·4
Total figures			327·5	271·75	79·5	116·5	45·5	109·5	40·25	138·75	89·25	62·5	24·25	55·5	15·75	122·5	62·5
Average figs.			40·93	33·95	19·87	11·56	5·68	15·64	5·06	19·82	11·15	7·81	3·08	6·92	1·96	24·5	12·5
Average percentage			100	82·8	48·4	35·4	13·7	38·6	12·2	48·4	27·1	19	7·3	16·8	4·6	59·9	30·4

Principal measurements of skulls of Calcutta Mus rattus 17 *cm. and under* 18 *cm.*

No.	Serial No.	Sex.	G.L.	Basal length.	G.B.	N.L.	Io. length.	C.B.	Zy. Pl.	Pal. length.	Diastema.	Pal For.	P.F.B.	Up. M.L.	Up. M.B.	Length of lower jaw.	Depth of lower jaw.
1	56	♀	42 100	34 80·9	..	14·5 34·5	6 14·2	14·5 34·5	5 11·9	20 47·6	11·5 27·3	7 16·6		7 16·6	2 4·7		.. ..
2	144	♀	42 100	33·5 79·7		14·5 34·5	5·5 13·09	16 38·09	5 11·9	19·5 46·4	11 26·1	7 16·6	2·5 5·9	7 16·6	2 4·7		..
3	145	♂	43 100	36 83·07		16 37·02	6 13·9	16 37·02	6 13·9	21 48·8	12 27·9	8 18·4	3·25 7·55	7 16·2	2 4·6		
4	184	♀	41 100	35 85·3	20 48·7	14·25 34·75	6 14·6	16·25 39·63	5·5 13·4	20·5 50	11 26·8	7 17·07	2·5 6·69	7 17·07	2 4·8	25 60·9	12·5 30·4
5	221	♀	43 100	35·5 82·5	21 48·8	15·5 36·04	6 13·9	15·5 36·04	5 11·6	21 48·8	11·5 26·7	8 18·4	3 6·9	7·5 17·4	2 4·6		..
6	259	♀	41 100	34 82·9	20 48·7	15·5 37·8	6 14·6	15 36·5	5 12·2	19·25 46·95	12 29·2	7·5 18·2	3 7·3	7 17·07	2 4·8	25 60·9	12·5 30·4
7	279	♀	41 100	34 82·9	20 48·7	15·5 37·8	5·5 13·4	15·75 38·41	5·25 12·8	19·5 47·5	12 29·2	7·5 18·2	3 7·3	7 17·07	2 4·8	27 65·8	12·5 30·4
8	282	♀	41·5 100	35·25 84·9	21 50·5	14·5 34·9	6 14·9	15·5 37·3	5 12·04	20 48·1	11·5 27·7	8 19·2	3 7·2	7·5 18·07	2 4·8	26 62·6	13 31·3
9	283	♂	41·5 100	34 81·9	20 48·1	15 36·1	5·5 13·2	15·75 37·9	5·25 12·6	19·5 46·9	11·75 28·3	8 19·2	3 7·2	7·25 17·4	2 4·8	26·5 63·8	14 33·7
10	290	♂	40·5 100	34 83·9	19·5 48·1	14·5 35·8	5·75 14·1	15 37·03	4·75 11·7	19·5 48·1	11·5 28·3	7·5 18·5	2·5 6·1	7 17·2	2 4·9	25·5 62·9	11·5 28·3
11	297	♂	40 100	34 85	20 50	13·5 33·7	5·5 13·7	15·75 39·37	5 12·5	18·5 46·2	10 25	7 17·5	2·5 6·25	7·25 18·12	2 5	23 57·5	12·5 31·25
Total ..			456·5	379·25	161·5	163·25	63·75	171	56·75	218·25	125·75	82·5	28·25	78·5	22	178	88·5
Average figs.			41·5	34·47	20·18	14·84	5·79	15·54	5·15	19·84	11·43	7·5	2·82	7·1	2	25·4	12·6
Average percentage ..			100	83	48·4	35·7	13·9	37·4	12·4	47·7	27·5	18	6·7	17·1	4·8	61·2	30·3

Principal measurements of skulls of Calcutta Mus rattus 18 *cm. and under* 19 *cm.*

No.	Serial No.	Sex.	G.L.	Basal length.	G.B.	N.L.	I.O.B.	C.B.	Zy. pl.	Pal. L.	Diastema.	Pal. For.	P.F.B.	Up. M.L.	Up. M.B.	Length of lower jaw.	Depth of lower jaw.
1	91		47 100	39·5 84·04	..	17·5 37·2	5·75 12·23	16 34·04	5·75 12·23	23 48·9	13·5 28·7	10 21·2	3 6·3	8 17·02	2·25 4·78	30·5 64·8	14·5 30·8
2	130		44 100	36·75 81·25	22 50	16·5 37·5	6 13·6	15·75 35·79	5·25 11·93	21·5 48·8	12·5 28·4	8·5 19·3	3 6·8	7 15·9	2 4·5	.. ..	.. ..
3	135		43 100	35·5 82·5	.	16·25 37·78	7 16·2	16·5 38·3	5·5 12·7	21·5 50	11·75 27·32	8 18·6	3 6·9	7 16·2	2 4·6		. ..
4	225		41·5 100	34 81·9	20·5 49·3	14·5 34·9	6·25 15·06	16 38·5	5·5 13·2	19·5 46·9	11 26·5	7·25 17·4	3 7·2	7·5 18·07	2 4·8	28 67·4	12·5 30·1
Total figures			175·5	145·75	42·5	64·75	25	64·25	22	85·5	48·75	33·75	12	29·5	8·25	58·5	27
Average fig.			43·87	36·43	21·25	16·18	6·25	16·6	5·5	21·39	12·18	8·43	3	7·3	2·06	29·2	13·5
Average percentage			100	83·1	49·6	36·7	14·1	36·05	12·5	48·6	27·6	19·1	6·8	16·6	4·5	66·5	30·4

Principal measurements of skulls of Calcutta Mus rattus 19 *cm. and over.*

No.	Serial No.	Sex.	G.L.	Basal L.	G.B.	Nasal L.	Io.B.	C.B.	Zy. Plate.	Pal. L.	Diastema.	Pal For.	P.F.B.	Up. M.L.	Up. M.B.	L. of lower jaw.	Depth of lower jaw.
1	114	♂	47·5 100	39·5 83·1		18 37·8	6·5 13·6	16·5 34·7	5·75 12·1	23 48·4	12·75 26·8	9 18·9	..	7·5 15·7	2 4·2	..	.. ..
2	209	♂	45 100	37 82·2		16 35·5	6·5 14·4	15·5 34·4	5·25 11·6	21·5 47·7	12·5 27·7	8 17·7	4 8·8	7·5 16·6	2 4·4		.. .
3	222	♀	43 100	37 86·04		16 37·2	6·25 14·5	16 37·2	5·5 12·7	21·25 49·4	12·5 29·07	9 20·9	3·75 8·7	7·25 16·8	2 4·6		.. ..
4	270	..	44·5 100	38 85·3		17 38·2	6·5 14·6	16 35·9	6 13·4	22 49·4	13·5 30·3	9 20·2	3·5 7·8	7·5 16·8	2 4·4	28 62·9	14 31·4
5	286	♀	46·25 100	39 84·3	22 47·5	18 38·9	6·5 14·05	16·5 35·6	6 12·9	23 49·7	14 30·2	8 17·08	2·75 5·9	7 15·1	2 4·3	..	.. ..
Total figures			226·25	190·5	22	85	32·25	80·5	28·5	110·75	65·25	43	14	36·75	10	28	14
Average measurement			45·25	38·1	22	17	6·4	16	5·7	22·15	13	8·6	3·6	7·3	2	..	..
Average percentage			100	84·19	47·5	37·56	14·25	35·58	12·59	48·95	28·84	19	3·5	16·24	4·4	..	..

Fifty fresh measurements of Mus decumanus, *Calcutta.*

No.	Serial No.	Length of head and body.	Length of tail.	Length of hind foot.	Length of ears.	Relation of ears to eyes.	Teats.
		100	86·8	21			
1	61	19	16·5	4	2	½ cover.	
		100	87	18·3			
2	206	23	20	4·2	2	1 cm. from eye.	3/3
		100	91	18			
3	207	23	21	4·1	2·1	Reach.	3/3
		100	89	18			
4	213	24·5	22 estd.	4·5	2	Cover.	
		100	91	18 6			
5	214	22	20	4·1	2	½ cover.	2/3
		100	91	17·7			
6	226	22·5	20·5	4	2	1 cm. from eye.	3/3
		100	91	18·7			
7	234	23	21	4·3	2	½ cover.	3/3
		100	87·5	17·5			
8	235	24	21	4·2	2	Reach.	3/3
		100	88	18·1			
9	236	22·5	19·8	4·1	2		
		100	80	16·3			
10	237	27·5	22	4·5	2·1	Reach	
		100	90	17·4			
11	238	27	24·5	4·7	2·1	½ cover.	
		100	94	17·4			
12	239	23	21·5	4	2·1	Reach.	
		100	89	18·1			
13	240	21·5	19·5	3·9	1·9	Short.	
		100	81	18			
14	241	23·2	19·8	4·3	2·1		
		100	95	19			
15	81	21·5	20·5	4·1	2·2	·2 from eye.	1/3
		100	95	19			
16	83	20	19	3·9	1·9	·3 from eye.	
		100	100	19			
17	84	22	22	4·3	2·1	·3 from eye.	
		100	85·1	18·3			
18	242	23·5	20	4·3	2·1		

Fifty fresh measurements of Mus decumanus, *Calcutta*—(contd.)

No.	Serial No.	Length of head and body.	Length of tail.	Length of hind foot.	Length of ears.	Relation of ears to eyes.	Teats.
		100	87	20			
19	95	24	21	4·8	2·1	·5 from eye.	
		100	88·8	18·6			
20	243	22·5	20	4·2	2		$\frac{3}{3}$
		100	95	21			
21	97	20·5	19·5	4·4	2	Reach.	
		100	88·3	20			
22	244	21·5	19	4·3	1·9		
		100	97	20			
23	109	19	18·5	3·9	2	Cover very wide.	
		100	85·7	17·1			
24	245	24·5	21	4·2	2	1 cm. from eye.	
		100	91·3	19·5			
25	246	23	21	4·5	2·1	1 cm. from eye.	$\frac{3}{3}$
		100	93	19			
26	116	20·5	19	4	2	$\frac{1}{2}$ cover.	
		100	90	18			
27	117	21	19	3·8	1·5	·1 from eye.	
		100	100	21			
28	137	19·5	19·4	4·1	2	Reach.	
		100	80	20			
29	140	20·5	16·5	4·2	2	·2 from eye.	
		100	95	17			
30	149	21·2	20·2	3·8	1·9	Reach.	
		100	88	18			
31	150	22·5	19·8	4	1·8	·2 from eye.	
		100	92	17			
32	151	21	19·5	3·9	2	·2 from eye.	
		100	100	18·2			
33	247	23	23	4·2	2	·5 from eye.	$\frac{3}{3}$
		100	85	16			
34	185	25·7	22	4·2		Reach.	$\frac{3}{3}$
		100	90	20			
35	186	20	18	4	2	$\frac{1}{2}$ cover.	$\frac{3}{3}$
		100	95	19			
36	187	21	20	4	2	·3 from eye.	

Fifty fresh measurements of Mus decumanus, *Calcutta*—(concld.)

No.	Serial No.	Length of head and body.	Length of tail.	Length of hind foot.	Length of ears.	Relation of ears to eyes.	Teats.
		100	89	17			
37	188	24	21·5	4	2	½ cover	⅔
		100	86·9	18			
38	189	23	20	4·2	2·1	Reach.	
		100	95	18·6			
39	190	22	21	4·1	2	Do.	
		100	88	19			
40	191	21	18·5	4	2	Do.	
		100	90·9	18·6			
41	196	22	20	4·1	2	·5 from eye.	
		100	89·5	17			
42	197	24	21·5	4·1	2·1	Reach.	⅘
		100	89	17·8			
43	198	23	20·5	4·1	2·1	·2 from eye.	
		100	88	16			
44	199	25	22	4·1	2·1		½, ⅗
		100	89	17			
45	200	23·5	21	4	2	Reach.	⅔
		100	86	16·8			
46	201	25	21·5	4·2	2·1	·5 from eye.	
		100	88·8	17·7			
47	202	22·5	20	4	2	·2 from eye.	⅔
		100	80·8	17			
48	203	23·5	19	4	2	·5 from eye.	
		100	84·7	17			
49	204	23	19·5	3·9	2·2	·3 from eye.	¾, ⅗
		100	86	18·8			
50	205	21·7	18·7	4·1	2		⅗
Total figures		1126·8	1011·7	206·9			
Average percentage.		100	89·78	18·36			

Principal measurements of skulls of Calcutta M. decumanus.

No.	Serial No.	Gr. L.	Bas. L.	Gr. B.	Nasal L.	Io. B.	C B.	Zygom.	Palate L.	Dias.	Pal. For. L.	Pal. For. B.	Up. Mol. L	Up. Mol. B.	Length of lower jaw.	Depth of lower jaw.
1	243	100	90	50·7	40	13·3	32	12·8	50	28·4	17·6	8·0	12·2	4·1		..
		56·2	51	28·5	22·5	7·5	18	7·2	29	16	10	4·5	7	2·5	37	17
2	237	100	90	50	41·3	3·4	32·6	13·4	50	29·8	17·3	6·7	15·3	4·8		
		52	47	26	21·5	7	17	7	27·5	15·5	9	3·5	8	2·5	35·5	15·5
3	247	100	88	51·9	39·2	13·7	32·3	14·1	50	28·4	16·6	6·8	14·7	4·9		
		51	45	26·5	20	7	16·5	7·2	26	14·5	8·5	3·5	7·5	2·5	34	16·5
	Figd.															
4	243	100	87	51·8	36·5	3·2	31·5	12·1	50	30·4	18·2	9·1	15·2	5·0		
		49·2	43	25·5	18		15·5	6	25	15	9	4·5	7·5	2·5	33	15·5
5	226	100	85	47·8	35·8	13·9	32·8	13·4	49	27·8	17·9	7·9	15·9	4·9		
		50·2	43	24	18	7	16·5	6·75	25	14	9	4	8	2·5	32	15·5
6	234	100	86	49·0	38	14·50	35·0	14	50	29·5	17·0	7	14·5	5·0		
		50	43	24·5	19	7·25	17·5	7	25	14·75	8·5	3·5	7·25	2·5	34	15·5
7	238	100	89	55·1	38·7	16·82	34·18	13·77	50	30	18·3	8·1	16·3	4·6		
		49	44·0	27	19	8·25	16·75	6·75	25·0	15	9	4	8	2·3		
8	241	100	85		36·4	13·5	34·89	14·5	49	28·1	16·6	7·2	14·5	5·2		
		48	41		17·5	6·5	16·75	7	23·5	13·5	8	3·5	7	2·5	31	15·5
9	242	100	85	47·5	40	13·5	33	13·1	49	30 9	17·4	8·7	13·5	4·8		
		51·5	44	24·5	21	7	17	6·75	25·5	15·5	9	4·5	7	2·5	33	14·75
10	45	100	88	49	39·	13·9	34·3	13·9	50	29·4	17·15	7·35	15·6	4·9		
		51	45	25	20	7	17·5	7	26	15	8·75	3·75	8	2·5	34	16·5
11	246	100	89	51·4	38·8	15·5	33·9	13·5	50	29·6	18·4	8·7	15·5	4·8		
		51·5	46	26·5	20	8	17·5	7	27	15·25	9·5	4·5	8	2·5	35	17
12	248	100	87·9	50	37·9	14·8	33·3	13·4	50	29·6	18	7·4	14·8	4·6		
		54	47·5	27	20·5	8	18	7·25	28	16	9·75	4	8	2·5	34·5	17
13	176	100	84	50·9	37·2	13·7	34·3	13·7	49	28·4	17·6	7·8	14·7	4·9		
		51	43	26	19	7	17·5	7	25	14·5	9	4	7·5	2·5		
14	187	100	90	50·4	37·8	14·5	33	13·5	50	29·1	17·4	7·7	13·5	4·8		
		51·5	46·5	26	19·5	7·5	17	7	27·5	15	9	4	7	2·5	35	17
15	204	100	89·8	48·4	40·4	14	32·8	14	50	29	18	8	14	5		
		49·5	44·5	24	20	7	16·25	7	25	14·5	9	4	7	2·5	32	15·5
16	214	100	88	49	40	14	34	14	50	31	17	8	15	5		
		50	44	24·5	20	7	17	7	25	15·5	8·5	4	7·5	2·5		
17	84	100	86		38·4	13·9	33·6	15·3	50	29·3	17·2	7·6	15·3	4·8		
		52	45		20	7·25	17·5	8	26	15·25	9	4	8	2·5	34	16·5
18		100	87·2	53·9	39·2	14·7	33	13·7	49	29·4	15·6	7·8	15·6	4·9		
		51	44·5	27	20	7·5	17	7	25	15	8	4	8	2·5	35	16

Principal measurements of skulls of Calcutta M. decumanus—(contd.)

No.	Serial No.	Gr. L.	Bas. L.	Gr. B.	Nasal L.	Io. B.	C.B.	Zygom.	Palate L.	Dias.	Pal. For. L.	Pal. For. B.	Up. Mol. L.	Up. Mol. B.	Length of lower jaw.	Depth of lower jaw.
19	165	100	87	53·3	38·8	14·5	35·9	15·5	50	30·8	16·5	7·7	15·5	4·8		
		51·5	45	27·5	20	7·5	18·5	8	26·5	15·75	8·5	4	8	2·5		
20	213	100	86	50	39·2	13·7	35·2	13·7	49	28·9	16·6	7·8	15·6	4·9		
		51	44	25·5	20	7	18	7	25	14·75	8·5	4	8	2·5	34	16
Total ..		1021·1	896	465·5	395·5	144·75	343·25	140·9	517·5	300·25	177·5	79·75	152·25	49·8	543	257·25
Average		51·05	44·8	25·8	19·7	7·23	17·	7·4	25·8	15·1	8·6	3·98	7·61	2·4	33·6	16·07 *
Average percentage ..			88	50	38·7	14·7	33·6	13·8	50	29·5	17·3	7·8	14·9	4·8	66·4	31·4

Fifty fresh measurements of Nesokia bengalensis.

No.	Serial No.	Body and head.	Tail.	Hind foot.	Ears.	Teats.	Relation of ears to eyes.	REMARKS.
		100	87	17				
1	192	19·5	17	3·5	2·2	⅛	½ cover.	
		100	79	17·6				
2	193	17	13·5	3	2		Reach.	
		100	81	17				
3	41	18·5	15	3·6	2·1		·75 from eye.	
		100	87	19				
4	43	19·5	17	3·8	1·9		Reach.	
		100	76	18				
5	44	16·5	12·6	3	1·9		..	
		100	83	21				
6	48	17·5	14·6	3·8	2		½ cover.	
		100	80	17				
7	232	20	16	3·5	2·2		·6 from E.	
		100	80	18				
8	52	17·5	14	3·3	1·9		·75 from E.	
		100	77	18				
9	194	17·5	13·5	3·2	2		½ cover.	
		100	94	17				
10	195	17·5	16·5	3	2		Reach.	
		100	75	15				
11	208	19·5	14·7	3	1·8	⅝	Do.	
		100	76	20				
12	63	15	11·5	3	1·9		Do.	
		100	78	19				
13	64	17	13·5	3·4	2		·3 from E.	
		100	82	16				
14	77	20·5	17	3·7	1·9		½ cover.	
		100	70	18				
15	216	18·5	14	3·3	2	¾	Cover.	A few white hairs at root of tail below.
		100	74	19				
16	217	17·5	13	3·3	1·8		·3 from E.	
		100	79	19				
17	218	19	15	3·6	1·9	¼	Reach E.	
		100	79	17				
18	249	19·5	15·5	3·3	2	¾		

Fifty fresh measurements of Nesokia bengalensis—(contd.)

No.	Serial No.	Body and head.	Tail.	Hind foot.	Ears.	Teats.	Relation of ears to eyes.	REMARKS.
19	220	100 19	81 15·5	16 3	2	¼ ¾	Reach	A few white hairs at base of tail.
20	227	100 19·5	77 15	17 3·4	2			
21	228	100 18	83 15	17 3·1	2			
22	110	100 19·5	74 14·5	15 3	2		Cover.	Five or six white hairs below.
23	113	100 19·5	79 15·5	17 3·2	2		Do.	
24	118	100 18	78 14	17 3	2		Do.	A few white hairs below base of tail.
25	119	100 19	78 15	17 3·2	2·1		Do.	Do.
26	120	100 18	80 14·5	18 3·2	2		Reach.	A few hairs below have white tips.
27	121	100 16·5	85 14	18 3	2		Cover.	
28	122	100 17	83 14·2	18 3	1·9		·2 from eye.	
29	123	100 17	79 13·5	18 3	1·9		·2	
30	220	100 19·5	77 15	17 3·4	2			
31	125	100 19·5	82 16	16 3·2	2·2		Reach.	Five or six white hairs below tail.
32	126	100 18·2	84 15·5	16 3	2·1	¾	Cover.	Do.
33	127	100 18·5	75 14	16 3	1·9		Reach.	
34	128	100 17·5	78 13·7	17 3	1·9	¾	½ cover.	
35	138	100 17·5	77 13·5	18 3·2	2		½ cover.	
36	139	100 18	78 14	17 3·1	2		Cover.	

Fifty fresh measurements of Nesokia bengalensis—(concld.)

No.	Serial No.	Body and head.	Tail.	Hind foot.	Ears.	Teats.	Relation of ears to eyes.	Remarks.
		100	87	17				
37	141	16	13	2·8		⅓	Reach.	Gravid.
		100	91	18				
38	143	17·5	16	3·2	2	⅓		Pregnant.
		100	82	18				
39	168	17	14	3	2		·2 from E.	
		100	79	16				
40	169	18·8	14·6	3·2	2		·3 from E.	
		100	75	17				
41	170	19·5	14·8	3·3	2	⅓	·3 from E.	Teats very prominent though not pregnant.
		100	74	17				
42	171	18	13·3	3	2	⅓	·3 from E.	Do. do.
		100	73	18				
43	172	20·5	15	3·7	2·1		·2 from E.	Left hind outer pad very faint so that at first not seen.
		100	69	18				
44	177	17·5	12	3·2	2		·5 from E.	
		100	76	18				
45	178	17	13	3	1·8		·3 from E.	Five or six white hairs below base of tail.
		100	75	17				
46	179	18	13·5	3·1	2	⅓	Reach	Do. do.
		100	89	15				
47	180	19·6	17·5	3	2	¼		
		100	89	17				
48	181	18	16	3·1	2	⅓	Cover very wide.	
		100	81	16				
49	183	18·5	15	3	2	¼	Reach.	
		100	81	16				
50	230	19	15·5	3	2·2	⅝		
Total		912 1	739·7	159·8	97·6			
Average measurement		18·22	14·79	3·19	19·52			
Average percentage		100	81·1	17·4	10·7			

Principal measurements of skulls of Calcutta Nesokia bengalensis.

No.	Serial No.	Gr. L.	Bas. B.	Gr. B.	Nasal L.	Io. B.	Cran. B.	Zygom.	Palate L.	Dias.	Pal. For. L.	Pal. For. B.	Up. Mol. L.	Up. Mol. B.	Lower Jaw, length.	Lower Jaw, depth.
		100	91	62·16	28·37	14·86	43·24	16·78	52	30·4	22·97	6·75	18·91	6·75		
1	128	37	34	23	10·5	5·5	16	6·25	19·5	11·25	8·5	2·5	7	2·5		
		100	88	60·75	18·75	16·25	43·75	16·25	51	30	20	6·25	17·5	6·25		
2	127	40	35·5	24·3	7·5	6·5	17·5	6·5	20·5	12	8	2·5	7	2·5	32	17
		100	90	58·53	29·26	14·63	40·24	15·85	53	31·7	19·51	6·7	17·56	7·31		
3	218	41	37	24	12	6	16·5	6·5	22	13	8	2·75	7·2	3	29·5	16
		100	91	59·74	29·48	15·38	41·02	16·66	55	31·41	19·25	6·41	19·25	6·66		
4	118	39	35·5	23·3	11·5	6	16	6·5	21·5	12·25	7·5	2·5	7·5	2·6	27	15
		100	95	60	31·87	16·25	42·5	17·5	56	32·5	20	6·87	17·5	6·25		
5	220.	40	38	24	12·75	6·5	17	7	23	13	8	2·75	7	2·5		
		100	89	58·22	30·37	16·45	42·4	16·45	53	29 74	17·72	6·32	17·72			
6	126	39·5	35·5	23	12	6·5	16·75	6·5	21	11·75	7	2·5	7			
		100	90	59·21	28·94	15·78	42·1	16·44	53	28·94	18·42	6·57	19·73	7·89		
7	171	38	34·5	22·5	11	6	16	6·25	20·5	11	7	2·5	7·5	3		
		100	90	60·5		17·1	42·76	15·78	52	30·26	18·42	6·57	18·94	6·c4		
8	121	38	34·5	23		6·5	16·25	6·	20	11·5	7	2·5	7·2	2·6	28	15·5
		100	90	58·75	30	16·25	41·25	15	54	3·.25	20	6·25	18	6·25		
9	217	40	36	23·5	12	6·5	16·5	6	21·75	12·5	8	2·5	7·2	2·5		
		100	91	59·48	28·2	15·38	42·94	16·02	53	29·74	17·94	7·05	17·43	6·41		
10	183	39	35·5	23·2	11	6	16·75	6·25	21	11·5	7	2·75	6·8	2·5	28·5	16
		100	90		29·65	13·95	38·37	15·11	55	32·55	20·93	6·39	18·6	6·04		
11	172	43	39		12·75	6	16·5	6·5	24	14	9	2·75	8	2·6	29	15·75
		100	92	58·4	30·69	15·9	40·9	15·9	55	29·54	19·3	6·81	17·04	6·81		
12	232	44	40·5	25·7	13·5	7	18	7	24·5	13	8·5	3	7·5	3	32	16·5
		100	91	63·33	30·76	16·02	43·58	17·94	55	30·76	17·94	6·41	17·94	6·41		
13	219	39	35·5	24·7	12	6·25	17	7	21·5	12	7	2·5	7	2·5		
		100	89		30·57	15·78	43·42	15· 8	52	28·94	20·51	6·57	18·42	6·57		
14	208	38	34		12	6	16·5	6	20	11	8	2·5	7	2·5	30	16
		100	90	59·25	30·62	15	42·5	16·25	51	32·5	17·5	6·28	16·25	7·5		
15	168	40	36	23·7	12·25	6	17	6·5	20·5	13	7	2·5	6·5	3		
		100	93	60·25	30·76	16·66	41·66	15·38	55	33·33	19·23	6·57	17·94	6·57		
16	125	39	36·5	23·5	12	6·5	16·25	6	21·5	13	7·5	2·5	7	2·5		
		100	90	60	30	16·25	43·75	16·25	56	33·75	20	6·25	17·5	7·5		
17	170	40	36·15	24	12	6·5	17·5	6·5	23	13	8	2·5	7	3	30·16	
		100	90	60		15	41·25	16·87	52	30	17·5	6·87	18	6·75		
18	133	40	36	24		6	16·5	6·75	21	12	7	2·75	7·2	2·7	28	16

Principal measurements of skulls of Calcutta Nesokia bengalensis—(contd.)

No.	Serial No.	Gr. L.	Bas. B.	Gr. L.	Nasal L.	Io. B.	Cran. P. B.	Zygom.	Palate L.	Dias.	Pal. For. L.	Pal. For. B.	Up. Mol. L.	Up. Mol. B.	LOWER JAW, length.	LOWER JAW, depth.
		100	91	60·25	30·12	16·66	41·02	16·02	52	31·41	17·94	7·69	18·46	6·41		
19	122	39	35·5	23·5	11·75	6·5	16	6·25	20·5	12·25	7	3	7·2	2·5	28	15
		100	90	62·5	30	16·87	42·5	15	53	32·5	20	7·5	18·75	6·25		
20	180	40	36	25	12	6·75	17	6	21·5	13	8	3	7·5	2·5	29	16
Total ..		793·5	721·15	427·9	210·5	125·5	333·5	128·25	428·75	246	153	52·75	143·3	50·5	351	190·75
Average measurement		39·67	36·5	23·7	11·1	6·27	16·6	6·41	21·43	12·3	7·6	2·63	7·1	2·6	29·2	15·8
Average percentage			90·8	59·8	29·3	15·7	42	16	54	31	19·2	6·5	18	6·6	73	39·8

The following is the measurement of an abnormally large skull, No. 328 ♂. This skull, in the cranial breadth and the length of the upper molars, shows some approximation to the *decumanus* type of skull and is possibly an instance of the occasional hybrid described by Anderson.

	328 ♂	50	46	29	15	7	18·5	8	27	16·5	10	3	8	3	36	19·5
		100	92	58	30	14	37	16	54	35	20	6	16	5	72	39

Chief measurements of Calcutta Nesokia bandicota *var.* nemorivagus.

No.	Serial No.	Sex.	Body and head.	Tail.	Hind foot.	Ears.	Teats.	Relation of ears to eyes.
1	152	♂	27 100	26·5 98·1	5·7 21·1	3 11·1		Reach.
2	175	♀	28 100	25·4 90·7	5·1 18·2	3·1 11·07	⅗	½ cover.
3	184	♀	27 100	26·5 98·1	5 18·5	2·8 10·3		Do.
4	211	♀	27 100	26 96·2	5·2 19·2	3 11·1	⅔	Reach.
5	212	♀	26·5 100	22·5 84·9	4·5 16·9	2 7·5		Do.
6	215	♂	24·5 100	23 93·8	5 20·4	2·6 10·6		Do.
7	250	♂	28 100	26·5 94·6	6·0 21·4	2·9 10·3		·3 short.
8	255	♀	26·5 100	26·5 100	5·1 19·2	2·8 10·5		
9	303	♂	28 100	26·5 94·6	5 17·8	2·7 9·6		
Total ..			242·5	229·4 851	46·6 172·7	24·9 92	2·2	
Average measurement ..			26·9	25·5	5·1	2·7	1·1	
Average percentage				94·5	19·18	10·2		

Skull measurements of Calcutta Nesokia bandicota *var.* nemorivagus.

No.	Sex and Ser. No.	G.L.	Basal L.	G.B.	N.L.	Io. B.	Cr. B.	Zg. Pl.	Pal. L.	Diast.	Pal. For. L.	Pal. For. B.	Up. Mol. L.	Up. Mol. B.	Lower Jaw, length.	Lower Jaw, depth.
1	152 ♂	59 100	54	32	21·5 36·4	8	20·5	10·5	32	18·5	10·5	3·5	11	3	44	21
2	212	58 100	52	31	21 36·2	8	20·5	10	30·5	18	10·5	3·5	11	3	43	21·5
3	184	58 100	52	31	21 36·2	7·5	20	10·5	31	17·5	11	4	11	3	42	21
4	175	63 100	58	34	23 36·5	9	21	10·5	36·5	19·5	10	3·5	11	3	45	23·5
5	255	58 100	52	31	21 36·2	8.5	20·5	10	31	18	11	3	10·5	3	42	19.5
6	303	57 100	52	31	21 36·6	8	20·5	10	31	18	11	3	10·5	3	42	22
7	215	55 100	51	31	20 36·3	8	19·5	9	30	17	10·5	3	10·5	3	40	20
8	..	61 100	55	—	22 36	9	20·5	10	34	21	11	3·25	11	3	45·5	21
Total ..		469	426	221	170·5	65·5	163·0	80·5	25·6	147·5	84·5	26·75	87	24	343·5	169·5
Average measurement		58·62	53·2	31·5	21·31	8·19	20·3	10·06	32	18·43	10·56	3·33	10·96	3	42·9	21·1
Average percentage ..		100	90·7	53·9	36·3	13·97	34·8	17·1	54·5	31·43	18·01	5·68	18·69	5·11	73·0	36

Skull measurements of Nesokia Bandicota *from the Indian Museum.*

LOCALITY.	Mus. No.	G.L.	Basal L.	G.B.	N.L.	Io. B.	Cr. B.	Zg. Pl.	Pal. L.	Diast.	Pal. For. L.	Pal. For. B.	Up. Mol. L.	Up. Mol. B.	LOWER JAW,	
															length.	depth.
Manbhoom ..	d	62 100	59	33·5	25·5 41·1	9·75	21·5	10·75	35	19·5	11	3	12	3		
Goona, Central I. ..	w	67 100	61	34	26 38·9	9·5	22	10·25	37	22	12	3·5	12·5	3		
Ditto ..	j	62 100	56	34·5	24·5 39·5	9	21·5	9·5	34·5	19	12·5	2·75	12	3		
Madras (taken from spirit specimen) ..		62 100	59 95	33 53·1	25 40·3	9 14·5	21 33·8	9 15·3	36 58	21 33·8	11·5 18·5	3 4·8	11 17·7	3 4·8		
Ceylon ..	f	65 100			22 33·8	8 12·3	21 32·3	9·5 14·6	36 55·3	20·5 31·5	13 20	3·75 5·76	11·75 18·07	3 4·61		
Total ..		318	235	135	123	45·25	107	49	178·5	102	60	16	59·25	15		
Average measurement		63·6	58·7	33·7	24·6	9·06	21·4	9·8	35·7	20·4	12	3·2	11·85	3		
Average percentage		100	92·2	52·7	38·7	14·2	33·6	15·4	56·1	32·0	18·8	5·0	18·6	4·7		

Skull measurements of Nesokia hardwickii *from the Indian Museum.*

Museum No. and Sex.		G.L.	Basal L.	G.B.	N.L.	Io.B.	Cr.B.	Zg. Pl.	Pal. L.	Diast.	Pal. For. L.	Pal. For. B.	Up. Mol. L.	Up. Mol. B.	LOWER JAW, C. to I.	LOWER JAW, C. to A.
u	♀	39·5	35·5		11	5·5	17	7·5	22	13	5	1·5	8·5	3		
a	♂	44	39	27	13	6	18	7·5	24·5	15·5	5·5	1·5	8·5	3		
o	♀	40·5	36·5	25·5	11·5	6	17	7	22·5	14	5	1·5	8	3		
m	♀	41	37	26	12	6	17·5	8	23·5	14	4	1·5	8·5	3		
s	♀	39	35	26	11	6	17	7·5	22	13	4·5	1·5	8	3		
Total		204·0	184	104·5	58·5	29·5	86·5	37·5	114·5	69·5	24·0	6·5	41·5	15		
Average		40·8	36·2	26·1	11·7	5·9	17·3	7·5	22·9	13·9	4·8	1·5	8·3	3		
Average percentage		100	88·7	63·9	28·6	14·4	42·1	18·3	56·1	31·6	11·7	3·6	20·3	7·3		

Measurements of type skull of Nesokia scullyi, *Indian Museum.*

a	47 100			15 31·9	7·25 15·4	19·5 41·5	9 19·1	27 57·4	15·5 32·9	6·5 13·4	1·75 3·7	10·5 22·3	3 5 7·4		

Measurements of type skull of Nesokia huttoni, *Indian Museum.*

a	44 100			13·5 30·4	6 13·6	18 40·6	8 18·1	26 59·0	15·5 35·2	6 13·6	2 4·5	8·5 19·3	3 6·8		

TABLE COMPARING THE PRINCIPAL MEASUREMENTS OF VARIOUS RATS.

	Head and body.	Tail.	Hind foot.	Ear.	Authority.
M. rattus (full-grown)	17·3	20·97	3·31	2 12	Hossack.
M. rattus var. *nitidus*	18·5	18·5	3·6	2·16	Do.
M. decumanus	22·6	20·2	4·15	1·97	Do.
N. bengalensis	18·22	14·79	3·19	1·95	Do.
N. bandicota var. *nemorivagus*	26·9	25·5	5·1	2·7	Do.
N. bandicota	33·75	30	6·25		Blanford.
N. hardwickii	16·5	11	3·05	1·25	Do.
N. huttoni	16·8	11·4	3·7		Anderson.
N. scullyi	16·5	13	4·4		Do.
N. from Jagdispur, Behar	15·25	14	3·4	1·77	Hossack.

TABLE COMPARING THE PRINCIPAL MEASUREMENTS OF VARIOUS RATS EXPRESSED AS PERCENTAGES OF LENGTH OF HEAD AND BODY.

M. rattus (full-grown)	100	121·2	19·1	12·2
M. rattus var. *nitidus*	100	100	19·4	11·6
M. decumanus	100	89	18	8·2
N. bengalensis	100	81	17·4	10·7
N. bandicota var. *nemorivagus*	100	94·5	19·18	10·2
N. bandicota	100	88·8	18·4	
N. hardwickii	100	66·6	19	7·5
N. huttoni	100	67·8	22	
N. scullyi	100	78·4	26·6	
N. from Jagdispur, Behar	100	91·8	22·2	11·6

Table of Average Cranial Measurements Compared.

(Of 16 cm. and over.)	G.L.	Basal L.	G.B.	N.L.	Io. B.	Cr. B.	Zg. Pl.	Pal. L.	Diast.	Pal. For. L.	Pal. For. B.	Up. Mol. L.	Up. Mol. B.	Lower Jaw. C. to I.	Lower Jaw. C. to A.	Authority.
Mus rattus	42·3	35·2	20·3	15·3	5·9	15·7	5·2	20·4	11·7	7·9	2·8	7·1	2	25·8	12·7	Hossack.
Mus rattus var. *nitidus*	44·8	38·1	21·5	17·6	6·1	17	5·5	22·3	12·8	8·3	3·3	7	2	30	13·8	Do.
M. decumanus	51·5	44·8	25·27	18·77	7·23	17·16	7·04	25·9	15·01	8·87	3·98	7·61	2·49	33·9	16·07	Do.
N. bengalensis	39·67	36·05	23·7	11·1	6·27	16·6	6·41	21·43	12·3	7·6	2·63	7·1	2·6			Do.
N. bandicota var. *nemorivagus*	58·62	53·2	31·5	21·31	8·19	20·3	10	32	18·43	10·56	3·33	10·96	3			Do.
N. bandicota	63·6	58·7	33·7	24·6	9·05	21·4	9·8	35·7	20·4	12	3·2	11·85	3			Do.
Ceylon *do.*	65			22	8	21	9·5	36	20·5	13	3·75	11·75	3			Do.
N. hardwickii	40·8	36·2	26·1	11·7	5·9	17·3	7·5	22·9	13·9	4·8	1·5	8·3	3			Do.
N. scullyi	47			15	7·25	19·5	9	27	15·5	6·5	1·75	10·5	3·5			Do. (from Ander-
N. huttoni	44			13·5	6	18	8	26	15·5	6	2	8·5	3			Do.) son's type.
N. from Jagdispur, Behar	38	34	23·5	11	6	17	6·5	21	11·5	8·5	2	8·5	3	27·5	15·5	Do.

Table of Average Cranial Percentages Compared.

M. rattus	100	83·2	47·9	36·1	13·9	37·1	12·2	47·9	27·1	18·6	6·6	16·7	4·7	60·9	30
M. rattus var. *nitidus*	100	84·8	47·2	39·3	13·6	37·9	12·2	49·7	28·6	18·5	7·3	16·7	4·4	67	30·8
M. decumanus	100	88	49·5	36·7	14·1	33·6	13·7	50	29·4	17·3	7·7	14·9	4·8	64	31·4
N. bengalensis	100	90·8	53·9	26·5	15·7	41·8	16·1	53·9	31	19·1	6·6	17·9	6·5		
N. bandicota var. *nemorivagus*	100	90·7	53·9	36·3	13·97	34·8	17·1	54	31·43	18·01	5·68	18·69	5·11		
N. bandicota	100	92·2	52·7	38·7	14·2	33·6	15·4	56·1	32	18·8	5	18·6	4·7		
Ceylon *do.*	100			33·8	12·3	32·3	14·6	55·3	31·5	20	5·76	18·07	4·61		
N. hardwickii	100	88·7	63·9	28·6	14·4	42·1	18·3	56·1	31·6	11·7	3·6	20·3	7·3		
N. scullyi	100			31·9	15·4	41·5	19·1	57·4	32·9	13·4	3·7	22·3	7·4		
N. huttoni	100			30·4	13·6	40·6	18·1	59	35·2	13·6	4·5	19·3	6·8		
N. from Jagdispur, Behar.	100	89·4	61·8	28·9	15·7	44·7	17·1	55·2	30·2	22·3	5	22·3	7·8	72·3	40·7

NOTE.

THE RELATIONS OF THE MUS RATTUS OF INDIA TO THE MUS RATTUS OF GREAT BRITAIN.

One difficulty that has caused me trouble in the writing of this paper is that, except for a couple of skins of the English black rat preserved in the Indian Museum, both faded to a ruddy plum-colour, I have had no opportunity of examining specimens of English rats. Indeed, I have not even been able to find access to any full and reliable account of the rats of Great Britain, so that it has not been possible for me to come to any definite conclusions as to the relationship of the British and Indian forms of *Mus*. While the work was in the press, however, I have fortunately been able to consult Millais's recent work on the Mammals of Great Britain and Ireland in which the rats of Great Britain are treated very fully. *Mus decumanus* is apparently identical in both countries except that Millais agrees with Thomas in making the tail uniformly brown as compared with the bi-coloured tail found in Calcutta and apparently in India generally; the skull and general body measurements appear to be the same in both countries.

The subject of *Mus rattus* is wrapped up in such confusion that before attempting to correlate the findings of Millais and the result of my own investigations, it would be as well to clearly define the position we both take up.

With regard to the *Mus rattus* of India the distinction formerly drawn between *Mus rattus* var. *rufescens* and *Mus rattus* var. *alexandrinus*, must be abandoned. Thomas has shown that for India generally the distinction is indeterminate, as the two varieties intergrade completely; and the only conclusion to be drawn from my investigation in Calcutta is that only one form has in reality to be dealt with, a form with an extreme range of both size and colour; and from this form two varieties have been artificially manufactured. *Mus rattus* var. *nitidus* is, I am inclined to think, a clearly marked Indian hill variety distinguished by its short bi-coloured tail and long fur, but the evidence on which I have to rely is extremely incomplete.

Millais describes three sub-species of *Mus rattus* found in Great Britain, as follows:—

1. *Mus rattus alexandrinus.*—

This is the original Alexandrine Rat of Geoffroy, or southern type of *Mus rattus*. He describes it as a long-tailed rat, but in the example he gives the respective measurements of the head and body and tail are 9 in. and 7½ ins. It is a light yellowish-brown above with white underparts, with a dividing line of grey. He regards it as the parent race of *Mus rattus rattus* and recently imported into England.

2. *Mus rattus rattus.*—

This is the old English Black Rat, now practically extinct in England. He distinguishes it from the next purely by the colour, which he describes as blue rather than black, bluish or purplish-black above, and greyish-black below, with yellowish soles to the feet. His knowledge of this rat has been gained apparently in main part from an examination of a hundred specimens collected from all parts of Great Britain in the last fifty years. There is no doubt that the old English Black Rat existed as a distinct northern variety; but I maintain that to lay down from old faded specimens that the old English rat was "blue" rather than black, is rather a courageous undertaking, considering what is known as to the changes in colour in old specimens.

3. *Mus rattus ater.*—

This, the Black Alexandrine Rat, is separated from the two previous sub-species only by its colour, and by the doubtful fact that its tail is not so thick at the base and is proportionately longer. The back is a rich black with greenish lights; the lower parts are blackish, as are the feet and soles. It is an imported rat found mostly in seaports. I am afraid this differentiation into three sub-species cannot be accepted, for it is one based practically entirely on shades of colour and is absolutely contradicted by

the observations of Blanford, Liston and myself, at least as far as regards *Mus rattus alexandrinus*. This is not a rat that uniformly shows a light brown upper surface with light underparts as described by Millais, but is a rat with an extreme range of colour from white through yellow and brown to black, with a belly varying from lemon-white through orange-grey to almost black. What he seems to have done is to separate the light and the dark varieties of the Alexandrine Rat, giving them respectively the distinctive trinomen of *alexandrinus* and *ater*. That he is right in deriving *Mus rattus rattus*, the old English Black Rat, from the original Alexandrine Rat no one can dispute who has read the extremely interesting and convincing paper of M. de l'Isle written in 1865.[1] This French naturalist, after establishing his contention on the purely theoretical grounds of identity in morphology and habits, proceeded to prove it beyond dispute by a series of convincing experiments in interbreeding.[2]

The old English Rat or *Mus rattus* of France written of by de l'Isle is simply an occasional variety of *Mus alexandrinus* that has been fixed by climatic influences as a definite geographical race; it is now practically extinct and probably the real explanation of its rare reported recent occurrences are to be explained by the occasional capture of specimens of *Mus rattus ater*, or in other words of black specimens of *Mus rattus alexandrinus*.

Conclusion.—

The final conclusion at which I arrive is that there is no distinction between the *Mus rufescens* and *Mus alexandrinus* of India; that both are identical with the *Mus rattus* of Great Britain, and probably Europe; that all should be known alike under the common specific name of *Mus rattus*; and that the trinominal nomenclature at present in vogue as regards *M. rattus* should be dropped as a non-scientific fallacy. These may seem bold words to be written by one who is but an amateur, but they are based on the moral support afforded by the discovery, after this memoir was in the press, that my paper is little more than a duplicate of that written fifty years ago by the French scientist M. de l'Isle. The parallelism between the two papers is extraordinary; he decries the artificial manufacture of species, he deplores the reliance on colour variations and minute differentiations, holds up to scorn the non-recognition of the characteristics of immaturity, and generally where I have been satisfied with mildly protesting, openly denounces. The following is a sample sentence: "Quelques naturalistes, MM. Brehm et Crespon par exemple, avaient multiplié les types à plaisir, et même, en quelques genres, publiés à peu près autant d'espèces qu'ils avaient d'individus entre les mains." This paper of M. de l'Isle's is distinguished by precise and accurate observations and its clear and logical deductions, and is a mine of information to the naturalist who regards animals from a wider standpoint. I regret that I have come across it too late to incorporate it in my work, but I hope shortly to publish a note on it in the *Records of the Indian Museum*.

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[1] *De l'existence d'une Race Nègre chez le Rat, ou de l'identité spécifique du Mus Rattus et du Mus alexandrinus*, Ann. Sci. Nat. (v), Zool., Tom. iv, 1865, pp. 172—222.

[2] My own experiments in breeding with *Mus rattus* failed. They were kept in a large aviary with some piebald domesticated Brown Rats, and as the result, were soon killed by them.