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XIII.—A new subspecies of hamster from Daghestan (Mesocricetus raddei, Nehr.), and some remarks on the Russian species of Mesocricetus (with a key to them)

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A. Formosov and Heptner. It will be described in the results of the Daghestan Zoological Expedition. Lastly, *A. amphibius djukovi*, described in this paper, belongs to Middle Daghestan.

There is no doubt that a further study of the Caucasus fauna will make it necessary to establish a whole new series of high-mountain forms also belonging to this genus.

Zoological Museum, Moscow University,
March 1926.

XIII.—*A new Subspecies of Hamster from Daghestan* (Mesocricetus raddei, *Nehr.*), *and some Remarks on the Russian Species of* Mesocricetus (*with a Key to them*). By S. I. Ognev and W. G. Heptner.

In 1894 A. Nehring described *, from a single specimen procured by Radde near the sources of the river Samur (Caucasus, Daghestan), in June 1886, a new form of blackish hamster, naming it *Cricetus nigricans*, Brandt, var. *raddei*. Later on †, this author, after studying the same specimen more minutely, did not any longer consider this form a variety, as at first, but was inclined to admit its being a different species, naming it *Mesocricetus raddei*, sp. n. In the latter, as well as in the former, article, the skull only was described and its characters alone were given, as differentiating *M. raddei* from the closely allied *M. nigriculus*, Nehr., of Northern Caucasus. According to the author, the original specimen was in such an imperfect state of preservation (having lost its colour in alcohol) that he did not describe the colouring at all. The deficiency was filled up in the detailed work of Nehring on the genus (subgenus) *Mesocricetus* ‡; but the description given was from two other skins received from the Russian zoologist K. A. Satunin, who had taken them on August 23rd, 1897, upon the Khunsakh plateau in Western Daghestan, that is at no small distance from the spot whence the type of species had come. In the same article two skulls of *M. raddei* are reproduced, that of a comparatively young type from the

* 'Zoologischer Anzeiger,' No. 445, 1894, p. 148.

† *Op. cit.* No. 553, 1898, p. 182, "*Cricetus raddei*, sp. n."

‡ 'Archiv für Naturgeschichte,' 1898, p. 373, "Die Gruppe der *Mesocricetus*, Arten."

Samur and of an old individual from the Khunsakh plateau. The study of the series of *Mesocricetus raddei* from Khunsakh * (collections of S. I. Ognev and of the Daghestan Zoological Expedition) and from other places in Daghestan, where this small hamster, as well as the topotype of the sources of the Samur, was only recently discovered, owing to the unflagging energy of N. N. Djukov, has enabled us to bring to light some interesting facts :—

First of all, that this species, whose habitat was thought to be limited to a surface of only a few square versts on the Khunsakh plateau, occupies a region of much greater extent. Further, it enabled us to establish that *M. raddei*, in the whole area of its distribution in the mountains of Daghestan, is not monotypic, but forms two distinct groups. One of them occupies the Khunsahk plateau, the other extends further east. Also that the specimens, collected by N. N. Djukov in Eastern Daghestan (see below), are markedly alike. The description as well as the distinctive characters of the new subspecies are given farther on ; here it is only worth noting that Nehring has described and figured, under the name of *M. raddei*, two different races of one species. Nehring's first description having been very schematic and unsatisfactory, it was, as it were, forgotten, and his succeeding one, where the skulls and skins of adult *M. raddei* from Khunsakh are minutely described, was accepted as an authority. Thus it became a fixed opinion in zoological literature that Khunsakh was the *terra typica* of this species—Satunin, Radde, and others wrote in this sense. In this way it turned out that the old classical habitat, where this species was always taken, is inhabited by a new form, whilst the newly discovered interesting places of habitat are taken up by the typical *M. raddei raddei*. After these preliminary considerations we pass on to the description of the new form.

Mesocricetus raddei avaricus †, subsp. n., typus ♀ sen.

Near the (village) aoul Khunsakh, Avarsky district. Province of Daghestan, 5530 feet alt., 23. vii. 24. Collection of the Zoological Museum of the Moscow University, No. S. 4520, leg. D. Behme.

Diagnosis.—This subspecies resembles *Mesocricetus raddei*

* The topotype material which has served to describe the colouring in the original work.

† Named after the tribe of the Avarci which inhabit this country, called Avaria by the natives, and which belongs to the Avarsky district of the Daghestan province.

raddei, Nehr., but differs from it by the colouring of the belly, which is quite black and not greyish, by the zygomatic arches narrowing in front and being slightly compressed, and by the distinctly projecting forward ossa nasalia. The rostrum cranii is somewhat lighter and narrower. Length of body up to 220 mm.; length of skull 46·7 mm.; breadth of zygomatic arches up to 25·1 mm.; the alveolar length of the upper molars 8·2 mm.

Comparative Remarks.—This new form of hamster, though very near to the typical *M. raddei raddei*, differs from it by the following characters :—

Skull.—A comparison between specimens of the two races (see measurement table) makes it evident that, on the whole, the skull of the new form is somewhat smaller in size and possesses some peculiarities of structure. The brain-case is smaller and narrower. The ossa nasalia of *M. raddei avaricus* are slightly compressed in the middle third of their length, and the outward line of the sides is gently undulated. The front part of the lateral limit of the ossa nasalia is a little rounded inwards, while the foremost extremities of these bones are visibly elongated and pointed. In *M. raddei raddei* the shape of the ossa nasalia is different, their lateral limit-line is a straighter one, the compression in the middle is scarcely perceptible, and there is no narrowing of the bones towards the front. They have an almost regular wedge-shaped appearance. Besides, the nasalia are obtuse in front and do not project forward as strongly as in *M. raddei avaricus*, subsp. n. The posterior limit of the ossa nasalia in this last species is generally more acute. Some differences in the structure of the rostrii cranii attract attention: if we look down upon the skull, we see that the rostrum of *M. raddei avaricus* is, on the whole, less broad and becomes narrower towards the front. The typical form has a broader and heavier rostrum that does not narrow forwards, and which looks as if it were chopped off. The outline of the rostrum is likewise different in each form; it is massive, with a straight upper margin in *M. raddei raddei*, whilst in *M. raddei avaricus* it is visibly slighter, the anterior part of the upper margin perceptibly slanting downwards, producing thus a strongly inclined profile. It is to be noticed that the os interparietale is shorter and somewhat broader in *M. raddei avaricus*.

The difference is especially striking in the shape of the zygomatic arches. Those of *M. raddei avaricus* diverge, slanting backwards, becoming narrower towards the front, and, as it were, forming the figure of a triangle. Those of

M. raddei raddei present a figure resembling a quadrangle. The processi zygomatici os. maxill. strongly diverge sideways, forming, midway in their course, an obtuse angle directed backwards. Owing to this, the middle part of the whole zygomatic arch in *M. raddei raddei* is more on a parallel with the longitudinal cranium axis than in *M. raddei avaricus*. Except this, the general disposition of the zygomatic arches is rather broader and the basis of the processus zygom. os. maxill., if looked at from the front, appears more massive.

All the characters here enumerated are well demonstrated in the figures and by the table of measurements. As a conclusion, it must be remarked that the skull of very aged specimens of *M. raddei avaricus* appear lighter than in the typical form.

The colouring in our series of the two forms under comparison shows rather strong variations (individual and seasonal). Thus, towards autumn, the fur grows longer, more dense, and, so it seems, in a certain degree darker in colour. The differences of the fur-colouring, although they are easily noticeable, cannot be said to be thoroughly constant, so that we do not attribute to them the significance of fundamental characters.

Mesocricetus raddei avaricus is generally of a light and yellowish colour above, the typical form being darker and more blackish. This general darker colouring of the upper part of the body may be explained by the joint action of the following causes: the presence of black tips on the soft under-fur, which is less developed in *M. raddei avaricus*; the greater number of perfectly black hairs, which, to a certain amount, exist in all the forms of the genus (in *M. raddei raddei* the yellow band on the hair is narrower, and therefore the darker shades of colouring predominate upon it *). The difference of intensity of the rusty tints upon the muzzle in the two subspecies is an insignificant one. In the typical form the yellow-tinted surfaces around and between the eyes, on the cheeks and forehead, are a little darker with a brownish tinge, whereas in *M. raddei avaricus* these parts are more yellowish †, this being the more frequent colour of this form. The colouring of the underpart

* The hair consists of the following coloured bands:—The lowest, taking up about three-fourths of the total length, is of a colour approaching a "dark mouse-grey," and the tip, for one-fourth of the length, somewhat duskier than a "buckthorn-brown" colouring. Sometimes there is a small black tip.

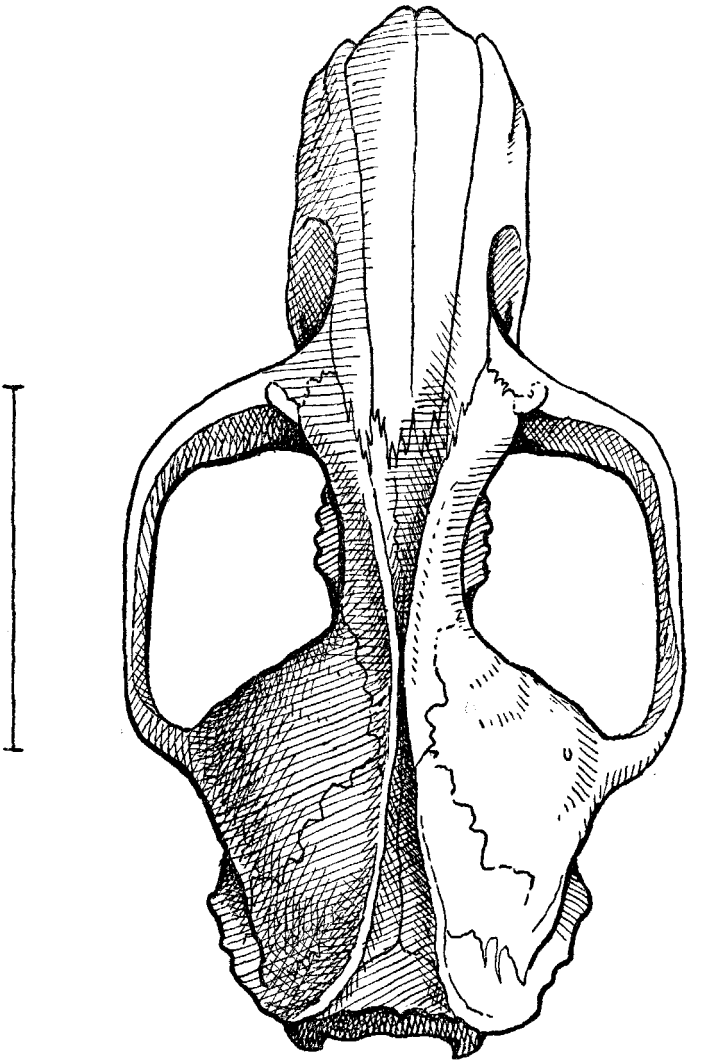
† In both forms the general colouring approaches a "cinnamon" colour.

of the body, of the breast and belly, gives good characteristics. In *M. raddei avaricus* the whole neck, the breast, and the belly, as far as the root of the tail, are a pure black, especially bright and intense upon the pectoral region, between the fore-feet. The colour in *M. raddei* is pure black, almost the same as in the form *M. avaricus*, only sometimes the breast-spot has a dirtier tinge. All the region of the belly has a much lighter colouring than in *M. raddei avaricus*, and is of a greyish milky white. The colouring of this part of the body of some specimens is very like that of the lower sides. Especially the specimen from the Upper Samur (Rutul) is very lightly coloured below.

In this way the contrast between the colouring of the breast and that of the belly, perfectly evident in that of *M. raddei raddei*, is scarcely noticeable in the new form. It is useful to note that in *M. raddei avaricus* there are sometimes, on the dark background of the lower part of the body, irregular white spots as large as 1 cm. These spots are most often found in the typical form. Whatever the age, the characteristic colouring of the lower part of the body is very marked : the contrast between the colour of the breast and that of the belly is very evident in *M. raddei raddei* when very young. As far as one can judge from our series of specimens, the dimensions of the body in *M. raddei avaricus* are smaller than those of the typical form. In conclusion, it must be remarked that the skulls of the two different races are represented, in the above referred to fundamental work of Nehring, under the general name of *M. raddei*, Nehr., that of a young *M. raddei raddei* of the Samur type, and that of an adult *M. raddei avaricus* from Khunsakh.

The error of Nehring is easy to understand, as he had only three specimens of different ages, insufficient material to judge by accurately. The young specimen represented by Nehring belongs to the form with broad zygomatic arches, and has nothing to distinguish it from our Samur specimen of the same age.

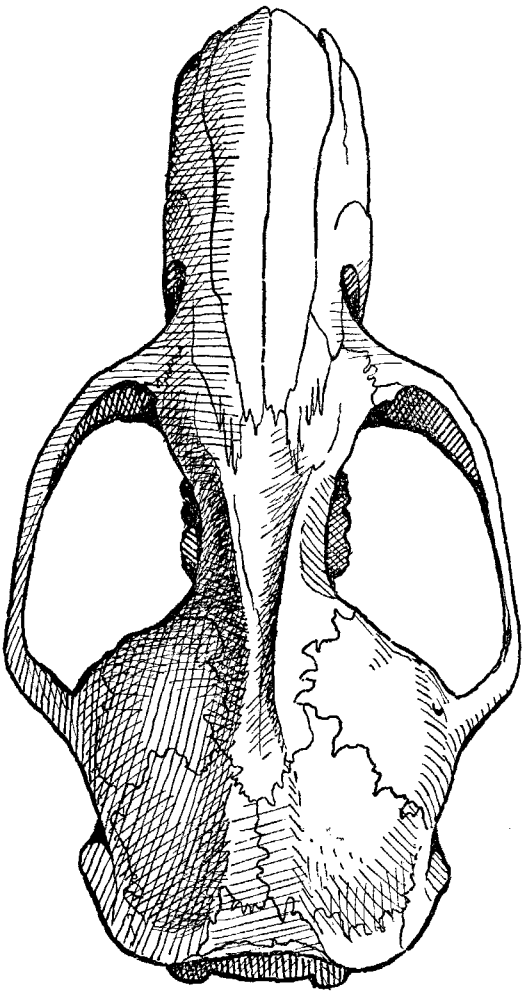
Geographical Distribution.—Mesocricetus raddei raddei lives along the upper course of the Samur aoul Rutul, near its sources, a little below the confluence of Samur proper with Karasamur and, it may be, the aoul Akhty, where the river of that name joins the Samur. Further, it has been found in the aoul Tchirakh, situated at the sources of the river Kurakh-tchai, which, under the name of Ghul-gyaritchai, flows into the Caspian Sea not far from the mouth of the Samur. More to the west, already beyond the mountain ridges, in the basin of the Sulak, the river which is the main



I.

Mesocricetus raddei raddei, Nehr.

♂ sen. Aoul Kosrek on the Kokma-tchai sources of the Koi-sou of the Kasi-kumukh, Lack circuit, Daghestan, 16. x. 1924, N. N. Djukov leg., No. M. 29. Collection of S. I. Ognev.



II.

Mesocricetus raddei avaricus, Ogn. et Heptn.

Typus ♀ sen. Aoul Khunsakh on the Avarsky Kio-sou (5558 feet alt.). Behme leg., No. S. 4520. Collection of the ZoologicalMuseum of the Moscow University.

artery of Daghestan, the typical form has been found in the following places: the sources of the Kasikumuk-koi-sou, the most eastern of the Sulak's affluents; the aoul Khosrek on the river Kokmatchai and the aoul Djaafaralmakhi, situated between the rivers Kokmatchai and Arzapanek. The same form has also been taken at the aoul Kumalou, not far from the large village of Khoumouk on the middle course of the Koi-Sou of Kasi-Kumukh. In short, this race is found near the sources of the rivers in the basin of the Samur and near those of the Kasikumukh-koi-sou, viz., in the mountainous part of the Kasikumukh (Lack) and Samur districts of Daghestan. We find it difficult to give the exact altitude above the sea-level, but it is certainly not below 5000 feet.

Upon this limited territory this little hamster is not numerous, living in the vicinity of cultivated places. More restricted still is the extension range of *M. raddei avaricus*. So far this form has only been known out of the neighbourhood of the aoul and the fortress of Khunsakh, situated further west on the river Avarsky Koi-sou.

The species we are describing is found here in considerable numbers upon a plateau of several square versts of 5530 feet above the sea-level, where it injures the crops so visibly that it has to be controlled. Such seemingly strange extension ranges of the different forms must not make us wonder, as we have to deal with a very peculiar and complicated mountainous region. From the allied species, nearest to it by their geographical distribution, *M. raddei* seems to be sharply isolated. On the south, the high ranges of the principal mountain-chain of the Caucasus and its ramifications into the government of Tiflis cut it off from the Transcaucasian *M. brandti*, Nehr. On the north it is separated from the *M. nigriculus* of the plains, a species extending only to Khassav-Jurth eastwards, by a wide stretch of typical barren Daghestan hill-ranges and by the belt of the lowest mountains.

The Caucasian representatives of the genus *Mesocricetus* may be divided into two groups. The Transcaucasian, comparatively small species, with a light colouring of the belly, *M. koenigi* and *M. brandti*, and the North Caucasian *M. raddei* and *M. nigriculus* with a dark belly. Externally the two last species appear very much like one another, but in reality it is impossible to confound them. The most marked difference is that in size, the comparison being made, of course, between specimens of the same age. It must be remarked

that *M. nigriculus*, by several features in the structure of the skull, is nearer to *M. raddei raddei* than to *M. raddei avaricus*. In the species of the plains, the outline of the zygomatic arches is somewhat widened and the rostrum is also rather massive in shape. This only concerns the shape and nowise the size of the skull. The points of difference between the nearest forms are given in the dichotomous table, which, as compared to the former ones, has been extended and completed (corrected and improved) in accordance with new data. For the sake of completeness, *M. eversmanni* and *M. microdon* have been included in it. The latter species has been described recently (1925) by S. I. Ognev from one specimen. Some time ago the Academy of Sciences of St. Petersburg has received several specimens of this curious form, obtained from a locality close to the one where the type was discovered.

Key to the Russian Representatives of the Genus Mesocricetus, *Nehr.* (1898).

I. Belly dark—black or blackish; a black spot on the breast. Difference of colouring between the breast and belly insignificant or imperceptible.

a. Length of body in adult or older animals up to 280 mm. Greatest length of skull 50·5 mm. Zygomatic width up to 27·0 mm. Alveolar length of the row of upper molars up to 8·6 mm. ..... *M. raddei*, consp.

b. The zygomatic arches wider in the anterior part. The ossa nasalia straightish, broad and blunt in front. Breast-spot brilliant black, belly dark grey, sometimes only grey ..... [Nehr., 1894. *M. raddei raddei*,

b'. The zygomatic arches narrowed forwards in the anterior part. Ossa nasalia slightly compressed in the middle, visibly projecting in front, and somewhat pointed. The breast-spot pure black, the belly dull black.. [Ogn. et Heptn. *M. raddei avaricus*,

a'. Length of body up to 185 mm. Greatest length of skull 42·86 mm. Zygomatic width up to 23·5 mm. Alveolar length of the upper molar row up to 7·3 mm. [1898. *M. nigriculus*, Nehr.,

II. Belly light-coloured. A transversal black stripe on the breast between the fore-paws. Striking contrast between the colouring of the breast and of the belly.

a. Length of body up to 170 mm. Greatest length of skull 40 mm. Zygomatic width up to 24·5 mm. Alveolar length of the upper molar row up to 7·1 mm. The stripe on the breast small and narrow, of a brownish tint..... [1900. *M. koenigi*, Satunin,

a'. Length of body up to 135 mm. Greatest length of skull 35 mm. Zygomatic width up to 20 mm. Alveolar length of the upper molar row up to 6 mm. The breast-stripe somewhat larger, clear black in colour ..... [1898. *M. brandti*, Nehr.,

III. Belly pure white; on the breast, between the fore-paws, a slightly marked spot of a greyish-sandy colour.

a. Back brownish grey, a wide pale greyish band across the breast and on the inside parts of the front paws. Alveolar length of upper molar row 4·4 mm. .... [1925*. *M. microdon*, Ognev,

a'. Back pale, sandy-straw coloured. The breast-spot very small, in colour and tint like the back. Length of body up to 136 mm. Greatest length of skull 30·3 mm. Alveolar length of the upper molar row up to 5 mm. .. [Brandt, 1859. *M. eversmanni*,

The geographical distribution of these forms, excluding *Mesocricetus raddei*, which has already been discussed, is as follows in its main features :—

M. nigriculus, Nehr. Plains to the north of the Caucasus mountains, from the hill-ranges on the south to the river Kouma on the north. Does not extend to the east further than Khassav-Jurt, province of Terek. Westward it is known from the valley of the river Malka.

M. koenigi, Sat. The Transcaucasus. Plateau of Kars to Mount Ararat on the east. The boundaries between this and the next species are the Zangesur, Hangin, and Gotcha mountain ranges.

M. brandtii, Nehr. Government of Tiflis and Talish (according to Satunin it may be perhaps a distinct subspecies).

M. microdon, Ogn. So far, found in the district of Bougourouslan, government of Samara, about 53° north lat., and in the northern part of the government of Orenbourg.

M. eversmanni, Brandt. The Kirghis steppes, as far as the government of Orenbourg on the north and the province of Ouralsk on the west. It is possible that this species is found in some parts of the Russian Turkestan, and that it reaches to the right side river-banks of the Volga on the west.

Moscow University Zoological Museum,
March 1926.

* S. I. Ognev, Mammifères du gvt. de Samara et de la province de l'Oural, Bulletin de la Soc. des Naturalistes de Moscou, 1925, t. xxxii. pp. 1-47.

[*To face* p. 150.

Measurements of Specimens of the Genus Mesocricetus.

	Mesocricetus raddei raddei, Nehr.						*Mesocricetus raddei auratus*, subsp. n.									*M. koenigi*, Sat.		*M. nigriculus*, Nehr.		
	♂, Tebiraih, Daghestan, 17. x. 24. Coll. S. I. Ognev.	♂, Rutul distr. of Samour, Daghestan, 16. xi. 24. Coll. S. I. Ognev.	♀, Khasreh, Daghestan, 16. x. 24. Coll. S. I. Ognev.	♀, Kusi-Kumukh, Daghestan, 11. x. 24. Coll. S. I. Ognev.	♂, Khosrek, Daghestan, 16. x. 24. Coll. S. I. Ognev.	♂, Kouaslou, Daghestan, 10. x. 24. Coll. S. I. Ognev.	♂, Khunsakh, Daghestan, 8. ix. 24. Coll. S. I. Ognev.	♂, Khunsakh, Daghestan, 8. ix. 24. Coll. S. I. Ognev.	♀, Khunsakh, Daghestan, 8. ix. 24. Coll. S. I. Ognev.	♀, Khunsakh, Daghestan, 20. v. 24. Coll. S. I. Ognev.	♂, Khunsakh, Daghestan, 20. v. 24. Coll. S. I. Ognev.	♀, Khunsakh, Daghestan, 23. vii. 24. Coll. Daghestan Zool. Exped.	♂, Khunsakh, Daghestan, 18. v. 24. Coll. Daghestan Zool. Exped.	♀, Khunsakh, Daghestan, 28. vii. 24. Coll. Daghestan Zool. Exped.	♀, Khunsakh, Daghestan, 23. vii. 24. Coll. Daghestan Zool. Exped.	♀ typus!, Khunsakh, Daghestan, 23. vii. 24. Coll. Zool. Mus. Moscow Univ.	Mt. Aspart, 8000 ft. K. A. Satunin. Coll. Zool. Mus. Moscow Univ.	Galy-Soargun, distr. of Kars. K. A. Satunin. Coll. Zool. Mus. Moscow Univ.	Murtsevo, near Naltchik, Tersky distr., 2. viii. 23. Coll. S. I. Ognev.	Tashkovo, near Naltchik, 4. viii. 23. Coll. S. I. Ognev.	Khassa-Yurt, Tersky distr., viii. 1925. Coll. S. I. Ognev.
	M. 33. *a.*	M. 30. *b.*	M. 28. *c.*	M. 32. *g.*	M. 29. *l.*	M. 31. *m.*	M. 25. *d.*	M. 23. *e.*	M. 26. *e.*	M. 24. *g.*	M. 27. *k.*	*f.*	*i.*	*h.*	*m.*	S. 4520. *l.*	S. 4494. *a.*	S. 4210. *g.*	M. 34. *d.*	M. 35. *k.*	M. 22. *m.*
Length of head and body	....	171	203	....	280	253	185	185	185	195	220	187	213	203	207	209	....	....	155	183	....
Length of tail	....	26	25	....	22	42	30	26	30	30	34	28·2	28·8	29·6	29·3	29	....	....	15·7	20·2	....
Length of hind foot	....	24·6	25	....	26	28	25	25	26	27·5	30	26	27·6	27	26·7	27	....	....	23·5	21·1	....
Length of ear	....	24	22	....	20	28	24	24	25	23	29	29·5	22·5	29	20·5	31	....	....	23	18·6	....
Greatest length of skull	36·5	40·5	41·2	44·3	47·5	50·5	40·5	40·0	42·0	44·1	45·2	44·2	44·9	45·1	46·3	46·7	def.	35·4	37·4	40·4	42·8
Basal length	32·0	35·2	36·9	38·8	42·1	44·9	35·7	34·2	36·4	38·2	36·6	38·8	38·7	39·2	40·6	41·5	25·3	30·6	32·0	35·0	37·9
Condylo-basal length	36·1	39·8	41·0	43·8	47·3	50·0	39·6	39·1	41·1	43·2	44·4	73·2	43·7	44·4	45·2	45·8	27·8	34·5	36·6	39·7	42·3
Zygomatic breadth	−(19·6)	21·0	def.	−(23·7)	26·6	−(27·0)	−(21·9)	−(22·3)	24·7	24·3	25·2	−(23·7)	24·9	−(24·8)	25·1	25·0	−(16·8)	18·4	−(20·0)	22·3	−(23·5)
Interorbital breadth	5·1	5·2	5·2	4·9	5·2	5·2	5·1	4·7	4·6	4·8	4·7	5·2	5·1	4·9	4·7	4·9	3·6	3·7	4·8	5·1	4·1
Length of ossa nasalia	14·8	15·9	15·4	17·2	21·1	20·2	16·0	15·7	17·5	17·6	17·9	17·7	17·3	18·0	18·7	19·2	def.	14·2	15·5	16·1	18·0
Breadth of ossa nasalia in front.	4·5	4·9	5·1	5·2	5·8	5·7	4·6	4·7	4·7	4·9	5·2	4·2	5·0	5·1	5·1	5·1	def.	4·3	4·2	4·4	4·7
Breadth of rostrum	7·7	8·6	8·7	8·9	10·4	10·3	8·7	8·8	8·8	9·4	9·0	9·2	9·2	9·5	9·4	9·6	6·4	7·7	7·3	8·3	8·5
Maxillary tooth-row	7·6	8·6	8·1	8·1	7·9	8·0	8·2	7·7	7·7	8·0	7·8	7·7	7·5	7·5	8·0	7·8	5·9	6·2	7·0	7·0	7·3
Mandibular tooth-row	7·6	7·3	7·5	7·8	7·6	8·2	6·9	7·4	7·4	7·9	7·3	7·3	7·4	7·5	7·9	7·2	5·8	5·9	7·0	7·4	7·3
Length of foramina incisiva	5·6	6·4	5·3	5·7	6·7	7·4	6·4	5·1	6·4	6·0	7·0	6·7	6·8	6·7	7·0	7·0	4·7	5·2	4·9	6·5	6·1
Length of mandibula	22·7	24·9	24·6	26·5	29·3	30·6	24·2	23·5	24·9	26·5	25·7	26·6	25·9	27·3	27·8	26·7	17·9	21·8	22·7	23·7	25·7
Os interparietale	2·4×4·4	2·4×5·4	2·7×4·4	2·7×4·9	2·6×3·8	2·6×3·1	2·5×5·8	2·2×5·5	2·0×4·6	1·9×5·2	2·5×5·8	2·1×4·9	2·3×4·8	2·1×4·8	2·4×4·2	2·2×5·4	1·8×4·1	1·8×4·1	2·9×4·9	2·4×4·2	2·0×4·8

The measurements are all given in millimetres. For the body the measurements were taken "with flesh on" before anatomizing or from alcohol specimens.

Figures between parentheses preceded by a minus sign show that the measurement lacks precision, and that, in reality, the size is slightly above the one given. Letters from "*a*" to "*m*" indicate specimens of the same age (according to the degree of wear shown by the teeth and to the sculpture of the skull), "*a*" being the youngest in age.

M. preceding a number indicates specimens in the collection of S. I. Ognev, S. those of the Zoological Museum of the Moscow University.

The specimens not bearing any number belong to other collections.