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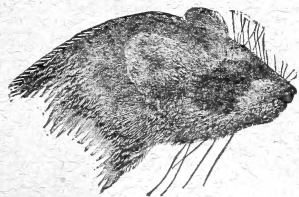
BUREAU OF BIOLOGICAL SURVEY

HENRY W. HENSHAW, *Chief*

NORTH AMERICAN FAUNA

No. 36

[Actual date of publication, June 5, 1914]



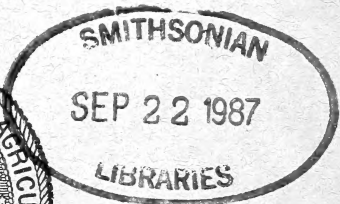
REVISION OF THE AMERICAN HARVEST MICE

(Genus REITHRODONTOMYS)

BY

ARTHUR H. HOWELL

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY



WASHINGTON
GOVERNMENT PRINTING OFFICE

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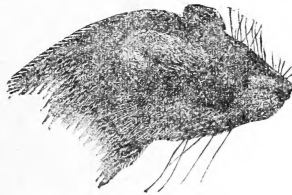
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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., January 3, 1914.

SIR: I have the honor to transmit herewith, for publication as North American Fauna No. 36, the results of a study of the American harvest mice by Arthur H. Howell, assistant biologist, Biological Survey.

The American harvest mice occur abundantly in or near meadows and cultivated lands over a large part of the United States. Their exact economic relations are still little known, but they belong to a group of mammals many species of which are injurious to agriculture, and there is no doubt that they consume large quantities of forage and some grain.

Up to the present time the relationships and distribution of the many species have been imperfectly understood. The present report furnishes for the first time a complete systematic synopsis of the group, with maps showing the ranges of the species of most economic importance.

Respectfully,

H. W. HENSHAW,
Chief, Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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REVISION OF THE AMERICAN HARVEST MICE.

(GENUS REITHRODONTOMYS.)

By ARTHUR H. HOWELL.

INTRODUCTION.

HISTORY AND MATERIAL.

The mice of this genus have been known to naturalists since the days of Audubon and Bachman. At that time only a single species, the eastern harvest mouse, was known, it having been described by Bachman in 1841 under the name of *Mus humilis* from specimens collected near Charleston, S. C. The following year (1842) the same authors redescribed this species as *Mus leontii* from a specimen collected by Maj. John Leconte in Liberty County, Ga.

Although the species was known from only a few localities (Georgia, South Carolina, and Virginia), and considered rare, its habits were quite fully described by Bachman in "Quadrupeds of North America," published in 1851. The spelling of the name was there changed to "*humilis*." Even at that time Bachman appreciated the fact that this species was not closely related to true *Mus*, as is indicated by the following statement:

In examining the teeth of this species, we have found that the tuberculous summits on the molars were less distinct than in those which legitimately belong to the genus *Mus*, and that there are angular ridges on the enamel by which it approaches the genus *Arvicola*; it is in fact an intermediate species, but in the aggregate of its characteristics perhaps approaches nearest to *Mus*, where we for the present have concluded to leave it.¹

His keenness in noting the distinction between the molars of the harvest mouse and of *Mus* makes his failure to mention the grooving of the incisors all the more remarkable, but as pointed out by Osgood² the rest of the description fits the species so well that there

¹ Aud. & Bach., Quad. N. Am., II, 1851, p. 106.

² Proc. Biol. Soc. Wash., XX, 1907, pp. 49-50.

can be no doubt of the applicability of the name *humilis* to the harvest mouse of the Atlantic coast.

In 1853 Leconte pointed out that "*Mus Lecontei* of Bachman is a *Reithrodon*, and neither a *Mus* nor a *Hesperomys*."¹

In 1855 Baird described a second species in the genus, *Reithrodon montanus*, based on a single specimen collected on one of the Government exploring expeditions in the Rocky Mountains, the exact locality being unknown. This specimen remained unique in collections for over 50 years, and not until 1907 was a series of topotypes secured, making possible accurate characterization of the species. In his great work on the "Mammals of North America," published in 1857, Prof. Baird recognized four valid species—*humilis* and *montanus*, already described, and *megalotis* and *longicauda*, proposed as new, the range of the genus being extended to the Mexican border and to the coast of California. A fifth species, *R. carolinensis* (Aud. & Bach.), was provisionally recognized.

Baird realized that considerable differences existed between true *Reithrodon* of South America and the North American mice placed in the same genus, but as he had never seen either skins or skulls of the former, he found it impossible to indicate the discrepancies.

In 1860 De Saussure described a species from Vera Cruz, Mexico, as *R. mexicanus* and the next year another, *R. sumichrasti*, also from Mexico but without definite locality.

In 1874 Coues published a synopsis of the genus,² pointing out the characters which distinguish it from true *Reithrodon* and proposing the name *Ochetodon* for the North American species. Five species were recognized in this paper—*humilis*, *longicauda*, *mexicanus*, *montanus*, and *sumichrasti*, the last two provisionally. *R. megalotis* was placed in synonymy under *humilis*. Using practically the same material, he published in 1877 a more detailed revision of the genus³ in which he recognized only four species, having dropped *O. sumichrasti* even from synonymy.

The name *Ochetodon* quickly became current, American naturalists having overlooked the name *Reithrodontomys* proposed by Giglioli some months earlier than *Ochetodon*, and not until Merriam called attention to this fact in 1892,⁴ was the earlier name given precedence.

In 1893 Allen revived the names *megalotis* and *montanus*, placing them formally in the genus *Reithrodontomys* and naming a new form, *R. aztecus*, from New Mexico.⁵

In 1895 Allen published an extended revision of the genus⁶ in which he recognized 15 forms, 8 of which were there first described,

¹ Proc. Acad. Nat. Sci. Phila., 1853, p. 410.

² Proc. Acad. Nat. Sci. Phila., 1874, pp. 184-186.

³ Mon. N. Am. Rodentia, Rept. U. S. Geol. Surv. Terr., XI, 1877, pp. 120-130.

⁴ Proc. Biol. Soc. Wash., VII, 1892, p. 26.

⁵ Bull. Am. Mus. Nat. Hist., V, 1893, p. 79.

⁶ Bull. Am. Mus. Nat. Hist., VII, 1895, pp. 107-143.

and the range of the genus was shown to extend practically across the continent from the Carolinas to California and south to Costa Rica. Of the 15 forms recognized, three (*nebrascensis*, *deserti*, and *pallidus*) are considered synonyms by the present writer. Dr. Allen's material consisted of 920 specimens, chiefly from the United States. The paucity of material from southern Mexico, where the genus reaches its highest development, of course accounts for the incompleteness of this revision in so far as the southern forms are concerned. Only 2 specimens from southern Mexico and 17 from Costa Rica were at that time available—only 19 specimens from a region where over 35 subspecies are now known.

As a result of increased activity in the collection and study of North American mammals, new species were discovered almost every year. In 1898 Thomas described *R. söderströmi* from Ecuador, thus extending the range of the genus into South America. In 1901 Merriam published a paper¹ giving descriptions of 23 new forms, based chiefly on the unexampled collections of Nelson and Goldman in Mexico and Guatemala. Since that date 9 additional species have been described, bringing the total number of named forms up to 67, of which 16 are at present regarded as synonyms. Fifty-eight forms are recognized in the present revision, of which 7 are here described as new.

The material on which the present revision is based consists of 2,280 specimens contained in the collections of the United States National Museum, including that of the Biological Survey, and the Merriam Collection. This material has been supplemented by a considerable number of specimens borrowed from other American museums, thus bringing the total number of specimens examined up to 2,583. All the existing types have been examined with the exception of *R. tenuis*, *R. söderströmi*, and *R. modestus*, which are in the British Museum, and *R. mexicanus* and *R. sumichrasti*, which are in the Geneva Museum. Of the last two I have seen photographs of the type skulls, while of *tenuis* and *modestus* I have examined practical topotypes. The National Museum collections contain representatives of all but 5 or 6 of the recognized forms and in most cases considerable series showing all ages and pelages.

In this connection I wish to acknowledge the kindness of the following gentlemen, who have generously loaned from the collections under their charge such material as was needed to supplement the collections in the National Museum: Dr. J. A. Allen, of the American Museum of Natural History; Mr. Outram Bangs, of the Museum of Comparative Zoology; Mr. F. J. V. Skiff, of the Field Museum of Natural History; Mr. Witmer Stone, of the Academy of Natural Sci-

¹ Proc. Wash. Acad. Sci., III, 1901, pp. 547-558.

ences of Philadelphia; and Mr. Joseph Grinnell, of the Museum of Vertebrate Zoology, Berkeley, Cal. I am indebted, also, to Mr. Gerit S. Miller, jr., and Mr. Ned Hollister for valuable criticism.

DISTRIBUTION.

The genus *Reithrodontomys* is clearly of Austral origin, being most abundant and highly developed in southern Mexico.

In western North America the typical subgenus ranges practically throughout the Upper and Lower Austral Zones, the northern limits of its range being indicated by the following localities where specimens have been taken: Prescott, Wash.; Custer, Mont.; and Fort Clark, N. Dak. East of the Mississippi River its range is more restricted, and so far as known the genus does not occur north of the Ohio and Potomac Valleys, the most northerly records being at Ceredo, W. Va., and Falls Church, Va. Southward the subgenus *Reithrodontomys* ranges through Mexico and Central America to Panama, but it is not known from South America.

The subgenus *Aporodon*¹ ranges from central Mexico (Jalisco and Vera Cruz) south throughout Central America and thence to Ecuador, its exact limits being very imperfectly known.

In the United States the genus is confined to the Austral Zones, but in Mexico and Central America ranges from the Tropical at or near sea level through all the zones to and including the Canadian at timber line.

HABITS AND ECONOMIC STATUS.

The harvest mice are preëminently field mice. Practically all the known species live in more or less open grassy situations and are partial to neglected fields overgrown with grasses or sedges and to weedy and grassy borders of cultivated tracts. Many species seem to prefer moist situations, and some (as *R. raviventris*) live exclusively in wet marshes, either salt or fresh; others (notably *R. albescens* and *R. montanus*) are found only in dry, sandy uplands. In the arid West in general harvest mice are most often taken along the grassy borders of sloughs, small streams, or irrigation ditches; but they may be found in almost any situation where there is sufficient cover of vegetation to hide them from their enemies.

Certain Mexican and Central American species ascend the mountains to timber line and live in grassy openings or among brush in the more open parts of the forest. *R. söderströmi*, of South America, is described as living in gardens among climbing plants.

Some species, and perhaps all, construct substantial nests of grasses, often lined with soft materials and placed either on the

¹ See page 63.

ground or in vines, bushes, or low trees some distance above the ground. Deserted birds' nests are sometimes used as a base for the nest of the mouse. Mr. H. P. Attwater has found their nests in old woodpecker holes in fence posts, and Mr. Howard Lacey, at Kerrville, Tex., has found them on cornstalks and made of corn silk. The breeding season extends in northern latitudes from April to October and in tropical regions may cover the entire year. The number of young produced at a birth varies from three to seven.

All the species live chiefly above ground, but burrows are also used, and cracks and openings in the ground are often occupied by the nests. The mice sometimes travel in narrow beaten paths of their own, and also are caught in the runways of other mammals, particularly those of cotton rats (*Sigmodon*) and meadow mice (*Microtus*). They are both nocturnal and diurnal in habit and remain active during the entire year.

FOOD.

The food of harvest mice consists largely of seeds and grain, with considerable green vegetation and occasionally fruit. Our knowledge of their preferred habitat indicates that most of their food must be obtained from wild plants of little or no value to man.

Bachman, who had studied the habits of the eastern harvest mouse rather closely, writes of it as follows:

We doubt whether this species is of much injury to the farmer. It consumes but little grain, is more fond of residing near grass fields, on the seeds of which it subsists, than among the wheat fields. We have observed in its nest small stores of grass seeds—the outer husks and other remains of the broom grass (*Andropogon dissitiflorum*)—also that of the crab grass (*Digitaria sanguinalis*), and small heaps of the seeds of several species of *paspalum*, *poa*, and *panicum*, especially those of *panicum italicum*.¹

Mr. H. P. Attwater, writing of *Reithrodontomys intermedius*, as observed in Bexar County, Tex., says:

These mice seem to be fond of peaches, eating the peach and leaving the stone hanging on the tree.²

Mr. E. A. Goldman, at Metlaltoyuca, Mexico, captured a specimen of *R. mexicanus goldmani* on a bunch of bananas hanging about 8 feet above the ground.

Only rarely is any damage to crops reported. Mr. C. W. Seegmiller, of St. George, Utah, states that he has known harvest mice to do some damage by climbing grain stalks and cutting off the heads. He has found their nests built several feet from the ground in close-growing clusters of grain stalks. Prof. D. E. Lantz reports that in eastern Kansas *Reithrodontomys dychei* is often found in the fall under shocks of wheat and corn, and in such situations it may be expected to glean some of the grain.

¹ Aud. & Bach., Quad. N. Am., II, 1851, p. 105.

² Allen, Bull. Am. Mus. Nat. Hist., VIII, 1896, p. 236.

Although in most places harvest mice are only moderately numerous, in a few regions they occur in great abundance.

PELAGES.

The mice of this genus usually molt but once a year, normally in the late fall (at least in northern latitudes), but the changes produced in the pelage by wear and fading are so great that the summer pelage of adults differs markedly from their winter pelage. The young are usually less ochraceous and in some species darker than adults, but the difference between young and adults is less marked than in *Peromyscus* and other related genera. Of the forms examined, *R. humulis merriami* presents the greatest differences between young and adults.

Immature or subadult individuals taken in summer and fall always present a fresh, unworn appearance, the color usually being decidedly paler than in fresh winter pelage. Adults taken in midsummer or early fall are almost always in a more or less worn condition—often so much so as to appear “ragged”—but occasionally one may be found in summer in fresh pelage. The fresh, full pelage is retained during most of the winter, and little evidence of wear is seen before March or April. As the tips of the hairs wear off, the pelage in most species becomes redder, and by midsummer the evidences of fading are often pronounced, individuals and local colonies, however, showing marked differences in the amount of wear and the date of its appearance. Excessively worn individuals of certain species (particularly *R. megalotis*) often become very pale and gray.

Specimens showing clearly the process of molting are comparatively rare, and in the majority of cases the molt seems to progress insidiously, new hairs coming in simultaneously over all parts of the body. In a few cases, however, the line of demarcation is plainly evident, new pelage appearing first on the hinder back and along the sides, the fore part of the back being the last portion to be invested. This is equally true of young and adults.¹

While the fall molt is doubtless normal in northern latitudes, occasional exceptions have been noted, indicating the occurrence (probably abnormal, at least rare) of a spring or midsummer molt. A young adult male specimen of *R. megalotis dychei*, from Meadow, Wyo., taken June 28, 1909, has nearly completed a full molt, the new pelage covering the whole of the anterior portion of the body to the rump, where the old pelage, decidedly redder than the new, remains. A specimen of *R. fulvescens aurantius* (also a young adult male), from Sour Lake, Tex., taken July 18, 1902, shows a fresh, long

¹ Specimens showing this molt are as follows:

R. humulis merriami, ♀ juv., Lexington, Ky., November 19.

R. megalotis longicauda, ♂ ad., Stanford University, Cal., November 7.

R. megalotis aztecus, ♀ subadult, Grand Junction, Colo., November 2.

R. montanus, ♀ ad., Medano Ranch, Colo., November 4.

pelage covering the anterior half of the body. As in the previous instance, the new pelage is darker and more ochraceous (less reddish) than the old. In both examples it will be noticed that the progress of the molt is directly the reverse of the normal autumn molt, the rump being the last part of the body to be invested, instead of the first, as in the usual method.

The molting period of the species inhabiting Mexico and Guatemala is less strictly confined to the autumn, but as a general rule (with many exceptions) individuals taken from December to June show a fuller and fresher pelage than those taken in the other half of the year. In the entire collection from Mexico I have been able to find only two specimens showing a clearly marked molting line. These are both adult males of *R. megalotis alticolus*, taken at La Parada, Oaxaca (in the lower edge of the Transition Zone), August 19, 1894. In these the molt is nearly completed, the new pelage covering the anterior portion of the body to the rump.

Genus REITHRODONTOMYS Giglioli.

Reithrodon Leconte, Proc. Acad. Nat. Sci. Phila., 1853, pp. 410, 413; Baird, Mamm. N. A., 1857, p. 447. (Not *Reithrodon* Waterhouse.)

Reithrodontomys Giglioli, Ricerche intorno alla Distrib. Geog. Gener. <Boll. Soc. Geog. Ital., Roma, XI, May-July, 1874, p. 326. Author's separates dated 1873 (probably dated from first part of paper in Vol. X), repaged, p. 160. (North American members of the genus *Reithrodon*; no species mentioned.)¹

Ochetodon Coues, Proc. Acad. Nat. Sci. Phila., December 15, 1874, p. 184 (no type selected; species included: *O. humilis*, *O. longicauda*, *O. mexicanus*, *O. montanus*, and *O. sumichrasti*).

Aporodon Howell, *postea*, p. 63. Type, *Reithrodontomys tenuirostris* Merriam.

Remarks.—Since no species were mentioned by Giglioli when he named the genus *Reithrodontomys*, the type must be fixed by subsequent designation. Miller and Rehn² have selected *Mus lecontei* Aud. and Bach. [= *R. humilis*] as the type, but this is in violation of Opinion 46 of the International Commission on Zoological Nomenclature, which advises that the species first associated with the name be considered the type.³ Allen, in 1893, was the first to use the generic name in connection with a specific name, his paper including three species—*R. megalotis*, *R. aztecus*, and *R. montanus*.⁴ Since both *megalotis* and *montanus* were published prior to the naming of the genus, either may be selected as the type. I therefore designate *Reithrodon megalotis* Baird as the type of the genus *Reithrodontomys*.

GENERIC CHARACTERS.

Form murine; tail long, always more than one-third, often more than one-half total length, slender, scaly, thinly haired; ears promi-

¹ Elliot in Pub. Field Columb. Mus., Zool. Ser. III, 1903, p. 145, and several times subsequently, spells this name "*Rhithrodontomys*".

² Proc. Boston Soc. Nat. Hist., XXX, 1901, p. 95.

³ Smiths. Inst., Pub. 2060, February, 1912, p. 104.

⁴ Bull. Am. Mus. Nat. Hist., V, 1893, pp. 79-80.

ment, often large, more or less hairy; soles of hind feet 6-tuberculate; mammæ, 6— $P \frac{1}{2}$, $I \frac{2}{2}$; no cheek pouches. Skull with smoothly rounded braincase, more or less inflated, without prominent ridges; zygomata slender; outer wall of anteorbital foramen a broad thin plate; anterior palatine foramina relatively large, forming long narrow slits separated by a thin septum, slightly narrower anteriorly, terminating about at the plane of anterior border of tooth row; posterior border of palate square, often with a slight median spine, terminating at plane of posterior border of tooth row; pterygoids nearly parallel; audital bullæ more or less inflated, longer than broad, and obliquely situated. Descending process of mandible a broad flattened plate, strongly deflected inward, the lower portion twisted into a nearly horizontal position and the inner margin raised, leaving a distinct depression in the ramus;¹ coronoid process short. Upper incisors with a deep longitudinal groove near the middle of the tooth. Molars brachyodont, tuberculate, the tubercles arranged in two longitudinal series; first upper molar with five principal tubercles, an anterior median one, and two pairs of lateral ones; m^1 and m^2 with or without accessory tubercles or enamel loops in the principal angles; upper molars normally three-rooted, but in some species four-rooted; lower molars two-rooted.

List of Species and Subspecies, with Type Localities.

Subgenus REITHRODONTOMYS.

R. humulis group:

- Reithrodontomys humulis humulis* (Bachman).....Charleston, S. C.
humulis impiger Bangs.....White Sulphur Springs, W. Va.
humulis merriami Allen.....Alvin, Tex.
albescens albescens Cary.....18 miles northwest of Kennedy,
 Nebr.
albescens griseus Bailey.....San Antonio, Tex.

R. megalotis group:

- Reithrodontomys montanus* (Baird)....."Rocky Mountains, latitude 38°"
 [=San Luis Valley, Colo., near
 San Luis Lakes].
megalotis megalotis (Baird)....."Between Janos, Sonora [=Chi-
 huahua] and San Luis Spring"
 [New Mexico].
megalotis aztecus Allen.....La Plata, N. Mex.
megalotis dychei Allen.....Lawrence, Kans.
megalotis nigrescens nobis.....Payette, Idaho.
megalotis longicaudus (Baird).....Petaluma, Cal.
megalotis pensinsulæ Elliot.....San Quintin, Lower California.
megalotis cinereus Merriam.....Chalchicomula, Puebla.

¹ Less importance is to be ascribed to this character in distinguishing *Reithrodontomys* from *Peromyscus* than the remarks of Baird (Mamm. N. Am., p. 447) and Coues (Mon. N. Am. Rodentia, p. 122) would indicate, for although typical *Peromyscus* differs noticeably on the average from *Reithrodontomys* in the shape of the descending process, yet certain species of the subgenus *Haplomytomys* show practically the same condition as *Reithrodontomys*.

R. megalotis group—Continued.*Reithrodontomys megalotis saturatus* Allen &

Chapman.....	Las Vigas, Vera Cruz.
<i>megalotis alticolus</i> Merriam.....	Cerro San Felipe, Oaxaca.
<i>megalotis arizonensis</i> Allen.....	Chiricahua Mountains, Ariz.
<i>megalotis zacatecæ</i> Merriam.....	Valparaiso Mountains, Zacatecas.
<i>amoles nobis</i>	Pinal de Amoles, Queretaro.
<i>catalinæ</i> Elliot.....	Santa Catalina Island, Cal.
<i>raviventris raviventris</i> Dixon.....	Redwood City, Cal.
<i>raviventris halictæes</i> Dixon.....	Petaluma, Cal.

R. fulvescens group:*Reithrodontomys fulvescens fulvescens* Allen....

Oposura, Sonora.	
<i>fulvescens tenuis</i> Allen.....	Rosario, Sinaloa.
<i>fulvescens intermedius</i> Allen.....	Brownsville, Tex.
<i>fulvescens aurantius</i> Allen.....	Lafayette, La.
<i>fulvescens difficilis</i> Merriam.....	Orizaba, Vera Cruz.
<i>fulvescens toltecus</i> Merriam.....	Tlalpam, D. F., Mexico.
<i>fulvescens helvolus</i> Merriam.....	Oaxaca, Oaxaca.
<i>fulvescens chiapensis nobis</i>	Canjob, Chiapas.
<i>fulvescens nelsoni nobis</i>	Colima, Colima.
<i>fulvescens mustelinus nobis</i>	Llano Grande, Oaxaca.
<i>amœnus</i> Elliot.....	Reforma, Oaxaca.
<i>otus</i> Merriam.....	Sierra Nevada de Colima, Jalisco.

R. rufescens group:*Reithrodontomys rufescens rufescens* Allen &

Chapman.....	Jalapa, Vera Cruz.
<i>rufescens luteolus nobis</i>	Juquila, Oaxaca.
<i>alleni nobis</i>	Mountains near Ozolotepec, Oaxaca.
<i>colimæ colimæ</i> Merriam.....	Sierra Nevada de Colima, Jalisco; altitude, 12,000 feet.
<i>colimæ nerterus</i> Merriam.....	Sierra Nevada de Colima, Jalisco; altitude, 6,500 feet.
<i>dorsalis</i> Merriam.....	Calel, Guatemala.
<i>australis australis</i> Allen.....	Volcan de Irazu, Costa Rica.
<i>australis modestus</i> Thomas.....	Jinotega, Nicaragua.

Subgenus APORODON.

R. levipes group:

<i>Reithrodontomys levipes</i> Merriam.....	San Sebastian, Jalisco.
<i>hirsutus</i> Merriam.....	Ameca, Jalisco.

R. chrysopsis group:

<i>Reithrodontomys chrysopsis chrysopsis</i> Merriam..	Mount Popocatepetl, Mexico.
<i>chrysopsis toluçæ</i> Merriam.....	Volcan Toluca, Mexico.
<i>chrysopsis orizabæ</i> Merriam.....	Mount Orizaba, Puebla.
<i>perotensis</i> Merriam.....	Cofre de Perote, Vera Cruz.

R. mexicanus group:

<i>Reithrodontomys mexicanus mexicanus</i> (De Sausure).....	Mountains of Vera Cruz.
<i>mexicanus goldmani</i> Merriam.....	Metlatoyuca, Puebla.
<i>mexicanus cherrii</i> (Allen).....	San Jose, Costa Rica.
<i>milleri</i> Allen.....	Munchique, Colombia.
<i>söderströmi</i> Thomas.....	Quito, Ecuador.
<i>gracilis</i> Allen & Chapman.....	Chichen Itza, Yucatan.

R. tenuirostris group:

<i>Reithrodontomys tenuirostris tenuirostris</i> Merriam	Todos Santos, Guatemala.
<i>tenuirostris aureus</i> Merriam	Calel, Guatemala.
<i>creper</i> Bangs	Volcan de Chiriqui, Panama.
<i>microdon microdon</i> Merriam	Todos Santos, Guatemala.
<i>microdon albilabris</i> Merriam	Cerro San Felipe, Oaxaca.

Key to Species and Subspecies.¹

[Based on adults.]

- a. Outer wall of anteorbital foramen decidedly broader than width of interpterygoid fossa; upper molars usually without subsidiary enamel loops.²
- b. Tail length, 120 mm. or more.
- c. Greatest length of skull more than 24 mm. *hirsutus* (p. 66).
- cc. Greatest length of skull less than 24 mm.
- d. Dorsal area blackish
- dd. Dorsal area not blackish
- *toltecus* (p. 51).
- *otus* (p. 55).
- bb. Tail length less than 120 mm.
- c. Tail length more than 65 mm.
- d. Ears blackish brown, without ochraceous hairs.
- e. Underparts whitish.
- f. Tail length 100 mm. or more.
- g. Hind foot more than 20 mm. *tolucæ* (p. 68).
- gg. Hind foot less than 20 mm. *alleni* (p. 59).
- ff. Tail length less than 100 mm.
- g. Upperparts mainly ochraceous
- *chiapensis* (p. 53).
- gg. Upperparts mainly blackish or brownish.
- h. Paler; sides light ochraceous-buff.
- i. Larger; hind foot more than 18 mm. *cinereus* (p. 35).
- ii. Smaller; hind foot less than 18 mm.
- j. Sides of face pure buff (Arizona)
- *arizonensis* (p. 38).
- jj. Sides of face ochraceous-buff or grayish.
- k. Tail length more than 80 mm. (Lower California)
- *peninsulæ* (p. 35).
- kk. Tail length less than 80 mm.
- l. Feet gray (California)
- *longicaudus* (p. 33).
- ll. Feet white
- *nigrescens* (p. 32).
- hh. Darker; sides dark ochraceous-buff or pinkish cinnamon.
- i. Skull length less than 21.5 mm.
- j. Smaller; hind foot less than 17 mm. *amoles* (p. 40).
- jj. Larger; hind foot more than 17 mm. *halicætes* (p. 42).
- ii. Skull length more than 21.5 mm.
- j. Tail length more than 80 mm.
- k. Breadth of braincase more than 11 mm. *tolucæ* (p. 68).
- kk. Breadth of braincase less than 11 mm.
- l. Skull larger, with wider zygomata
- *dorsalis* (p. 61).
- ll. Skull smaller, with narrower zygomata
- *saturatus* (p. 36).
- jj. Tail length less than 80 mm.
- k. Ear from notch more than 13 mm. *alticolus* (p. 37).
- kk. Ear from notch less than 13 mm. *modestus* (p. 63).
- ee. Underparts ochraceous-buff or pinkish cinnamon.
- f. Tail unicolor or nearly so.
- g. Tail length more than 80 mm. *rufescens* (p. 56).
- gg. Tail length less than 80 mm
- *raviventris* (p. 41).

¹ Color comparisons made with Ridgway's "Color standards and color nomenclature" (1912).² Present in *levipes*, *hirsutus*, *chrysoptis*, *tolucæ*, *orizabæ*, and *perotensis*.

- ff.* Tail distinctly bicolor.
- g.* Pelage long; upper molars always with subsidiary enamel loops (except in *colimæ*); habitat above 9,000 feet altitude.
- h.* Braincase flattened. *perotensis* (p. 69).
- hh.* Braincase globular.
- i.* Larger; tail length more than 95 mm.
- j.* Breadth of braincase more than 11 mm *chrysopsis* (p. 66).
- jj.* Breadth of braincase less than 11 mm *orizabæ* (p. 69).
- ii.* Smaller; tail length less than 95 mm *colimæ* (p. 59)
- gg.* Pelage short; upper molars usually without subsidiary enamel loops; habitat below 9,000 feet altitude.
- h.* Skull length less than 22 mm *zacatecæ* (p. 39).
- hh.* Skull length more than 22 mm.
- i.* Larger; hind foot 20–21 mm.
- j.* Braincase flattened *luteolus* (p. 57).
- jj.* Braincase rounded *nerterus* (p. 60).
- ii.* Smaller; hind foot 18–20 mm.
- j.* Nasals longer (8–9.7 mm.); black dorsal area well defined.
- k.* Skull larger, with wider zygomata *dorsalis* (p. 61).
- kk.* Skull smaller, with narrower zygomata *saturatus* (p. 36).
- jj.* Nasals shorter (7.3–8.8 mm.); black dorsal area not well defined.
- k.* Tail longer (88–101 mm.); (Mexico) *difficilis* (p. 50).
- kk.* Tail shorter (82–92 mm.); (Costa Rica) *australis* (p. 62).
- dd.* Ears light brown or drab, with ochraceous hairs.
- e.* Underparts buffy or ochraceous.
- f.* Skull length more than 22.5 mm.
- g.* Length of nasals more than 8.5 mm *toltecus* (p. 51).
- gg.* Length of nasals less than 8.5 mm *levipes* (p. 64).
- ff.* Skull length less than 22.5 mm.
- g.* Tail length 105 mm. or more *mustelinus* (p. 54).
- gg.* Tail length less than 105 mm.
- h.* Upperparts strongly mixed with blackish.
- i.* Underparts strongly washed with buff *difficilis* (p. 50).
- ii.* Underparts faintly washed with buff *aurantius* (p. 48).
- hh.* Upperparts mainly ochraceous-buff.
- i.* Larger and paler *tenuis* (p. 45).
- ii.* Smaller and brighter *nelsoni* (p. 53).
- ee.* Underparts white.
- f.* Tail length more than 104 mm.
- g.* Larger; skull length 23 mm. or more *toltecus* (p. 51).
- gg.* Smaller; skull length less than 23 mm *helvobus* (p. 52).
- ff.* Tail length less than 104 mm.
- g.* Skull length less than 20 mm *amænus* (p. 55).
- gg.* Skull length more than 20 mm.
- h.* Tail length more than 80 mm.
- i.* Upperparts tawny-ochraceous, or cinnamon mixed with black.
- j.* Braincase flatter; nasals shorter *chiapensis* (p. 53).
- jj.* Braincase higher; nasals longer *aurantius* (p. 48).
- ii.* Upperparts ochraceous-buff or mixed with blackish.
- j.* Upperparts mainly ochraceous-buff.
- k.* Sides deep ochraceous-buff *tenuis* (p. 45).
- kk.* Sides pale ochraceous-buff.

- l. Paler; sides of face grayish.....*fulvescens* (p. 43).
 ll. Darker; sides of face ochraceous-buff.....*intermedius* (p. 47).
 jj. Upperparts mainly blackish or brownish.
 k. Skull heavy; interpterygoid fossa broad.
 l. Paler (less ochraceous).....*intermedius* (p. 47).
 ll. Darker (more ochraceous).....*aurantius* (p. 48).
 kk. Skull light; interpterygoid fossa narrow.....*catalinæ* (p. 40).
 hh. Tail length less than 80 mm.
 i. Upperparts mainly deep ochraceous-buff....*longicaudus* (p. 33).
 ii. Upperparts mainly light ochraceous-buff or brownish.
 j. Skull length more than 21.5 mm.....*aztecus* (p. 30).
 jj. Skull length less than 21.5 mm.
 k. Tail longer; ear 12-13 mm.....*megalotis* (p. 26).
 kk. Tail shorter; ear 10-11 mm.....*dychei* (p. 30).
 cc. Tail length less than 65 mm.
 d. Upperparts mainly grayish or light buff, mixed with black.
 e. Black dorsal stripe distinct; ears usually with blackish patches.
 f. Paler; skull heavier.....*albescens* (p. 22).
 ff. Darker; skull lighter.....*griseus* (p. 23).
 ee. No distinct dorsal stripe; ears without blackish patches.
 f. Darker and more ochraceous.....*dychei* (p. 30).
 ff. Paler and less ochraceous.
 g. Larger; skull broader.....*megalotis* (p. 26).
 gg. Smaller; skull narrower.....*montanus* (p. 24).
 dd. Upperparts mainly blackish or dark brown.
 e. Upperparts Prout's brown.
 f. Ear from notch 8-9 mm.....*impiger* (p. 20).
 ff. Ear from notch 9-10 mm.....*humulis* (p. 19).
 ee. Upperparts sooty or with blackish stripe.....*merriami* (p. 21).
 aa. Outer wall of anteorbital foramen usually narrower than width of interpterygoid fossa;¹ upper molars always with subsidiary enamel loops.
 b. Skull length more than 25 mm.
 c. Upperparts tawny or ochraceous-tawny.
 d. Upperparts tawny.....*tenuirostris* (p. 78).
 dd. Upperparts ochraceous-tawny.....*aureus* (p. 78).
 cc. Upperparts mummy-brown (Panama).....*creper* (p. 79).
 bb. Skull length less than 25 mm.
 c. Rostrum long and slender; braincase inflated.
 d. Darker; underparts (in adult) pinkish cinnamon.....*microdon* (p. 80).
 dd. Paler; underparts white.....*albilabris* (p. 80).
 cc. Rostrum short and broad; braincase not inflated.
 d. Upperparts tawny or cinnamon-brown.
 e. Colors darker; skull smaller.....*mexicanus* (p. 70).
 ee. Colors paler; skull larger.
 f. Upperparts bright tawny.....*cherrii* (p. 73).
 ff. Upperparts dull tawny or brownish.
 g. Smaller; underparts white.....*milleri* (p. 74).
 gg. Larger; underparts buffy.....*söderströmi* (p. 75).
 dd. Upperparts pinkish cinnamon.
 e. Skull length less than 23 mm.....*gracilis* (p. 76).
 ee. Skull length more than 23 mm.....*goldmani* (p. 72).

¹ In *gracilis* of about equal width or slightly broader.

Subgenus **REITHRODONTOMYS** Giglioli.

Subgeneric characters.—Enamel pattern of upper molars simple, the first and second each with two outer reëntrant angles, usually without accessory tubercles.¹

REITHRODONTOMYS HUMULIS GROUP.

REITHRODONTOMYS HUMULIS HUMULIS (Bachman).

EASTERN HARVEST MOUSE.

(Pl. I, fig. 1; Pl. IV, fig. 1.)

Mus humulis Aud. & Bach., Proc. Acad. Nat. Sci. Phila., I, 1841, pp. 97-98.*Mus lecontei* Aud. & Bach., Journ. Acad. Nat. Sci. Phila., VIII, 1842, p. 307 (Georgia, taken by Major John Le Conte).*Mus humilis* Aud. & Bach., Quad. N. Am., II, 1851, pp. 103-106, Plate LXV.*Reithrodon lecontei* Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 413.*Reithrodon humilis* Baird, Mamm. N. Am., 1857, p. 448.*Ochetodon humilis* Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 185 [part].*Reithrodontomys humilis* Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, p. 161.*Reithrodontomys lecontei* Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 116.*Reithrodontomys humilis dickinsoni* Rhoads, Amer. Nat., XXIX, 1895, p. 590 (Willow Oak, Florida).*Reithrodontomys humilis* Rhoads and Young, Proc. Acad. Nat. Sci. Phila., 1897, p. 309.*Reithrodontomys humilis* Osgood, Proc. Biol. Soc. Wash., XX, 1907, pp. 49-50 (name formally reinstated).*Type locality.*—Charleston, S. C.*Distribution.*—Southeastern United States, east of the Alleghenies, from southern Virginia to central Florida.*Characters.*—Size small; color dark brown; skull narrow, with highly arched cranium and heavy rostrum.*Color.*—General tone of upperparts about Prout's brown, being a mixture of blackish brown and pinkish cinnamon, usually darkest along median line; underparts ashy, usually with a tinge of light pinkish cinnamon; tail bicolor, fuscous or hair-brown above, grayish white below; ears fuscous or fuscous-black; feet grayish white. Immature specimens are more fuscous above with slight admixture of brown.*Skull.*—Braincase narrow, highly arched; rostrum short and broad; nasals broad, ending nearly on a line with end of premaxillæ; zygomatica parallel or slightly contracted anteriorly; palatal foramina broadest in the middle, ending posteriorly about on a line with plane of first molars; bullæ rather small and elongated.*Measurements.*—Average of 5 adults from Georgia and South Carolina: Total length, 120 (114-124); tail vertebrae, 57 (53-60); hind foot, 16 (15-17); ear, 9.5 (9-10). Average of 8 adults from Dismal Swamp, Va.: 122; 56; 16; (ear) 9.6. Skull: (See table, p. 81).*Remarks.*—This little species—the first member of the genus to be described—has a rather extensive range in the South Atlantic States, from southern Virginia to Florida. In Georgia, Alabama, and Florida¹ Small tubercles irregularly present in some species, particularly *R. rufescens* and *R. dorsalis*.

the typical race shades insensibly into the subspecies *merriami* of the Mississippi Valley. Specimens from North Carolina and Virginia, as might be expected, exhibit the specific characters in their most pronounced form, the color of the upperparts being uniformly brownish. Specimens from Florida are intermediate but nearer on the whole to *humulis*. In a series of three from Kissimmee one is clearly *humulis*, while the others might without impropriety be referred to *merriami*. The skulls, however, are nearer to *humulis*. The type of "*dickinsoni*," from Willow Oak, is a very dark specimen, but is in the uniform sooty pelage indicative of immaturity. It is closely similar to numerous individuals of *merriami* examined from Alabama and Louisiana. A single specimen from Tarpon Springs, however, can be exactly matched by specimens of *humulis* from the coast of Georgia. In the absence

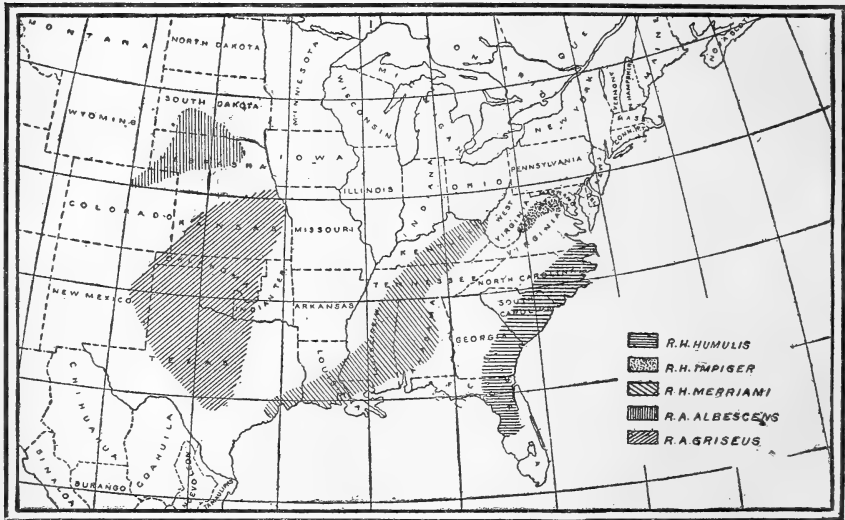


FIG. 1.—Distribution of *Reithrodontomys humilis*, *R. albescens*, and subspecies.

of suitable material the west Florida form is provisionally referred to *humulis*, but a larger series may show it to be nearer *merriami*.

Specimens examined.—Total number, 96, from the following localities:

Virginia: Dismal Swamp, 17.

North Carolina: Chapanoke, 1; Currituck, 4; Moran, 1; Raleigh, 53.

South Carolina: Georgetown, 1.

Georgia: Riceboro (Le Conte Plantation), 8.

Florida: Enterprise, 1;¹ Gainesville, 4;¹ Kissimmee, 3; Sawgrass Island, Polk County, 1; Tarpon Springs, 1;² Willow Oak, Pasco County, 1.²

REITHRODONTOMYS HUMULIS IMPIGER Bangs.

SMALL-EARED HARVEST MOUSE.

Reithrodontomys leontii impiger Bangs, Proc. Biol. Soc. Wash., XII, 1898, p. 167.

Type locality.—White Sulphur Springs, W. Va.

Distribution.—Northern Virginia and mountains of West Virginia.

¹ Collection Field Mus. Nat. Hist.

² Collection Acad. Nat. Sci. Phila.

Characters.—Closely similar in size and color to *humulis*; ears decidedly smaller.

Color.—Not appreciably different from that of *humulis*.

Skull.—Closely similar to that of *humulis*.

Measurements.—Average of 9 adults from type locality: Total length, 116 (114–122); tail vertebræ, 53 (50–57); hind foot, 15.7 (15–16.5); ear from notch, 8.7 (8–9). Skull: (See table, p. 81).

Remarks.—This subspecies is a rather poorly marked race of *humulis* occupying the northern end of the range of the species. In the series from the type locality—White Sulphur Springs, W. Va.—I have been unable to see any color differences to distinguish it from *humulis* from the coast of the Carolinas. Three specimens from the vicinity of Washington, D. C., however, are considerably paler than the series of topotypes, with which they agree in having very small ears. These may represent an undescribed race, but it seems best not to name it until more material can be secured.

Specimens examined.—Total number, 12, from the following localities:

West Virginia: White Sulphur Springs, 9.

Virginia: Alexandria, 1; Falls Church, 1; Fort Myer, 1.

REITHRODONTOMYS HUMULIS MERRIAMI Allen.

MERRIAM HARVEST MOUSE.

(Pl. I, fig. 2; Pl. IV, fig. 2; Pl. VII, fig. 8.)

Reithrodontomys merriami Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 119.

Type locality.—Austin Bayou, near Alvin, Tex.

Distribution.—Coast region of east Texas and southern Louisiana north to northeastern Kentucky and West Virginia; east to Alabama; limits of range imperfectly known.

Characters.—Similar to *humulis*, but upperparts blacker and grayer (less brownish); ears smaller and blacker.

Color.—*Adults:* Upperparts mixed blackish and light pinkish cinnamon, the black prevailing and forming usually a well-defined stripe in middle of back. Specimens in full, unworn pelage show an indistinct lateral stripe of light pinkish cinnamon. Ears blackish brown; tail fuscous above, grayish white below; underparts grayish, sometimes with a distinct wash of light pinkish cinnamon. Some specimens in worn pelage have a broad median dorsal band of black and scarcely any cinnamon on the sides. *Young:* Upperparts fuscous-black, practically without cinnamon hairs.

Skull.—Practically identical in size and proportions with that of *humulis*, but rostrum slightly heavier.

Measurements.—Average of 7 adults from type locality: Total length, 113 (107–128); tail vertebræ, 54 (51–60); hind foot, 16 (15.5–17). Skull (see table, p. 81).

Remarks.—This subspecies is a slightly differentiated race of *humulis*, with which it is connected by a complete series of intergrades. Indeed, occasional specimens of *humulis* from localities within the range of the typical race are difficult to distinguish from *merriami*. The differences are perhaps most evident on comparing individuals of the two forms in worn pelage, *merriami* being in that condition decidedly sooty, while *humulis* is a warm brown. Three specimens from Lexington, Ky., seem referable to this subspecies, but one from Ceredo, in the extreme western corner of West Virginia, is intermediate in color between *merriami* and *humulis*.

Specimens examined.—Total number, 37, from the following localities:

Texas: Austin Bayou near Alvin, 8; Richmond, 2.

Louisiana: Hackley, 1; Lafayette, 3; Mermentau, 3.¹

Alabama: Barachias, 5; Carlton, 1; Dean, 1; Jackson, 2; York, 7.

Kentucky: Lexington, 3.

West Virginia: Ceredo, 1.

REITHRODONTOMYS ALBESCENS ALBESCENS Cary.

PALLID HARVEST MOUSE.

(Pl. I, fig. 4; Pl. IV, fig. 4.)

Reithrodontomys albescens Cary, Proc. Biol. Soc. Wash., XVI, 1903, p. 53.

Reithrodontomys montanus albescens Cary, N. Am. Fauna No. 33, 1911, p. 110.

Type locality.—Eighteen miles northwest of Kennedy, Nebr.

Distribution.—Sand-hill region of Nebraska and western South Dakota; west to Loveland, Colo.

Characters.—Similar to *R. montanus*, but paler, with a more distinct dorsal stripe; ears smaller; skull shorter and broader.

Color.—*Unworn winter pelage* (November): Upperparts mixed blackish and light buff, darkest on the median line and shading to pure buff on the sides; ears buffy, usually with two rather large brownish or blackish patches; tail sharply bicolor, dark hair-brown above, white below; feet soiled whitish; underparts pure white. *Worn summer pelage* (October): Upperparts mixed ochraceous-buff and blackish, the buff prevailing, shading to light ochraceous-buff on sides. A gray phase occurs in which the upperparts are mixed blackish and pale mouse-gray, with very slight admixture of buff.

Skull.—Shorter and relatively broader than that of *montanus*; rostrum short and heavy; zygomata heavy and widely expanded.

Measurements.—Average of 6 adults from Nebraska: Total length, 125 (121-129); tail vertebræ, 53.4 (50-56); hind foot, 16.7 (16.5-17). Skull (see table, p. 81).

Remarks.—This handsome mouse is the palest member of the genus. According to Cary it occurs only in sand-hills or on sandy land. At

¹ Collection Field Mus. Nat. Hist.

Kennedy and Neligh, Nebr., it has been taken in the same weed patches with *R. megalotis dychei*. It may be distinguished from the latter by its smaller size, paler and less ochraceous coloration, and small ears with distinct black spots.

Although closely resembling *montanus* in color, it differs considerably from it in cranial characters, and no evidence of intergradation between the two species has been obtained. In southern Nebraska it grades into the subspecies *griseus*.

Specimens examined.—Total number, 25, from the following localities:

Nebraska: Kennedy, 1; 18 miles northwest of Kennedy, 4; Neligh, 8; Niobrara, 1; Niobrara River, 10 miles south of Cody, 2; Verdigris, 4.

South Dakota: Belle Fourche River (15 miles from mouth), 1.

Colorado: Loveland, 4.¹

REITHRODONTOMYS ALBESCENS GRISEUS Bailey.

LITTLE GRAY HARVEST MOUSE.

(Pl. I, fig. 3; Pl. IV, fig. 3.)

Reithrodontomys dychei Allen, Bull. Am. Mus. Nat. Hist., VIII, 1896, p. 67 (not of VII, 1895, p. 120).

Reithrodontomys griseus Bailey, N. Am. Fauna No. 25, 1905, p. 106.

Type locality.—San Antonio, Tex.

Distribution.—Southern Nebraska, Kansas, Oklahoma, central and western Texas, and eastern New Mexico. Limits of range imperfectly known.

Characters.—Similar to *albescens* but colors darker and skull narrower; much paler and grayer than *merriami*.

Color.—Upper parts mixed black and light ochraceous-buff, the black predominating and usually forming an indistinct stripe along the median line; lateral line of buff very faintly indicated; buff on sides of head darker than in *montanus*; ears same color as back, usually with a large blackish patch on exterior surface; tail sharply bicolor, hair-brown above, grayish white below.

Skull.—Similar to that of *albescens*, but zygomata weaker and less widely expanded and rostrum narrower. Compared with *merriami*: Braincase less elongated; rostrum slenderer; zygomata more widely expanded posteriorly; interpterygoid fossa averaging narrower; bullae less elongated. Compared with *montanus*: Braincase shorter and relatively broader, with shorter rostrum; zygomata more contracted anteriorly.

Measurements.—Average of 9 specimens (mostly immature) from type locality: Total length, 115 (107–120); tail vertebræ, 54 (48–61); hind foot, 14.6 (14–16).² Average of 2 adults from Clyde and San

¹ Collection of G. S. Miller, jr.

² The total length is probably less than in adult specimens and the foot measurements are apparently smaller in some cases than they should be.

Angelo, Tex.: 142; 60; 15. Average of 8 (subadult) from Alva, Okla.: 117; 51.5; 16. Skull: (See table, p. 81).

Remarks.—Although clearly belonging in the same group with *R. humulis merriami*, this form appears not to intergrade with it. In both skin and skull characters it agrees closely with *albescens* and differs widely from *merriami*, its nearest relative geographically. Specimens from Kansas and Oklahoma and one from Santa Rosa, N. Mex., can not be distinguished from typical examples.

Specimens examined.—Total number, 82, from the following localities:

Nebraska: London, 2.

Kansas: Onaga, 18; Pendennis, 5; Trego County, 10.

Oklahoma: Alva, 12.¹

Texas: Clyde, 1; Gainesville, 1; Mason, 9; San Angelo, 1; San Antonio, 22.

New Mexico: Santa Rosa, 1.

REITHRODONTOMYS MEGALOTIS GROUP.

REITHRODONTOMYS MONTANUS (Baird).

SAN LUIS VALLEY HARVEST MOUSE.

(Pl. I, fig. 5; Pl. IV, fig. 5.)

Reithrodon montanus Baird, Proc. Acad. Nat. Sci. Phila., VII, 1855, p. 335; Mamm. N. Am., 1857, p. 449.

Ochetodon montanus Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186.

Reithrodontomys montanus Allen, Bull. Am. Mus. Nat. Hist., V, 1893, p. 80; VII, 1895, p. 123; Cary, N. Am. Fauna No. 33, 1911, p. 108.

Type locality.—"Rocky Mountains, latitude 38°" [upper end San Luis Valley, Colo., near San Luis Lakes].

Distribution.—San Luis Valley, Colo.

Characters.—Size medium (smaller than *R. m. megalotis*, larger than *R. a. griseus*); ears small; color slightly paler and less ochraceous than in *megalotis*; skull similar to that of *megalotis* but smaller and narrower. Compared with *R. a. albescens* and *R. a. griseus*: No distinct blackish dorsal stripe; skull relatively longer and narrower; tail slightly longer.

Color.—*Fresh winter pelage* (October and November): Light buff, clearest on sides and face, much mixed with blackish on dorsal surface; black hairs most pronounced on hinder back; no distinct median line of black; ears dark hair-brown, often clothed on inner surface with ochraceous-buff hairs (a little darker than body hairs), rarely with a distinct blackish area on lower outer margin; tail distinctly bicolor, dark hair-brown above, white beneath; feet and underparts white. Compared with *megalotis*, the general tone is paler and less intensely ochraceous; the sides light buff instead of ochraceous-buff.

¹ Collection Field Mus. Nat. Hist.

Skull.—Similar in shape to that of *R. m. megalotis*, but smaller and braincase relatively narrower; zygomata (in adults) with sides parallel. Compared with *R. a. griseus*: Longer and relatively narrower, with longer rostrum.

Measurements.—Average of 10 specimens (including adults and subadults) from Medano Ranch, near Mosca, Colo.: Total length, 126 (118–139); tail vertebrae, 58 (51–64); hind foot, 17 (16–17); ear from notch, 11.2 (11–12). Skull: (See table, p. 81).

Remarks.—This species, the second member of the genus to be recognized, was described by Baird in 1855 from a single specimen, and until within the last few years has remained practically unknown. Efforts were made by the Biological Survey field party in 1904 to secure specimens from the San Luis Valley and a single immature individual was caught at Del Norte by Vernon Bailey. In the autumn of 1907, Merritt Cary trapped for about 10 days at Medano Ranch, 15 miles northeast of Mosca, and succeeded in securing a series of 20 specimens, including several adults, which for the first time made possible accurate comparison and characterization of the species. Most of the specimens taken by Cary were caught in a grassy weed-patch on a broad sand-ridge extending through the meadows and perhaps 6 feet above their level. None was taken in wet situations.

Dr. J. A. Allen has determined the approximate type locality of this species from a careful study of the records of Capt. Beckwith's expedition, on which the type was secured.¹ The type specimen (No. 13 of the expedition) was collected in August, 1853, in the upper end of the San Luis Valley, at some point between Fort Massachusetts and Sahwatch Creek. The route of the expedition was northward along the east side of the valley to a point a little north of 38° latitude, and thence westward across the valley not far from the present town of Saguache.² The second camp of the party, on the night of August 24, was on a small stream "nearly opposite to Roubideau's or Mosca Pass," about 21 miles from Fort Massachusetts. The specimens collected by Cary in 1907 were taken along the very creek on which the Beckwith party camped, now called Medano Creek. The type may have been taken on this creek or at one of the other camping places a few miles farther north.

Even with a series of 20 topotypes, the relationships of this species are not entirely clear. This uncertainty is due in part to the fact that the topotype series includes only two adults, one of which has the skull broken, and in part to the failure to find in the series a single skull that agrees with that of the type. The latter, an adult with moderately worn teeth, is decidedly smaller and has a much

¹ See Bull. Am. Mus. Nat. Hist., VII, 1895, pp. 124–125.

² See Expl. & Surv. Pac. R. R., II, pp. 41–45, and map accompanying Vol. XI.

shorter rostrum than the two adults taken by Cary at Medano Ranch, thus closely agreeing with specimens of *R. a. griseus* from Texas. The rostrum of this specimen is deflected markedly to the right, indicating an injury during life, which may account for its small size and peculiar characters. The original description of the color accords perfectly with the series now in hand, so that there seems no alternative but to consider the type skull aberrant, and to continue to use the name for the form represented by the modern series.

The species, although combining in a remarkable degree the characters of the *megalotis* and *albescens* groups, seems not to be directly connected with either of them. It is perhaps best placed in the *megalotis* group, but seems not to intergrade with any member of it.¹

Though but little smaller than *R. m. megalotis*, it is markedly smaller than *aztecus*—the form ranging through northern New Mexico, nearest to the home of *montanus*. It may be distinguished from both *megalotis* and *aztecus* by smaller size, particularly of the ears and tail, and by paler and less ochraceous coloration. Externally it much resembles *R. a. albescens* but is somewhat darker and has larger ears and feet. The nearest approach geographically of *R. albescens griseus* to the range of *montanus* is at Santa Rosa, N. Mex., and the single specimen taken there shows no departure from typical *griseus*.

Specimens examined.—Total number, 21, from the following localities:

Colorado: Del Norte, 1; Medano Ranch (15 miles northeast of Mosca), 20.

REITHRODONTOMYS MEGALOTIS MEGALOTIS (Baird).

DESERT HARVEST MOUSE.

(Pl. I, fig. 6; Pl. IV, fig. 6; Pl. VII, figs. 1, 7.)

Reithrodon megalotis Baird, Mamm. N. Am., 1857, p. 451.

Reithrodontomys megalotis Allen, Bull. Am. Mus. Nat. Hist., V, 1893, p. 79; VII, 1895, p. 125.

Reithrodontomys megalotis deserti Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 127 (Oasis Valley, Nev.).

Reithrodontomys megalotis sestiniensis Allen, Bull. Am. Mus. Nat. Hist., XIX, 1903, p. 602 (Rio Sestin, northwestern Durango).

Type locality.—Between Janos, Chihuahua, and San Luis Springs, N. Mex.

Distribution.—From northern Nevada and southern Idaho south to Zacatecas, Mexico; occupying the greater part of Nevada, Arizona, and Utah (except eastern part); southern New Mexico; western Texas (west of Pecos River); desert regions of southern and northeastern California, northeastern Lower California, and northern Sonora; and northern portion of Mexican table-land.

¹ Cary's assignment of this species to the *albescens* group (N. Am. Fauna No. 33, 1911, p. 108) was on the authority of the present writer, who, after more detailed study, has reached the conclusions set forth above.

Characters.—Size medium (larger than *R. montanus* and smaller than *R. f. fulvescens*); general tone brownish buff above and white below; ears usually without dark markings.

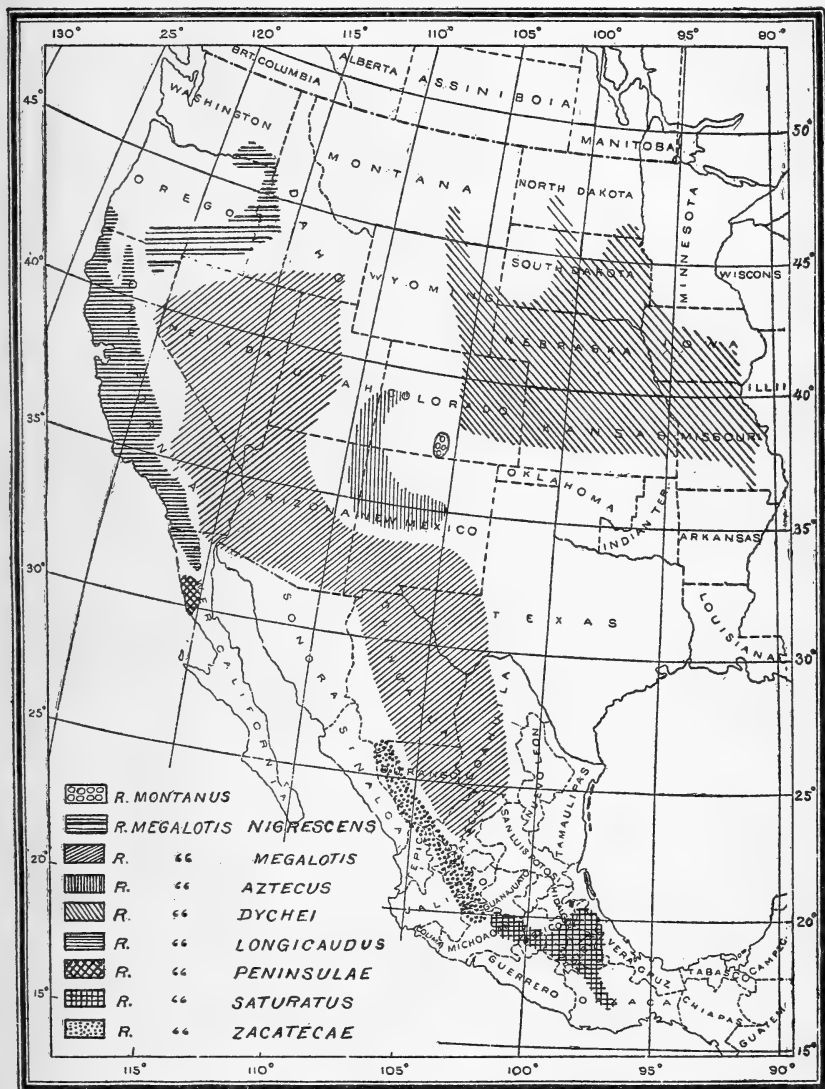


FIG. 2.—Distribution of *Reithrodontomys montanus*, *R. megalotis*, and subspecies.

Color.—*Unworn winter pelage:* Upperparts mixed blackish brown and light ochraceous-buff, darkest in middle of back, shading to nearly pure buff on sides; feet and underparts white; tail hair-brown above, whitish below; ears drab, usually with a tuft of ochraceous-buff hairs at base. *Unworn summer pelage:* Similar to the fresh

winter pelage, but colors less strongly contrasted and black variations of upperparts much reduced. *Worn spring and summer pelage:* General tone browner and colors less contrasted than in the winter pelage, the buff on sides less pronounced and often lacking.

Skull.—Larger than that of *montanus*, with broader, flatter braincase. Compared with *fulvescens* and *tenuis*: Slightly smaller, with longer palatal foramina and narrower interpterygoid fossa.

Measurements.—Average of 6 adults from type region (Casas Grandes, Chihuahua; Mexican boundary, 50 to 100 miles west of El Paso; and Organ Mountains, N. Mex.): Total length, 140 (128–145); tail vertebræ, 71 (65–77); hind foot, 17.6 (17–18.5); ear from notch, 12.5 (12–13.2). Average of 12 adults from Lone Pine, Cal.: 139; 70; 17.5; of 10 adults from Oasis Valley, Nev. (measured to end of tail hairs): 139; 72; 18.4. Skull: (See table, p. 81).

Remarks.—This subspecies has the widest range of any of the forms of *megalotis* and is subject to considerable individual variation, both in color and in size of skull. It intergrades with *aztecus* in central New Mexico, with *longicaudus* in California, with *nigrescens* in southern Idaho, and with *cinereus* in central Mexico. The present writer is in accord with Dr. J. A. Allen, who revised the group in 1895, in his failure to find any constant color differences between the series from the deserts of Nevada and California and that from the type region (southern New Mexico and northern Chihuahua), individuals in comparable pelage from the two regions being practically indistinguishable. Specimens from the Death Valley region of southern California and Nevada have slightly larger skulls than those of the typical form from Chihuahua and southern New Mexico but smaller than those of *aztecus*. These have been separated as a subspecies, "*deserti*" by Dr. Allen on the basis of an alleged difference in the relative length of body and tail. A careful comparison of measurements of adult specimens from the two regions, however, fails to show any appreciable differences in proportion. The apparent differences shown in Dr. Allen's published measurements probably are due in part to differences in methods of measurement and in part to the inclusion of a greater number of immature examples in the series from New Mexico and Utah. The cranial differences are considered too slight and inconstant to warrant recognition of the form by name.

A large series from the Colorado River, Sonora, at Monument No. 204, Mexican boundary, are practically typical *megalotis*. Two individuals from Volcano Lake, head of Hardy River, Lower California, are very small, but no smaller than an individual in the series from Casas Grandes, Chihuahua, quite close to the type locality.

A large series from various places in northwestern Nevada and a small series from Salt Lake Valley, Utah, are fairly typical *megalotis*, having slightly smaller skulls than the Death Valley series and thus showing no approach to *aztecus*.

Intergradation with *longicaudus* is perfectly shown by a large series from the Mojave Desert in southern California. In color these specimens are intermediate between the two races, but rather nearer to *megalotis*, while in skull characters they most resemble *longicaudus*. Some individuals in the series much resemble *nigrescens*, but are generally more suffused with buff. A series from the south fork of Kern River, Cal., are nearly typical *megalotis* but slightly browner.

In New Mexico the typical form occurs only in the extreme southern part, near the Mexican boundary, a gradual increase in size of skull being observed as we proceed northward toward the range of *aztecus*. Southward over the Mexican table-land there is no perceptible change in color as far as Zacatecas. Specimens from north-western Durango, described by Allen under the name "*sestinensis*," do not differ appreciably from the typical form.

Specimens examined.—Total number, 415, from the following localities:

Idaho: American Falls, 2; Swan Lake, 1.

California: Amedee, 2; Argus Mountains, 1; Barstow, 12; Bishop Creek, 1; Cartago, Owens Lake, 10; Colorado River (opposite Parker, Ariz.), 4; Emigrant Spring, 1; Fort Yuma, 1; Furnace Creek, Death Valley, 5; Grapevine Spring, 4; Keeler, 4; Lone Pine, 30; Long Valley (Lassen County), 4; Mojave, 3;¹ Olanche, Owens Lake, 22; Owens Valley, 8; Onyx, south fork of Kern River, 19;¹ Panamint Mountains, 7; Panamint Valley, 2; Pilot Knob, 8; Resting Spring, 3; Saratoga Spring, 3; Shepherd Canon, Argus Mountains, 1; Tehachapi, 20;¹ Twelve Mile Spring, Inyo County, 1; Victorville, 1.^{1, 2}

Nevada: Ash Meadows, 30; Carson Sink, 1; Fallon, 5; Gardnerville, 1; Grapevine Mountains, 2; Oasis Valley, 16; Pahrangat Valley, 4; Pahrump Valley, 11; Panaca, 1; Pine Forest Mountains, 7;³ Quinn River Crossing, 20;³ St. Thomas, 1; Smoky Creek, 1; Vegas Valley, 5; Verdi, 3; Virgin Valley, 1.³

Arizona: Colorado River at Monument No. 204, Mexican boundary, 27; Fairbank, 2; Grand Canyon (Indian Gardens), 2; Lee's ferry, 1; Parker, 5; St. Johns, 2; Winslow, 17; Zuni River, 1.

New Mexico: Animas Valley, 1; Deming, 3; Dry Creek, Socorro County, 3; Fairview, 1; Gallo Canyon, 35 miles southeast of Corona, 1; Gila, Grant County, 1; Glenwood, 1; Jicarilla Mountains, 1; Kingston, 2; Las Cruces, 3; Las Palomas, 5; Mesa Jumanes, 2; Monument No. 15, Mexican boundary, 1; Monument No. 40, Mexican boundary, 3; Organ Mountains, 3; Pleasanton, 1; Redrock, Grant County, 1; Roswell, 1; San Andreas Mountains, 2; San Mateo Mountains, Socorro County, 2; Silver City, 3; Tularosa, 5.

Texas: Alpine, 1; 25 miles west of Fort Stockton, 1; Franklin Mountains, 1; Guadalupe Mountains, 1; Pecos City, 1.

Lower California: Gardners Lagoon, 1; Seven Wells, 2.

Sonora: Cienega Well, 30 miles south of Monument No. 204, Mexican boundary, 1.

Chihuahua: Casas Grandes, 4; Chihuahua, 2.

Coahuila: Saltillo, 1; Sierra Guadalupe, 1.

Durango: Rio Sestin, 4.⁴

Zacatecas: Zacatecas, 2.

¹ Approaching *longicaudus*.

³ Collection Mus. Vert. Zool., Univ. of Cal.

² Received from Jos. Grinnell.

⁴ Collection Amer. Mus. Nat. Hist.

REITHRODONTOMYS MEGALOTIS AZTECUS Allen.

AZTEC HARVEST MOUSE.

Reithrodontomys aztecus Allen, Bull. Am. Mus. Nat. Hist., V, 1893, p. 79.

Type locality.—La Plata, N. Mex.

Distribution.—Northern New Mexico, northeastern Arizona, southeastern Utah, and western Colorado, north to Grand Junction and Rifle.

Characters.—Similar to *megalotis* but with larger ears and skull.

Color.—Not appreciably different from that of *megalotis*; ears sometimes with irregular dusky blotches.

Skull.—Decidedly larger than that of *megalotis*.

Measurements.—Average of 7 adults from La Plata and Aztec, N. Mex., and Noland Ranch, Utah: Total length, 144 (133–155); tail vertebræ, 68 (62–73); hind foot, 18 (17–19); ear from notch, 13.8 (12–15.5). Skull (see table, p. 81).

Remarks.—This subspecies does not differ from *megalotis* in color, but its skull is so much larger that it seems desirable to recognize the race. The ears average larger, also, in the series from the type region. Dr. Allen provided the form with a provisional name many years ago, but later placed it in synonymy.

This race is connected with *megalotis* by a complete series of intergrades from New Mexico and Arizona. The specimens from Datil and Manzano Mountains are too young to be satisfactorily identified, but are provisionally referred to *aztecus*.

Specimens examined.—Total number, 143, from the following localities:

New Mexico: Aztec, 39; Espanola, 8; Farmington, 4; Fruitland, 6; Gallup, 1; Guadalupita, 1; La Plata, 32; Las Vegas, 2; Manzano Mountains, 1; Rinconada, 1; Rio Puerco, 4; Wingate, 2.

Arizona: Canyon de Chelly, 1.

Utah: Bluff City, San Juan River, 4; Noland Ranch, San Juan River, 5.

Colorado: Arboles, 1; Ashbaugh's Ranch, Montezuma County, 2; Cortez, 1; Grand Junction, 26; Rifle, 2.

REITHRODONTOMYS MEGALOTIS DYCHEI Allen.

PRAIRIE HARVEST MOUSE.

(Pl. I, fig. 7; Pl. IV, fig. 7.)

Reithrodontomys dychei Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 120.

Reithrodontomys dychei nebrascensis Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 122 (Kennedy, Nebr.).

Reithrodontomys griseus Ruthven & Wood, Proc. Iowa Acad. Sci., XIX, 1912, p. 204 (not of Bailey).¹

Type locality.—Lawrence, Kans.

¹ Misidentification of specimen by the present writer.

Distribution.—Greater part of Kansas, Nebraska, Iowa, Missouri, and South Dakota; southern North Dakota; southeastern Montana; eastern Colorado and eastern Wyoming.

Characters.—Similar to *megalotis*, but black of upperparts more extensive and ochraceous shades more intense; ears slightly smaller; tail shorter.

Color.—*Full winter pelage* (topotypes): Upperparts mixed black and light ochraceous-buff; in some specimens the median dorsal area is noticeably darker, in others the color is nearly uniform over the whole back; sides clear buff, the lateral line sometimes, though not always, well-marked; ears hair-brown externally, thinly clothed with buffy hairs on inner surface, and with a tuft of ochraceous-buff hairs at anterior base; feet and underparts white; tail sharply bicolor, dark hair-brown above, white beneath.

Skull.—About same size as that of *megalotis* (smaller than that of *aztecus*); rostrum shorter and broader.

Measurements.¹—Type: Total length, 133; tail vertebræ, 52; hind foot, 15.5. Average of 6 nearly adult specimens from eastern Nebraska (Neligh and Verdigris): Total length, 135 (130–142); tail vertebræ, 61 (57–65); hind foot, 17.5 (16.5–18); ear from notch, 10.5 (10.3–11.1). Average of 8 adults from Kennedy, Nebr.: 133; 63; 17.5; 10.8. Skull: (See table, p. 81).

Remarks.—This form clearly belongs in the *megalotis* group and apparently intergrades with *aztecus*, as indicated by specimens from central Colorado (Loveland, Greeley, and Canon City). These average slightly paler and grayer than the typical form and their skulls are intermediate in size, with somewhat longer rostri than in typical *dychei*.

The series from Kennedy, Nebr., on which Dr. Allen based the subspecies "*nebrascensis*" seem to be indistinguishable from specimens of typical *dychei* in comparable pelage. At many localities in Nebraska and Kansas *R. albescens griseus* occurs with the present species, and although occasional specimens are hard to distinguish by color alone, yet in size and cranial characters the species are distinct. Dr. Allen confused the two in his original description of *dychei*, the series listed from Onaga, Kans., and London, Nebr., being referable to *griseus*. The latter race may be distinguished from *dychei* by its smaller size, shorter tail, and smaller skull with short rostrum and short palatal foramina. In coloration *dychei* is more intensely ochraceous than *griseus* and often not conspicuously darkened on the dorsal area; *griseus* is distinctly grayer and the ochraceous-buff of the sides is paler and less extensive.

¹ The great variation in the measurements of this species given by Dr. Allen in the original description indicates that probably many of the specimens were immature and the average therefore too small.

Specimens examined.—Total number, 153, from the following localities:

North Dakota: Ellendale, 2; Fort Clark, 4; Hankinson, 4; Ludden, 2; Oakes, 1.

South Dakota: Clay County, 2.

Montana: Billings, 5; Fort Custer, 4.

Wyoming: Arvada, 4; Casper, 1; Meadow, 1; Pole Creek, Laramie County, 1; Splitrock, 3; Sun, 3.

Colorado: Boulder, 1; Canon City, 5; Denver, 2; Golden, 2; Greeley, 1; Loveland, 14; Valmont, 1.

Kansas: Cloud County, 2;¹ Lawrence, 9;² Neosho Falls, 1; Onaga, 18; Pennington, 5.

Nebraska: Alliance, 2; Beemer, 1; Callaway, 3; Cherry County, 1; 10 miles south of Cody, 1; Columbus, 3; Ewing, 1; Glen, Sioux County, 1; Haigler, 2;³ Kearney, 2; Kennedy, 12; 18 miles northwest of Kennedy, 5; Neligh, 9; Norfolk, 1; Two Mile Lake, Cherry County, 1; Valentine, 2; Verdigris, 2.

Iowa: Atlantic, 2; Hillsboro, 2; Palo Alto County, 1.⁴

Missouri: St. Louis, 1; Thayer, 2.

REITHRODONTOMYS MEGALOTIS NIGRESCENS subsp. nov.

DUSKY HARVEST MOUSE.

Type from Payette, Idaho. No. 201616, U. S. Nat. Mus., Biological Survey Collection, ♂ adult, June 9, 1913; L. E. Wyman. Original No. 98.

Distribution.—Eastern Oregon and western Idaho; north to Prescott, Wash., south to Bieber, Cal.

Characters.—Similar to *megalotis*, but upperparts more blackish and less buffy; grayer and less ochraceous than *longicaudus*.

Color.—*Winter pelage:* Upperparts mixed blackish and pale ochraceous-buff, the black predominating on dorsal area; lateral line of buff only faintly indicated; ears hair-brown, clothed with ochraceous hairs; tail blackish brown above, white below; feet and underparts white. *Summer pelage* (July): General tone of upperparts more brownish and less blackish than in winter pelage.

Skull.—Closely similar to that of *megalotis*, but with slightly longer nasals.

Measurements.—Average of 7 adults from Idaho: Total length, 144 (140–153); tail vertebræ, 68 (63–75); hind foot, 17 (16–18). Skull: (See table, p. 81).

Remarks.—This race occupies the extreme northwestern part of the range of the species, chiefly in a region of old lava beds where the soil is richer and vegetation more abundant than in the more arid deserts to the southward. It is most nearly related to *megalotis*, but probably intergrades also with *longicaudus*.

¹ Collection Kansas Univ. Mus.

² Collection Am. Mus. Nat. Hist.

³ Collection Univ. of Nebraska.

⁴ Collection Univ. of Michigan.

Specimens examined.—Total number, 36, from the following localities:

Washington: Prescott, 7.

Oregon: Narrows, Malheur County, 11; Vale, 1.

California: Bieber, 1; Brownell, 4.

Idaho: Nampa, 5; Payette, 5; Weiser, 2.

REITHRODONTOMYS MEGALOTIS LONGICAUDUS (Baird).

CALIFORNIA HARVEST MOUSE.

Reithrodon longicauda Baird, Mamm. N. Am., 1857, p. 451.

Ochetodon longicauda Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186; Mon. N. Am. Rodentia, 1877, p. 126.

Reithrodontomys pallidus Rhoads, Am. Nat., XXVII, 1893, p. 835 (Santa Ysabel, Cal.).

Reithrodontomys longicauda Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 129.

Reithrodontomys klamathensis Merriam, N. Am. Fauna No. 16, 1899, p. 93 (Shasta Valley, Cal.).

Reithrodontomys megalotis longicauda Grinnell, Proc. Cal. Acad. Sci., Ser. 4, III, 1913, p. 303.

Type locality.—Petaluma, Cal.

Distribution.—Greater part of western California, east to the foothills of the Sierra Nevada, San Bernardino, and San Jacinto Ranges; north to Grants Pass, Oreg., and south into northwestern Lower California to about latitude 32°.

Characters.—Slightly smaller than *megalotis*; colors darker and more intense.

Color.—*Fresh winter pelage:* Upperparts mixed blackish and ochraceous-buff, the black predominating on dorsal area, shading to nearly pure ochraceous-buff on sides; lateral line of buff often well defined; ears same color as back, clothed with scattering ochraceous hairs; feet grayish white; tail sharply bicolor, hair-brown or fuscous above, grayish white below; underparts grayish white, usually with a tinge and often with a strong wash of ochraceous-buff. *Fresh summer pelage:* Similar to the winter pelage, but decidedly paler and lacking most of the black on the dorsal area.

Skull.—Similar to that of *megalotis*, but smaller.

Measurements.—Adult topotype: Total length, 152; tail vertebræ, 75; hind foot, 17.5. Average of 13 specimens (mostly young adults) from vicinity of San Francisco Bay: 139 (130–146); 73 (68–79); 17 (16–18). Skull: (See table, p. 81).

Remarks.—This form has a wide range on the Pacific coast and intergrades with *megalotis* at various points along the edge of the deserts. Intermediate specimens have been examined from Barstow, Mojave, Tehachapi, Santa Paula, Kern River, Bieber, etc. The form from Shasta Valley described under the name "*klamathensis*" is likewise intermediate between *longicaudus* and *megalotis*, specimens from there agreeing exactly in color with summer specimens of *longicaudus* from

Petaluma, while their skulls can be matched very closely in the series of *megalotis*. The type of "*klamathensis*" is a very old individual and has a skull as large as that of *R. m. aztecus*. Skulls of topotypes, however, do not differ appreciably from skulls of *megalotis* from the Death Valley region. *Reithrodontomys* "*pallidus*" of Rhoads is a pure synonym of *longicaudus*, neither the type nor topotypes being distinguishable from typical specimens of this race. Color variation in this subspecies is considerable and the winter and summer pelages are strikingly different.

Specimens examined.—Total number, 555, from the following localities:

Oregon: Grants Pass, 1.¹

California: Adobe Station, 1;² Alton Junction, Humboldt County, 3; Aptos, 15; Armona, 1; Arroyo Seco, 10 miles south of Paraiso Springs, 4; Arroyo Seco Canyon, near Pasadena, 1;³ Ballena, San Diego County, 3; Banta, 8; Bear Valley, head of Carmel River, 2; Bear Valley, San Benito County, 1; Bergman, Riverside County, 1; Berkeley, 31; Boulder Creek, 2; Briceland, 2; Burbank, 4; Calabasas, 1; Cameron's Ranch, San Diego County, 1; Campo, San Diego County, 1; Carlsbad, San Diego County, 3; Carpenteria, 2; Chico, 6; Chinese Camp, 1; Church Ranch, 5 miles north of Tassajara Springs, 2; Dulzura, 1; El Nido, Jamul Creek, 9; Elsinore, 2; Eshom Valley, Tulare County, 1; Fairfield, 3; Fort Bragg, 1; (old) Fort Tejon, 1; Freestone, 2; Fremont Peak, Gabilan Range, 3; Fresno, 3; Fresno Flat, 4; Gaviota Pass, 5; Gilroy, 2; Glen Ellen, 10; Hueneme, 3; Humboldt Bay, 3; Jackson, 1; Jacumba, 8; Jamesburg, 5; Jolon, 4; King City, 1; Lagunitas, 1; Las Virgines Creek, 2; Laytonville, 1; Lebec, 1; Leesville, 6; Lemoore, 2; Los Banos, 1; Los Olivos, 2; Lower Lake, 3; Lytle Creek, Los Angeles County, 2; Martinez, 1; Marysville, 6; Marysville Buttes, 12; Mendota, 2; Milpitas Ranch, south base Santa Lucia Peak, 3; Milquatay Valley, 1; Modesto, 1; Mono Flats, Santa Ynez River, 2; Montalvo, 3; Monterey, 16; Morro, 2;² Mountain Spring, San Diego County, 3; Mount George, 2; Mount St. Helena, 2; Nelson, Butte County, 2; Nicasio, 5; Novato, 3; Oakland, 1; Oceanside, 1; Orosi, 2; Pacheco Pass, Santa Clara County, 1; Pacific Grove, 3; Pacific Ocean, near Mexican boundary, 6; Palo Alto, 1; Paraiso Springs, 8;² Paso Robles, 5; Petaluma, 6;¹ Petrolia, 9; Pine Valley, Monterey County, 1; Point Reyes, 19; Porterville, 1; Posts, 5; Pozo, 3;² Radec, Riverside County, 2; Riverside, 5; Rockport, 5; Salinas, 4; San Bernardino, 13;² San Bernardino Mountains (altitude 5,200 feet), 6; San Diego, 6; San Emigdio Canyon, 7; San Fernando, 7; San Jacinto, 1; San Luis Obispo, 5;² San Marcos, 1; San Mateo, 15; San Pasqual Valley, 1; San Pedro, 1; San Simeon, 5; Santa Barbara, 2; Santa Maria, 3; Santa Monica, 4; Santa Paula, 17;² Santa Ynez Mission, 4; Santa Ysabel, 5; Santiago Springs, San Luis Obispo County, 1;² San Ygnacio Valley, San Diego County, 1; Shasta Valley, 7;² Soledad, 2;² Stanford University, 22; Strawberry Valley, San Jacinto Mountains, 3; Sur, 6; Sur River, 6; Tecate Valley, 3; Tecelote Canyon, 1; Tehama, 4; Tejon Canyon, 3; Temescal, 2; Three Rivers, 1; mouth Tia Juana River, 1; Tracy, 10; Twin Oaks, 1; Ventura River, 2; Walnut Creek, 20; Warren's Ranch, Riverside County, 1; Westport, 2.

Lower California: El Rayo, Hanson Laguna Mountains, 1; La Huerta, Hanson Laguna Mountains, 1; Nachoguero Valley, 2; Rancho Viejo, 15 miles east of Alamos, 1; San Isidro Ranch, near monument No. 250, Mexican boundary, 5.

¹ Collection Field Mus. Nat. Hist.

² Approaching *megalotis*.

³ Collection of Joseph Grinnell.

REITHRODONTOMYS MEGALOTIS PENINSULÆ Elliot.

PENINSULA HARVEST MOUSE.

Rhithrodontomys peninsulæ Elliot, Pub. Field Columb. Mus., Zool. Ser., III, 1903, p. 164.

Type locality.—San Quintin, Lower California.

Distribution.—West coast of Lower California, between latitude 30° and 31°; southern limit of range not definitely known.

Characters.—Similar to *longicaudus*, but with larger ears and longer tail.

Color.—*Fresh pelage* (October to January): Similar to corresponding pelage of *longicaudus*, but averaging richer and redder, and less brownish on the back; underparts white with a tinge of ochraceous-buff. *Worn summer pelage*: Specimens not appreciably different from *longicaudus* in same pelage.

Skull.—Similar to those of *megalotis* and *longicaudus*.

Measurements.—Average of 11 specimens (adult and subadult) from type locality: Total length, 154 (140–170); tail vertebræ, 84 (78–91); hind foot, 17.4 (16–18). Skull: (See table, p. 81).

Remarks.—This form has a rather restricted range on the Pacific coast of Lower California. It is closely related to *longicaudus*, with which it intergrades in the vicinity of San Telmo.

Specimens examined.—Total number, 32, from the following localities:

Lower California: Pozo Luciano (northwest slope San Pedro Martir Mountains), 1; Rosario, 20;¹ San Quintin, 8; San Telmo, 1; Socorro, 2.

REITHRODONTOMYS MEGALOTIS CINEREUS Merriam.

ASHY HARVEST MOUSE.

Reithrodontomys saturatus cinereus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 556.

Type locality.—Chalchicomula, Puebla, Mexico.

Distribution.—Southern portion of Mexican table-land in the States of Hidalgo, Puebla, and Tlaxcala.

Characters.—Slightly larger and darker than *megalotis* with much darker ears and tail; paler than *saturatus*.

Color.—Upperparts mixed black and light ochraceous-buff; darkest in the median line where the black sometimes appears as a broad band; sides light ochraceous-buff; underparts grayish white with a tinge of ochraceous-buff and sometimes with one or more small blotches of the same color, chiefly in the pectoral region; ears fuscous, with a large blackish patch on the inferior inner margin and another on the superior outer margin; tail, fuscous, darker than in *megalotis*.

Skull.—Practically the same as that of *saturatus*, possibly a little shorter.

¹ Including 9 from Collection Mus. Comp. Zool.

Measurements.—Average of 5 adults from type locality: Total length, 148 (142–151); tail vertebræ, 74 (71–78); hind foot, 19 (18.5–19.5). Skull: (See table, p. 81).

Remarks.—This form is intermediate between *megalotis* and *saturatus*, being slightly larger externally than *megalotis*, with skull about the size of that of *saturatus*. One of the topotype series matches *megalotis* very closely in color, but the others are much darker; all have darker ears, tail, and underparts.

The range of *cinereus* is apparently not extensive and is nearly surrounded by that of *saturatus*, at least on the east, south, and west.

Specimens examined.—Total number, 11, from the following localities in Mexico:

Puebla: Chalchicomula, 5; Mount Orizaba, 1.

Tlaxcala: Apixaco, 2; Huamantla, 1.

Hidalgo: Real del Monte, 2.

REITHRODONTOMYS MEGALOTIS SATURATUS Allen & Chapman.

DUSKY HARVEST MOUSE.

(Pl. I, fig. 8; Pl. IV, fig. 8.)

Reithrodontomys saturatus Allen and Chapman, Bull. Am. Mus. Nat. Hist., IX, 1897, p. 201.

Type locality.—Las Vigas, Vera Cruz.

Distribution.—From Jalisco (Ocotlan), Hidalgo, and Vera Cruz south to Oaxaca; altitudinal range approximately from 6,000 to 10,000 feet.

Characters.—Larger and darker (blacker and more intensely ochraceous) than *cinereus*.

Color.—Upperparts mixed black and ochraceous-buff, the black predominating; sides with less black but without a distinct ochraceous line; underparts grayish white, often strongly suffused with ochraceous-buff; ears blackish, or fuscous with a large blackish patch on the inner posterior margin; tail sharply bicolor, fuscous-black above, whitish beneath; feet grayish white.

Skull.—Similar in proportions to that of *megalotis* but decidedly larger; zygomata parallel or slightly contracted anteriorly; closely similar to those of *tenuis* and *difficilis*, but averaging larger, with larger bullæ and longer palatal foramina.

Measurements.—Average of 7 adults from type locality: Total length, 162 (158–169); tail vertebræ, 87 (80–95); hind foot, 19 (18–19.5). Skull: (See table, p. 81).

Remarks.—This is the largest and darkest form in the *megalotis* group. It occupies the humid mountain slopes of southern Mexico, intergrading with *cinereus* along the edge of the table-land and with *zacatecæ* in Michoacan. Its range meets that of *R. fulvescens*

difficilis in Vera Cruz, and the two may occur together in some localities. They are closely similar in general appearance, but *saturatus* may be distinguished by its blacker ears and back, whiter underparts, and larger skull. Specimens from Oaxaca City are redder than typical specimens, with less black on the dorsal area, but two from the mountains west of Oaxaca are typical.

Specimens examined.—Total number, 68, from the following localities in Mexico:

Vera Cruz: Huauchinango, 1; Las Vigas, 11; Mount Orizaba, 2;¹ Perote, 6; Xuchil, 7.¹

Hidalgo: Tulancingo, 1.

Mexico: Salazar, 6; Toluca Valley, 2; Volcan Toluca, 1.

Morelos: Huitzilac, 3.

Michoacan: Nahuatzin, 9.

Jalisco: Ocotlan, 3.

Oaxaca: Mount Zempoaltepec, 4; mountains 15 miles west of Oaxaca, 2; mountains near Ozolotepec, 1; Oaxaca City, 6; Tamazulapam, 1; Tlapancingo, 2.

REITHRODONTOMYS MEGALOTIS ALTICOLUS Merriam.

CERRO SAN FELIPE HARVEST MOUSE.

(Pl. I, fig. 12; Pl. IV, fig. 12.)

Reithrodontomys megalotis alticolus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 556.

Type locality.—Cerro San Felipe, Oaxaca, Mexico (altitude 10,000 feet).

Distribution.—Known only from vicinity of type locality.

Characters.—Similar to *saturatus*; tail shorter; skull with larger bullæ and more inflated braincase.

Color.—Upperparts mixed black and ochraceous-buff, darkest on the dorsal area; ears fuscous, with a blackish patch on lower inner margin; feet buffy white; ankles with a dusky streak; tail hair-brown above, grayish white beneath.

Skull.—Similar in size and proportions to that of *saturatus*; braincase more inflated (subglobular); bullæ larger and more inflated; nasals narrowed to a point posteriorly.

Measurements.—Type (σ ad.): Total length, 153; tail vertebræ, 75; hind foot, 19. Average of two adults from La Parada, Oaxaca: 152; 78.5; 18.5. Skull: (See table, p. 81).

Remarks.—This subspecies is a slightly differentiated form, very closely related to *saturatus*, from which it differs chiefly in shorter tail and in slight cranial characters. It seems to be confined to the Cerro San Felipe and its environs. Specimens from La Parada, at the base of the mountain, are not quite typical.

Specimens examined.—Total number, 3, from the following localities in Mexico:

Oaxaca: Cerro San Felipe, 1; La Parada, 2.

REITHRODONTOMYS MEGALOTIS ARIZONENSIS Allen.

CHIRICAHUA HARVEST MOUSE.

Reithrodontomys arizonensis Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 134.

Type locality.—Rock Creek, Chiricahua Mountains, Ariz. (altitude about 8,000 feet).

Distribution.—Known only from the type locality.

Characters.—About the size of *megalotis*; tail averaging slightly longer; colors much darker and more ochraceous. Very similar to *longicaudus*, but a little redder on the head, ears blacker, and tail paler (hoary gray instead of brown).

Color.—Upperparts ochraceous-buff, heavily mixed with black; front and sides of face nearly pure buff; ears dark hair-brown, with darker patches on both inner and outer margins; feet white; ankles dusky; underparts white, with an ochraceous patch on the breast between the fore legs; tail mouse-gray above, grayish white below, clothed all around with scattered whitish hairs.

Skull.—Closely similar to that of *megalotis*.

Measurements.—Average of 4 adults from type locality: Total length, 149 (145–152); tail vertebræ, 78 (74–80); hind foot, 17 (16–18); ear, 13 (12.5–14). Skull: (See table, p. 81).

Remarks.—This subspecies, as noted by the original describer, bears a surprising resemblance to *R. megalotis longicaudus* of California, but the ranges of the two forms are separated by an extensive area occupied by *R. m. megalotis*, and the present form is probably more closely related to *R. m. zacatecæ* of the mountains of western Mexico, the range of which is known to extend north at least to southern Chihuahua. The latter differs from *arizonensis* chiefly in its more ochraceous underparts.

No intergrades between *arizonensis* and *megalotis* are known, but quite probably such will later be found. Likewise the present form is so close to *zacatecæ* that the two will probably be found to intergrade. Mr. W. W. Price, who collected the type series, thus describes its habitat:

Five specimens of this species were trapped on Rock Creek, in the Chiricahua Mountains, July 7–8, at an elevation of about 8,000 feet. Two were in rocks and dry soil away from the bed of the creek, and the others were caught under logs and brush near the water.¹

Specimens examined.—Four, from type locality.²

¹ Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 235.

² Two in Am. Mus. Nat. Hist., 2 in Field Mus. Nat. Hist.

REITHRODONTOMYS MEGALOTIS ZACATECÆ Merriam.

MOUNTAIN HARVEST MOUSE.

(Pl. I, fig. 11; Pl. IV, fig. 11.)

Reithrodontomys megalotis zacatecæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 557.

Reithrodontomys megalotis obscurus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 558 (Sierra Madre, near Guadalupe y Calvo, Chihuahua).

Reithrodontomys colimæ Allen, Bull. Am. Mus. Nat. Hist., XXII, 1906, p. 249 (not of Merriam; specimens from Volcan de Fuego, Jalisco).

Type locality.—Valparaiso Mountains, Zacatecas, Mexico.

Distribution.—Mountains of Western Mexico, from southern Chihuahua to Michoacan.

Characters.—Very similar to *arizonensis*, but with darker underparts; smaller and paler than *saturatus*, with less black on upperparts.

Color.—*Adults*: Upperparts ochraceous-buff, heavily mixed with black, the ochraceous color most pronounced on head and sides; the black predominating on dorsal area but not forming a distinct band; underparts washed with ochraceous-buff, this color usually most intense between the fore legs; ears fuscous or dark hair-brown, usually with a blackish patch on lower inner margin; feet whitish or buffy white, ankles dusky; tail sharply bicolor, dark hair-brown above, grayish white beneath. *Young*: Paler and grayer on upperparts; sides with a well-marked lateral line of light ochraceous-buff; underparts whiter.

Skull.—Similar to that of *megalotis* but smaller; rostrum slenderer, narrowed at the tip; zygomata slightly narrower anteriorly; nasals narrowed to a point posteriorly, ending on a line with premaxillæ.

Measurements.—Average of 3 adults from type locality: Total length, 154; tail vertebrae, 84; hind foot, 18.5. Average of 3 adults from Guadalupe y Calvo, Chihuahua: 160; 85; 18. Skull: (See table, p. 81).

Remarks.—This subspecies is a small, dark-colored race of *megalotis* inhabiting the mountains of western Mexico. No specimens have been seen indicating intergradation between *megalotis* and *zacatecæ*, but very likely such material may in the future be secured. Intergradation with *saturatus* is indicated by specimens from the State of Mexico (Salazar, Toluca Valley, etc.) which resemble *saturatus* in color but have smaller ears and skulls intermediate in size between the two forms. From Nahuatzin, Michoacan, specimens nearly typical of both forms are at hand. Some are larger with larger, darker ears and large skulls (as in *saturatus*), but at least 2 adult individuals, by reason of small size, small skull, small ears, and ochraceous underparts, must be referred to *zacatecæ*. Specimens from Patamban, Michoacan, average more intensely ochraceous, especially on the underparts, and have more black on the ears, but are otherwise typical. The

series from Guadalupe y Calvo, Chihuahua, forming the basis of "*obscurus*", is too slightly different to warrant recognition. The coloration of the two series is practically the same, and the skulls of "*obscurus*" average only slightly larger.

This subspecies bears a striking resemblance to *longicaudus* from California, but differs in having ochraceous underparts, slightly longer tail, and a little more ochraceous color on the head.

Specimens examined.—Total number, 27, from the following localities in Mexico:

Chihuahua: Sierra Madre, near Guadalupe y Calvo, 3.

Durango: El Salto, 2.

Zacatecas: Valparaiso Mountains, 14.

Michoacan: Nahuatzin, 2; Patamban, 4.

Jalisco: Volcan de Fuego, 2.¹

REITHRODONTOMYS AMOLES sp. nov.

QUERETARO HARVEST MOUSE.

Type from Pinal de Amoles, Queretaro, Mexico. No. 81234, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, September 20, 1896; E. W. Nelson and E. A. Goldman. Original No. 10169.

Characters.—Similar in color to *R. m. saturatus*, but very much smaller.

Color.—*Worn pelage*: Upperparts mixed blackish and ochraceous-buff; underparts whitish, strongly tinged on pectoral region with ochraceous-buff; tail fuscous above, grayish white below; hind feet whitish; fore feet white with a pronounced dusky stripe on upper surface; ears dark brown (much mutilated, and size not known).

Skull.—Similar to that of *R. m. megalotis* but much smaller; zygomata parallel; bullæ smaller and rather flat.

Measurements.—*Type*: Total length, 154; tail vertebræ, 83; hind foot 16.5. Skull: (See table, p. 81.)

Remarks.—On geographical grounds this form ought to be close to *R. m. saturatus*, but it differs markedly in size from that race. It is even smaller than *R. m. zacatecæ* of the Sierra Madre, which it somewhat resembles in color.

Specimen examined.—One, the type.

REITHRODONTOMYS CATALINÆ Elliot.

CATALINA HARVEST MOUSE.

Rhithrodontomys catalinæ Elliot, Pub. Field Columb. Mus., Zool. Ser. III, 1903, p. 246.
Reithrodontomys megalotis catalinæ Grinnell, Proc. Cal. Acad. Sci., Ser. 4, III, 1913, p. 304.

Type locality.—Santa Catalina Island, Cal.

Distribution.—Santa Catalina Island, Cal.

Characters.—Similar to *longicaudus* but larger and slightly paler.

Color.—*Worn spring pelage*:¹ Upperparts mixed light ochraceous-buff and blackish brown, darkest on back, but without a distinct dorsal stripe; underparts white, tinged with buff in pectoral region; tail dark hair-brown above, white beneath; ears hair-brown, clothed with ochraceous hairs.

Skull.—Larger than that of *R. m. longicaudus*, but not otherwise different.

Measurements.—Average of 10 adults from type locality: Total length, 169 (165–175); tail vertebræ, 94 (90–99); hind foot, 18.6 (18–19.5). Skull: (See table, p. 81).

Remarks.—So far as known this is the only insular species in the genus. Mr. C. P. Streater, who collected a series in 1892, found the mice abundant on the island in brush and cactus.

Specimens examined.—Twenty-eight, from type locality.

REITHRODONTOMYS RAVIVENTRIS RAVIVENTRIS Dixon.

RED-BELLIED HARVEST MOUSE.

(Pl. I, fig. 9; Pl. IV, fig. 9.)

Reithrodontomys raviventris Dixon, Proc. Biol. Soc. Wash., XXI, 1908, p. 197.

Type locality.—Redwood City, Cal.

Distribution.—Salt marshes of San Francisco Bay, Cal.

Characters.—Similar to *R. megalotis longicaudus* but upperparts darker and underparts reddish; skull larger; tail slightly shorter.

Color.—Upperparts mixed black and pinkish cinnamon, the black predominating on dorsal area; sides pale tawny in some individuals; underparts pinkish cinnamon (rarely with a small white spot on chin); ears black or fuscous on both surfaces, with a tuft of ochraceous hairs at anterior base; hind feet and tail usually very dark, varying from fuscous to clove-brown or sepia, the tail slightly paler beneath, but feet usually darker beneath; toes whitish; front feet sepia, often tinged with buffy white.

Skull.—Decidedly larger than that of *R. m. longicaudus*; with relatively shorter rostrum; nasals and palatal foramina shorter; zygomata more widely expanded anteriorly.

Measurements.—Average of 21 from type locality: Total length, 130.7 (120–142); tail vertebræ, 64.8 (56–74); hind foot, 16.6 (15–18). Average of 8 from Melrose Marsh, Alameda County: 137; 66; 17.7. Skull: (See table, p. 81).

Remarks.—This species is remarkable on account of its peculiar characters and limited distribution. It is the darkest form found in the United States and the only one having reddish underparts. In color it most nearly resembles *R. australis* of Costa Rica, but the underparts are even darker than in that species.

¹ Fresh pelage not seen.

It is apparently confined to the salt marshes in the southern part of San Francisco Bay and although in many places its range abuts on that of *longicaudus*, no evidence of intergradation between them has been discovered. Two specimens—one from Palo Alto and one from Berkeley—have whitish underparts but in other respects are typical *raviventris*. Intergradation with *halicætes* seems probable. The pelage of both of these marsh forms is longer and seemingly thicker than that of *longicaudus*.

Specimens examined.—Total number, 44, from the following localities:

California: Berkeley, 2; Elmhurst, 1;¹ Melrose Marsh, Alameda County, 13;¹ Palo Alto, 4;² Redwood City, 24.¹

REITHRODONTOMYS RAVIVENTRIS HALICÆTES Dixon.

PETALUMA MARSH HARVEST MOUSE.

(Pl. I, fig. 10; Pl. IV, fig. 10.)

Reithrodontomys halicætes Dixon, Univ. Cal. Pub. in Zool., V, 1909, p. 271.

Type locality.—Salt marsh 3 miles south of Petaluma, Cal.

Distribution.—Salt marshes of San Pablo Bay, Suisun Bay, and the lower San Joaquin and Sacramento Rivers.

Characters.—Similar in color to *raviventris* but larger; underparts white; ears and feet paler; tail more distinctly bicolor. Compared with *R. m. longicaudus*: Decidedly larger and darker, with a large white patch on the throat; skull larger, with more widely spreading zygomata.

Color.—*Fresh pelage*: Upper parts ochraceous-buff, heavily mixed on the back with black; sides ochraceous-buff without a well-defined lateral line; underparts white (the bases of hairs plumbeous), sometimes irregularly blotched with ochraceous-buff; throat and sides of mouth pure white to base of hairs; sides of nose and eye ring blackish; ears and upper surface of tail fuscous or fuscous-black; underside of tail dull grayish white with a buffy tinge; feet white or buffy white.

Worn pelage: Decidedly more ochraceous, the black tips of the hairs seemingly worn off.

Skull.—Similar to that of *raviventris*; larger than that of *R. m. longicaudus*; zygomata usually (at least in adults) widely expanded anteriorly.

Measurements.—Average of 13 from type locality: Total length, 156 (149–64); tail vertebræ, 82 (75–85); hind foot 17.7 (17–19). Skull: (See table, p. 81).

Remarks.—This form, although living only a short distance from *raviventris* and under seemingly identical conditions, is readily separable from it. Nor is it in any sense a connecting form between

¹ Collection Mus. Vert. Zool., Univ. of Cal.

² Three from Collection Mus. Vert. Zool.

raviventris and *longicaudus*, being larger than either with upperparts fully as dark as *raviventris*. The underparts are whiter than in *longicaudus*, the latter usually being more or less tinged with pale ochraceous-buff. The close resemblance between *halicætes* and *raviventris* in skull characters and the fact that nearly half of the specimens of *halicætes* examined from Petaluma are more or less suffused beneath with ochraceous (though never so completely as in *raviventris*) leads to the belief that the two are subspecifically related. Specimens of *halicætes* in worn pelage are much redder (less blackish) than those in fresh pelage, thus rather closely resembling in color certain specimens of *longicaudus*.

Mr. Joseph Dixon, who collected the type series of this mouse, states:

This mouse seems to be restricted to the salt marsh, its range being coextensive with that of the "pickle grass" (*Salicornia*). Diligent search and trapping failed to reveal its presence outside the *Salicornia* and no specimens of *R. longicauda* could be caught in the *Salicornia*. The harvest mice use the runways of *Microtus* extensively.¹

Specimens examined.—Total number, 56, from the following localities:

California: Brentwood, 1; Cordelia, Solano County, 6;² Grand Island (2 miles north of Knights Landing, Yolo County), 1;² Grizzly Island, Solano County, 27;² Petaluma, 21.²

REITHRODONTOMYS FULVESCENS GROUP.

REITHRODONTOMYS FULVESCENS FULVESCENS Allen.

SONORAN HARVEST MOUSE.

Reithrodontomys mexicanus fulvescens Allen, Bull. Am. Mus. Nat. Hist., VI, 1894, p. 319.

Reithrodontomys fulvescens Allen, Ibid., VII, 1895, p. 138.

Type locality.—Oposura, Sonora, Mexico.

Distribution.—Mountainous parts of southern Sonora, western Chihuahua, and northern Durango.

Characters.—Size medium—a little larger than *R. m. megalotis*, with decidedly longer tail; prevailing color of upperparts ochraceous-buff with a pronounced lateral line.

Color.—Upperparts light ochraceous-buff, sparingly mixed with blackish brown; buff color most strongly marked on sides where it frequently forms a pronounced lateral line, unmixed with brown; front and sides of face tinged with grayish; underparts white, sometimes faintly tinged with pale buff; feet buffy white; ears hair-brown externally, clothed on inner surface with ochraceous-tawny hairs; tail hair-brown above, grayish white beneath.

Skull.—Similar to that of *R. m. megalotis* but slightly larger; interpterygoid fossa broader.

¹ Univ. of Cal. Pub. in Zool., V, 1909, p. 271.

² Collection Mus. Vert. Zool., Univ. of Cal.

Measurements.—Type: Total length, 183; tail vertebræ, 102; hind foot, 19. One specimen (subadult) from Providencia Mines, Sonora: 158.5; 84; 20.5. Average of 4 (adult and subadult) from Casas Grandes, Chihuahua: 165 (157–174); 93 (84–97); 20. Skull: (See table, p. 81).

Remarks.—The mice of this group may be distinguished from *R. m. megalotis* by their greater size, longer tails, and more intensely ochraceous coloration. The present form resembles *megalotis* more closely than do any of the other subspecies and certain specimens of the two forms are colored almost alike on the back. The sides of *fulvescens*, however, are more extensively buffy and less mixed with brown than those of *megalotis*. The skulls of *fulvescens* may usually be distinguished from those of any member of the *megalotis* group by the greater breadth of the interpterygoid fossa.¹ The ranges of the two species meet along the eastern border of the Sierra Madre in Chihuahua, but there is no indication of intergradation between them.

This subspecies was the first member of the group to be described and the third distinctively Mexican species to receive recognition. Although described in 1894, it is still imperfectly known, only a small number of specimens having been collected in the type region. At the time of naming this form Dr. Allen considered it a subspecies of *mexicanus*² and noted its close relationship to the Rio Grande form. Later he accorded it specific rank. The abundant material now available from Mexico shows clearly that *fulvescens*, *tenuis*, and *intermedius* are closely related subspecies, connected through central Mexico by a perfect series of intergrades. The present form apparently intergrades, also, with *toltecus*, as indicated by a specimen from Inde, Durango, which agrees with *fulvescens* in color, but has a long tail like *toltecus*, and skull intermediate in size between the two forms. The series from Casas Grandes, Chihuahua, agrees with the type series in external characters, except for a more pronounced grayish wash on the head and shoulders, but the single adult in the series has a somewhat larger skull than any in the Oposura series. In this character it is matched by a specimen from Parral, Chihuahua.

Specimens examined.—Total number, 12, from the following localities in Mexico:

Sonora: Oposura, 3;³ Providencia Mines, 2.⁴

Chihuahua: Casas Grandes, 5; Parral, 1.

Durango: Inde, 1.⁵

¹ Skulls of *R. m. saturatus* are sometimes difficult to distinguish by this character from those of *R. f. tenuis*.

² The name *mexicanus* at that time was applied to all the mice of this group from Texas and Mexico.

³ Collection Am. Mus. Nat. Hist.

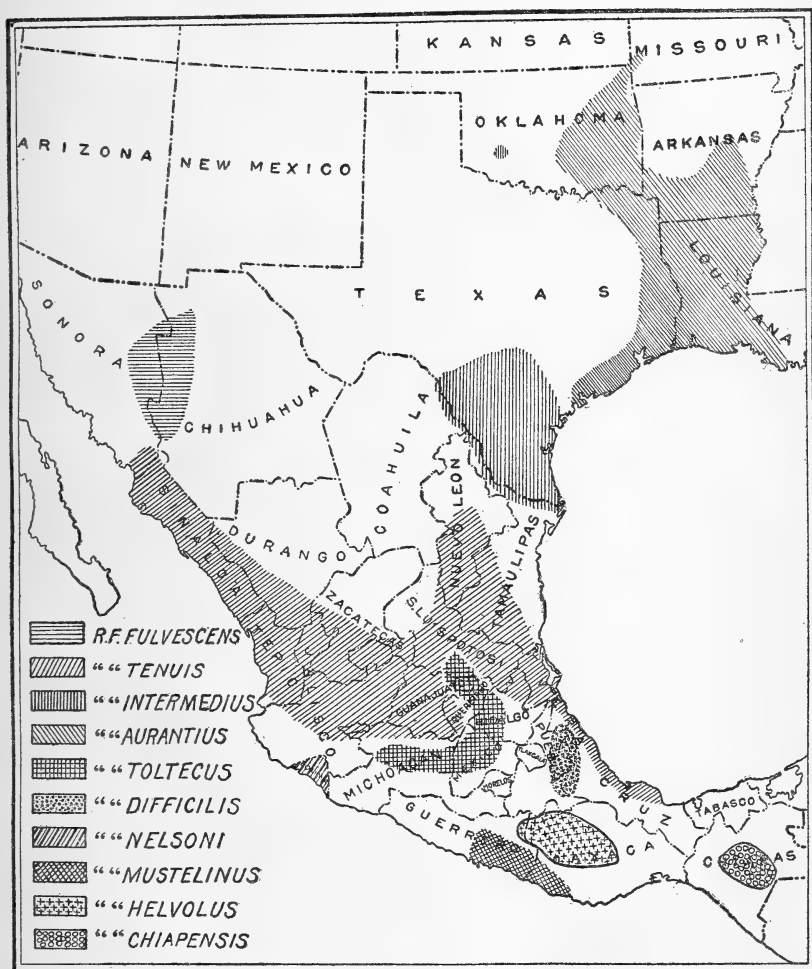
⁴ Collection Field Mus. Nat. Hist.

⁵ Approaching *toltecus*.

REITHRODONTOMYS FULVESCENS TENUIS Allen.

MEXICAN HARVEST MOUSE.

(Pl. II, fig. 7; Pl. V, fig. 7.)

Reithrodontomys tenuis Allen, Bull. Am. Mus. Nat. Hist., XII, 1899, p. 15.*Reithrodontomys griseoflavus* Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 553
(Ameca, Jalisco).*Type locality*.—Rosario, Sinaloa, Mexico.FIG. 3.—Distribution of *Reithrodontomys fulvescens* and subspecies.

Distribution.—Greater part of Mexico, except extreme northern and southern portions; from southern Sonora, Durango, Zacatecas, San Luis Potosi, Nuevo Leon, and central Tamaulipas, south to southern Jalisco, Michoacan, and the coast region of Vera Cruz.

Characters.—Similar to *fulvescens*, but colors darker and more intensely ochraceous.

Color.—Upperparts and sides rich ochraceous-buff; head and shoulders strongly ochraceous, without trace of grayish; back more heavily mixed with black than in *fulvescens*; ears slightly darker; underparts usually grayish white, sometimes faintly tinged with buff; tail hair-brown above, grayish white below.

Skull.—Closely similar to that of *fulvescens*.

Measurements.—Average of 3 adults from Mazatlan, Sinaloa: Total length, 169 (163–177); tail vertebræ, 98 (96–102); hind foot, 20.8 (20.5–21). Average of 5 adults from Chacala, Durango: 177; 105; 21.3. Skull: (See table, p. 81).

Remarks.—This is the most widely distributed member of the *fulvescens* group and over its extensive range shows remarkably little variation. Specimens from opposite sides of the continent can not be distinguished by characters either of skin or skull. There is considerable individual variation in both color and cranial characters, but none which is correlated with distribution.

The subspecies intergrades with *fulvescens* in southern Sonora, with *intermedius* in Nuevo Leon and Tamaulipas, with *difficilis* in Vera Cruz and with *toltecus* in Michoacan. Direct comparison with the type has not been possible, but specimens in the Biological Survey Collection from Mazatlan, forwarded to Mr. G. S. Miller, jr., while he was in London, were compared by him with the type in the British Museum and found to agree very closely with it. Mr. Miller states: "I should say there is no question of the identity of the Mazatlan specimens with *tenuis*." In making comparisons these specimens have been chiefly used.

Specimens from Ameca, Jalisco, forming the basis of "*griseoflavus*," show in comparison with *tenuis* a very slight cranial difference, consisting of a more inflated braincase. In this character they resemble *helvolus*, although on geographical grounds they should be approaching *toltecus*. In color and size they agree closely with *tenuis*. The type is decidedly more grayish on the back and less intensely buffy on the sides than is usual in this subspecies, but two topotypes agree perfectly with the Mazatlan specimens of *tenuis*. A series from Chacala, Durango, is a little darker and more richly colored, as well as slightly larger than the typical form. Specimens from the arid coast region of Vera Cruz (Carrizal, Santa Maria, and Catemaco) are clearly intermediate between *tenuis* and *difficilis*, the ears and tails being noticeably darker than in *tenuis* but the underparts and backs paler than in *difficilis*.

Specimens from as far north as Cerro de la Silla and Santa Catarina, Nuevo Leon, are referable to *tenuis*, though those from Santa Catarina might almost as well be considered *intermedius*. Specimens from Acambaro, Michoacan, are intermediate in size between *tenuis* and *toltecus*.

Specimens examined.—Total number, 127, from the following localities in Mexico:

Sinaloa: Sinaloa, 2; Altata, 1; Culiacan, 1; Mazatlan, 4; Rio Mazatlan, 1.

Sonora: Alamos, 6.¹

Jalisco: Ameca, 3; Atemajac, 2; Estancia, 1;² Etzatlan, 6;³ Lagos, 1; Las Canoas, 2;² Los Masos, 1;² Mascota, 1; Ocotlan, 2; Plantinar, 2; San Sebastian, 8;³ Talpa, 1; Zapotlan, 7.

Tepic: Tepic, 2.

Durango: Chacala, 8; Durango, 3.

Zacatecas: Berriozabal, 1; Valparaiso, 5.

San Luis Potosi: Hacienda La Parada, 3.

Queretaro: Jalpan, 2; Tequisquiapam, 2.

Michoacan: Acambaro, 2.

Morelos: Cuernavaca, 1.⁴

Guanajuato: Santa Rosa, 1; Silao, 2.

Vera Cruz: Carrizal, 4; Catemaco, 1; San Carlos, 2;⁵ Santa Maria, 4.

Tamaulipas: Alta Mira, 11; Hidalgo, 9; Jaumave, 1; Victoria, 5.

Nuevo Leon: Cerro de la Silla, 3; Santa Catarina, 3.

REITHRODONTOMYS FULVESCENS INTERMEDIUS Allen.

RIO GRANDE HARVEST MOUSE.

Ochetodon mexicanus Allen, Bull. Am. Mus. Nat. Hist. III, 1891, p. 223 (not *Reithrodontomys mexicanus* Saus.)

Reithrodontomys mexicanus intermedius Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 136.

Reithrodontomys laceyi Allen, Bull. Am. Mus. Nat. Hist., VIII, 1896, p. 235 (Watson's Ranch, 15 miles south of San Antonio, Tex.).

Reithrodontomys intermedius Bailey, N. Am. Fauna No. 25, 1905, p. 104.

Type locality.—Brownsville, Tex.

Distribution.—Southern Texas and adjacent parts of Mexico from Del Rio to Brownsville; east to Bexar and Bee Counties; north to Wichita Mountains, Okla.

Characters.—Very similar to *tenuis* but averaging duller and less intensely ochraceous above, and sides paler. Compared with *fulvescens*: Upper parts, particularly head and shoulders, deeper ochraceous.

Color.—*Winter pelage* (February): Ground color of upperparts light ochraceous-buff, brightest on sides, strongly mixed with blackish brown on the back; ears hair-brown, usually tinged with ochraceous on inner surface; tail hair-brown above, grayish white beneath; feet white; underparts white, sometimes faintly tinged with buff. *Summer (worn) pelage*: Decidedly redder on back and sides, some specimens approaching dull orange-cinnamon. *Young*: Colors grayer and less ochraceous.

¹ Approaching *fulvescens*.

² Collection Am. Mus. Nat. Hist.

³ Approaching *nelsoni*.

⁴ This specimen seems best referable to this subspecies, although on geographical grounds it should be either *toltecus* or *helveticus*.

⁵ Collection Field Mus. Nat. Hist.

Skull.—Very similar to that of *tenuis*, but braincase averaging slightly larger.

Measurements.—Average of 8 adults from Rio Grande Valley (Matamoros and Camargo, Tamaulipas): Total length, 169 (160–181); tail vertebræ, 98 (88–103); hind foot, 20.8 (20–21.5). Skull: (See table, p. 81).

Remarks.—This subspecies is most nearly related to *tenuis*, than which it has a much less extensive range. The differences between *intermedius* and *tenuis* are really very slight, consisting in a more intense suffusion of ochraceous-buff in *tenuis*, especially noticeable on the sides. Specimens from Bexar and Kerr Counties—the type region of “*laceyi*”—average slightly grayer and less ochraceous than specimens from the mouth of the Rio Grande, but individuals in each series may be matched by those from the other and the differences seem too slight to warrant recognition of the form. If both *intermedius* and “*laceyi*” were to be recognized, the former would be nothing more than a series of intermediates between *tenuis* on the one side and “*laceyi*” on the other.

Specimens examined.—Total number, 65, from the following localities:

Oklahoma: Mount Scott, 9.

Texas: Brownsville, 26; Corpus Christi, 2; Del Rio, 2; Lacey’s Ranch, near Kerrville, 4; Padre Island, 1; Rio Grande City, 1; San Antonio, 3; San Diego, 5; Santo Tomas, 2.

Tamaulipas: Camargo, 4; Matamoros, 6.

REITHRODONTOMYS FULVESCENS AURANTIUS Allen.

GOLDEN HARVEST MOUSE.

Reithrodontomys mexicanus aurantius Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 137.

Reithrodontomys chrysotis Elliot, Field Columb. Mus., Zool. Ser., I, 1899, p. 281 (Dougherty, Okla.).

Reithrodontomys aurantius Bailey, N. Am. Fauna No. 25, 1905, p. 105.

Type locality.—Lafayette, La.

Distribution.—Louisiana (west of the Mississippi River), southern and east-central Arkansas, eastern Texas, and eastern Oklahoma; north to southwestern Missouri (Carthage). Confined to Lower Austral Zone.

Characters.—Colors decidedly richer and darker than in *intermedius*; skull slightly larger.

Color.—*Adults in unworn pelage*: Upperparts varying from pinkish cinnamon to ochraceous-tawny, usually heavily mixed with blackish brown; sides of head and body usually rich ochraceous or tawny but without a pronounced lateral line where the color of the sides meets that of the underparts; dark markings of back frequently forming a

distinct median band; ears dull sepia, clothed on inner surface with tawny hairs; underparts grayish white, often with a distinct tinge of pale buff. *Immature pelage*: Decidedly more grayish, often lacking entirely the bright tawny shades. *Variation*: There is considerable variation in color in this subspecies, even among adult specimens. This consists both in the intensity of the ochraceous shades and in the amount of blackish suffusion on the back and sides. Some individuals have the whole back heavily sprinkled with blackish hairs, while others show only a rather narrow band down the median line. A specimen from Matagorda Island (March 31) is quite exceptional in being intensely tawny over the entire upperparts with only faint indications of black hairs on the back, thus closely resembling specimens of *Peromyscus nuttalli*. Other individuals from the same island are normal in color.

Skull.—Very similar to that of *intermedius*, but braincase averaging a little broader.

Measurements.—Adult from Houma, La.: Total length, 176; tail vertebræ, 100; hind foot, 20. Average of 5 adults from Velasco, Tex.: 170; 97; 21. Average of 9 young adults from Sour Lake, Tex.: 162 (154–170); 89 (83–94); 20 (19–21). Skull: (See table, p. 81).

Remarks.—This subspecies is a well-marked race, occupying the humid or Austroriparian division of the Lower Austral Zone, west of the Mississippi River. Although it shows considerable individual variation and occasional specimens—chiefly immature ones—are hardly distinguishable from specimens of *intermedius*, the general intensity of coloration shown by any series of specimens makes identification possible at a glance. The type and topotypes of "*chrysolis*" have been examined and found to agree perfectly with specimens of *aurantius* from eastern Texas.

Specimens examined.—Total number, 88, from the following localities:

Louisiana: Avery, 5; Belcher, 1; Foster (5 miles east of Shreveport) 1; Houma, 1; Iowa Station, 1; Lafayette, 2; Lecompte, 1 (skull); Mer Rouge, 4; Natchitoches, 1.

Arkansas: Beebe, 2; Delight, 4.

Missouri: Carthage, 2.

Oklahoma: Dougherty, 3;¹ Stilwell, 3.

Texas: Barnard Creek, west of Columbia, 6; East Caranchua Creek, Matagorda County, 2; Elliott, Matagorda County, 1; Hempstead, 8; Joaquin, 7; Matagorda, 5; Matagorda Island, 5; Nacogdoches, 2; Selkirk Island, Matagorda County, 1; Sour Lake, 10; Texarkana, 1; Velasco, 9.

¹ Collection Field Mus. Nat. Hist.

REITHRODONTOMYS FULVESCENS DIFFICILIS Merriam.

ORIZABA HARVEST MOUSE.

(Pl. II, fig. 8; Pl. V, fig. 8.)

? ? *Reithrodon sumichrasti* De Saussure, Rev. Mag. Zool., 2d Ser., XIII, 1861, p. 3.¹
Ochetodon mexicanus Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186; Mon. N. Am.

Rodentia, 1877, pp. 128-130. (Not *Reithrodon mexicanus* Sauss.)

Reithrodontomys mexicanus Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 135; IX, 1897, p. 199 (not *Reithrodon mexicanus* Sauss.).

Reithrodontomys difficilis Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 556.

Type locality.—Orizaba, Vera Cruz.

Distribution.—Interior mountain slopes along the southern end of the Mexican table-land in the States of Vera Cruz and Puebla.

Characters.—Similar to *tenuis*, but colors decidedly darker; ears and tail blacker, and underparts more ochraceous.

Color.—Upperparts pinkish cinnamon mixed with blackish brown, in some specimens the brown prevailing, in others the cinnamon; sides of face and body usually clear pinkish cinnamon, though in certain worn or immature specimens this color is nearly absent; ears fuscous or sepia, usually with more or less tawny hairs on inner surface; tail fuscous above, grayish white below; underparts grayish, with a strong wash of light pinkish cinnamon, the latter color prevailing in the majority of the individuals; feet grayish white; ankles dusky.

Skull.—Closely similar to that of *tenuis*; braincase averaging a trifle broader. Compared with *R. megalotis saturatus*: Skull shorter and relatively broader, with shorter nasals and broader interpterygoid fossa.

Measurements.—Average of 5 (subadult) from type locality: Total length, 170 (162-177); tail vertebræ, 96.6 (88-101); hind foot, 19.5 (19-20). Adult from Maltrata, Vera Cruz: 172; 97; 21. Skull: (See table, p. 81).

Remarks.—This is the darkest of the races of *fulvescens*. Although rather restricted in range, it is a well-marked form, easily distinguished from *tenuis* by its darker colors, but intergradation is clearly shown by specimens from the coast region of Vera Cruz (Carrizal and Santa Maria). From *R. megalotis saturatus*, the range of which is adjacent to that of *difficilis* in Vera Cruz, it differs in more tawny coloration, ochraceous instead of grayish underparts, and smaller and paler ears.

¹ When the type of *R. "sumichrasti"* can be compared with modern material it may be possible to identify the species and use the name. I have seen photographs of the type skull, which clearly show it to belong in the typical subgenus, and the original description agrees best with the present form; but as no definite type locality is assigned and the description is inadequate for subspecific determination, it seems best to let the name remain in synonymy.

Specimens examined.—Total number, 36, from the following localities in Mexico:

Vera Cruz: Maltrata, 1; Orizaba, 18; Mirador, 2; Jalapa, 14.¹

Puebla: Tehuacan, 1.

REITHRODONTOMYS FULVESCENS TOLTECUS Merriam.

TOLTEC HARVEST MOUSE.

(Pl. II, fig. 10; Pl. V, fig. 10.)

Reithrodontomys levipes toltecus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 555.
Rhithrodontomys inexpectatus Elliot, Field Columb. Mus., Zool. Ser., III, 1903, p. 145 (Patzcuaro, Michoacan).

Type locality.—Tlalpam, Federal District, Mexico.

Distribution.—Table-land region of southern Mexico, from southern San Luis Potosi to Michoacan and the Valley of Mexico.

Characters.—Similar to *tenuis*, but decidedly larger and slightly darker.

Color.—Upperparts mixed black and rich ochraceous-buff, with a cinnamon tinge, the black usually showing a tendency to form a median band on the back from nose to tail; sides pure ochraceous-buff or sparingly mixed with black; underparts with a slight tinge of pale buff; tail fuscous or hair-brown above, grayish white below.

Skull.—Similar in shape to that of *tenuis* but decidedly larger; braincase somewhat more inflated, and evenly rounded; rostrum long and relatively slender; zygomata nearly parallel to axis of skull.

Measurements.—Average of 2 adults from type locality: Total length, 193 (189–196); tail vertebræ, 106 (104–108); hind foot, 21.5 (21–22). One adult from Patzcuaro, Michoacan: 180; 105; 21. Average of 2 adults from Rio Verde, San Luis Potosi: 192; 110; 21.8. Skull: (See table, p. 81).

Remarks.—This is a well-marked form of the *fulvescens* group, occupying the higher parts of the Mexican table-land. It is poorly represented in the material at hand, and its characters and exact distribution are not well known. Skulls from the same or near-by localities show an unusual amount of variation in size.

Intergradation apparently takes place between *toltecus* and *tenuis* and between *toltecus* and *helvolus*, but the material at hand is too scanty to show this clearly. Specimens from Rio Verde, San Luis Potosi, and from Zamora and Los Reyes, Michoacan, are considered intermediates between this form and *tenuis*, and specimens from Huajuapam, Oaxaca, and Chilpancingo, Guerrero, intermediates between it and *helvolus*. The series from Los Reyes is very puzzling. In color the specimens are all exactly alike, being a little darker and redder than either *tenuis* or typical *toltecus*. One speci-

¹ Collection Am. Mus. Nat. Hist.

men, an adult male, equals *toltecus* in size and agrees perfectly with it in skull characters. Several other skulls in the series, however, equally old, are very much smaller—as small, indeed, as typical *tenuis*, while between the two extremes is a nearly perfect series of intergrades.

Two specimens from Patzcuaro, Michoacan, including the type of "*inexpectatus*," do not differ appreciably from *toltecus*. The topotype has the underparts strongly suffused with ochraceous and has no white on the tail. This species differs widely in skull characters from *levipes*, with which it was originally associated as a subspecies.

Specimens examined.—Total number, 30, from the following localities in Mexico:

Mexico: Tlalpam, 3.

Hidalgo: Marques, 1 (skull); Zimapan, 1.

San Luis Potosi: Rio Verde, 6.

Michoacan: Los Reyes, 13; Patzcuaro, 2;¹ Zamora, 4.

REITHRODONTOMYS FULVESCENS HELVOLUS Merriam.

OAXACA HARVEST MOUSE.

(Pl. II, fig. 9; Pl. V, fig. 9.)

Reithrodontomys griseoflavus helvolus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 554.

Type locality.—Oaxaca City, Oaxaca, Mexico.

Distribution.—Interior plateau of Oaxaca, Guerrero, and Puebla.

Characters.—About the size of *toltecus* but differing in paler colors, larger ears, and smaller skull; very similar to *tenuis*, but color of back and sides more pinkish (less ochraceous) and belly whiter.

Color.—Upperparts light ochraceous-salmon, sparingly lined with black but without a distinct median band; underparts white, often with a slight yellowish tinge, but never (in type series) with any suffusion of ochraceous. Ears dark hair-brown, clothed on inner surface with ochraceous hairs; tail fuscous or hair-brown, soiled whitish below.

Skull.—Smaller than that of *toltecus* and slightly larger than that of *tenuis*; braincase rounded and moderately inflated, narrowed posteriorly; rostrum rather short; interpterygoid fossa actually and relatively broader than in either *toltecus* or *tenuis*.

Measurements.—Average of 11 adults from type locality: Total length, 189 (181–200); tail vertebræ, 110 (104–116); hind foot, 20.5 (20–21); ear, 13.2 (12.5–13.7). Skull: (See table, p. 81).

Remarks.—This subspecies agrees in size with *toltecus*, but most nearly approaches *tenuis* in color and cranial characters. No intermediate specimens between *helvolus* and *tenuis* have been examined, however, and our present knowledge of the distribution indicates a

¹ Including type of "*inexpectatus*" from Collection Field Mus. Nat. Hist.

gap between the ranges of these two forms, but further collecting in Michoacan and Guerrero may show that they intergrade. From *toltecus* this form differs, as already pointed out, in having a decidedly smaller skull, larger ears, and whiter belly. A specimen from Huajuapam, Oaxaca, is intermediate in characters between the two forms.

Specimens examined.—Total number, 22, from the following localities in Mexico:

Oaxaca: Huajuapam, 1; Oaxaca, 18; Yalalag, 1.

Guerrero: Tlalixtaquilla, 1; Tlapa, 1.

REITHRODONTOMYS FULVESCENS CHIAPENSIS subsp. nov.

CHIAPAS HARVEST MOUSE.

Type from Canjob, Chiapas, Mexico. No. 132865, U. S. Nat. Mus., Biological Survey Collection, ♂ adult, May 2, 1904; Nelson and Goldman. Original No. 16741.

Distribution.—Highlands of Chiapas.

Characters.—Similar to *helvolus* but darker and smaller, with smaller ears.

Color.—Upperparts ochraceous-salmon heavily lined on back with black hairs; lateral line of salmon moderately well defined; ears fuscous; underparts grayish white; tail fuscous above, soiled whitish below; feet grayish; ankles fuscous.

Skull.—Not appreciably different from that of *helvolus*.

Measurements.—Average of 8 adults from type locality: Total length, 169 (163–183); tail vertebræ, 96 (92–102); hind foot, 20.1 (20–20.5); ear, 14. Skull: (See table, p. 81).

Remarks.—This is a small dark form apparently most nearly related to *helvolus*. In size and general color it resembles *tenuis* rather closely, but is darker, especially on the head and ears. It is almost as dark above as *difficilis*, but has whiter underparts. It closely resembles *aurantius* also, but the underparts are more nearly pure white (never tinged with buff), and the general tone of the upperparts is slightly paler. The skull of *chiapensis* averages a little broader with flatter braincase and shorter nasals than that of *aurantius*.

Specimens examined.—Total number, 17, from the following localities in Mexico:

Chiapas: Canjob, 9; Comitan, 4; San Bartolome, 3; San Vicente, 1.

REITHRODONTOMYS FULVESCENS NELSONI subsp. nov.

NELSON HARVEST MOUSE.

Type from Colima, Colima, Mexico. No. $\frac{33409}{432}$, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, Mar. 9, 1892; E. W. Nelson. Original No. 2050.

Distribution.—Coast region of Colima (and Jalisco?).

Characters.—Similar to *tenuis*, but smaller; colors brighter and more intensely ochraceous.

Color.—*Adults*: Upperparts varying from deep ochraceous-buff to pinkish cinnamon, mixed on top of head and back with black; underparts suffused (sometimes heavily) with pinkish buff; ears dusky hair-brown; tail dark hair-brown or fuscous above, grayish white below; fore feet pale buff; hind feet soiled whitish. *Young*: Colors less intensely ochraceous; underparts whiter.

Skull.—Similar to that of *tenuis*, but smaller; zygomata more contracted anteriorly.

Measurements.—Type: Total length, 173; tail vertebræ, 95; hind foot, 19. Average of 5 from type locality: 166; 92; 19.2. Skull: (See table, p. 81).

Remarks.—This subspecies is a small, bright-colored form occupying the coast plain of Colima and perhaps of adjacent States. Specimens from San Sebastian and Etzatlan, Jalisco, are intermediate between this form and *tenuis*, but seem to be nearer to the latter. A single specimen from Acaponeta, Tepic, is very small, and clearly referable to *nelsoni*, although on geographical grounds it might be expected to be *tenuis*.

Specimens examined.—Total number, 8, from the following localities in Mexico:

Colima: Colima, 7.

Tepic: Acaponeta, 1.

REITHRODONTOMYS FULVESCENS MUSTELINUS subsp. nov.

BUFF-BELLIED HARVEST MOUSE.

Type from Llano Grande, Oaxaca, Mexico. No. 71549, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, February 18, 1895; E. W. Nelson and E. A. Goldman. Original No. 7483.

Distribution.—Coast region of Oaxaca and Guerrero.

Characters.—Similar to *helvolus* but colors darker and richer; underparts buffy.

Color.—Upperparts varying from ochraceous-salmon to rich pinkish cinnamon, heavily mixed on head and back with black; underparts strongly suffused with pinkish buff; ears hair-brown; tail fuscous above, whitish beneath; fore feet buffy white; hind feet grayish white.

Skull.—Similar in size and proportions to that of *helvolus*; nasals longer, narrowed to a point posteriorly; palatal foramina short, not reaching plane of molars; bullæ small.

Measurements.—Type: Total length, 184; tail vertebræ, 105; hind foot, 20. Adult from Chilpancingo, Guerrero: 198; 110; 20. Skull: (See table, p. 81).

Remarks.—This subspecies is most nearly related to *helvolus*, differing from it in much deeper coloration. It resembles *R. levipes* rather closely in external appearance, but differs widely from it in skull characters. A specimen from Chilpancingo, Guerrero, has a longer skull than the type, somewhat suggesting the skull of *toltecus*.

Specimens examined.—Total number, 4, from the following localities in Mexico:

Oaxaca: Llano Grande, 2.

Guerrero: Acapulco, 1; Chilpancingo, 1.

REITHRODONTOMYS AMÆNUS Elliot.

TEHUANTEPEC HARVEST MOUSE.

(Pl. II, fig. 1; Pl. V, fig. 1.)

Rhithrodontomys amænus Elliot, Proc. Biol. Soc. Wash., XVIII, 1905, p. 234.

Type locality.—Reforma, Oaxaca, Mexico.

Distribution.—Known only from the type locality.

Characters.—Size very small; tail moderate; similar in color to *R. f. helvolus* but upperparts deeper ochraceous.

Color.—Upperparts bright ochraceous-buff, becoming tawny-ochraceous on middle of the back, where indistinctly lined with black; underparts and feet white; tail hair-brown above, paler below.

Skull.—Small, with short heavy rostrum; braincase moderately flat and narrowed posteriorly; zygomata slightly contracted anteriorly; bullæ small and flat; interpterygoid fossa very broad; palatal foramina long, reaching behind plane of molars.

Measurements.—Type: Total length, 141; tail vertebræ, 81; hind foot, 18.5. Skull: (See table, p. 81).

Remarks.—This species, known from only a single specimen, seems not to be closely related to any of the recognized forms. It most nearly resembles *R. f. helvolus* in color, but differs widely from it in size and cranial characters, being decidedly smaller than any other species in southern Mexico. It inhabits the low coast plain bordering the Gulf of Tehuantepec in southern Oaxaca.

Specimen examined.—One, the type.

REITHRODONTOMYS OTUS Merriam.

BIG-EARED HARVEST MOUSE.

(Pl. II, fig. 2; Pl. V, fig. 2.)

Reithrodontomys levipes otus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 555.

Type locality.—Sierra Nevada de Colima, Jalisco, Mexico (altitude 6,500 feet).

Distribution.—Known only from the type locality.

Characters.—Similar to *R. f. toltecus*, but tail longer and ears larger; colors more ochraceous and less blackish.

Color.—Upperparts pinkish cinnamon with an ochraceous tinge, mixed with brownish black; underparts heavily washed with light pinkish cinnamon; sides without a distinct lateral line of ochraceous; ears between fuscous and hair-brown with scattering ochraceous hairs on inner surface; front feet dull buffy white; hind feet grayish, with a tinge of buff; ankles dark hair-brown; tail hair-brown above, soiled whitish below.

Skull.—Similar in size and shape to that of *R. f. toltecus* but brain-case flatter and zygomata narrowed anteriorly; nasals and premaxillæ as in *toltecus*; audital bullæ also similar (larger than in *R. levipes*); foramen magnum very large; molars with simple enamel pattern, as in the *fulvescens* group.

Measurements.—Type: Total length, 202; tail vertebræ, 120; hind foot, 22. Skull: (See table, p. 81).

Remarks.—This seems to be a well-marked species, but as only a single specimen is known its relationships are not clear. In skull characters it resembles *R. f. toltecus* rather closely and differs from *R. levipes* in having a longer, narrower skull, with larger bullæ and no subsidiary enamel loops on the upper molars, being therefore in the typical subgenus. The ground color of the upperparts is similar to that of *toltecus*, but is a little duller and the blackish median band is lacking; the underparts are decidedly more ochraceous. There is no evidence to show that it intergrades with *toltecus*, so for the present it seems best to consider it a distinct species. The simple enamel pattern of the molars shows it to be not closely related to *levipes*, which is in the subgenus *Aporodon*.

Specimen examined.—One, the type.

REITHRODONTOMYS RUFESCENS GROUP.

REITHRODONTOMYS RUFESCENS RUFESCENS Allen & Chapman.

RUFESCENT HARVEST MOUSE.

Reithrodontomys rufescens Allen & Chapman, Bull. Am. Mus. Nat. Hist., IX, 1897, p. 199.

Type locality.—Jalapa, Vera Cruz, Mexico.

Distribution.—Mountain slopes of eastern Mexico in the States of Queretaro, Hidalgo, Puebla, Vera Cruz, and Oaxaca.

Characters.—Larger than *R. fulvescens difficilis* and much darker; sides lacking the bright ochraceous line characteristic of the *fulvescens* group; tail blackish, unicolor.

Color.—*Fresh pelage* (April specimens, Jalapa, Vera Cruz): Upperparts tawny, strongly mixed with black over the entire dorsal area from nose to tail; sides nearly pure tawny; ears varying from fuscous to fuscous-black; feet buffy white washed with fuscous; tail fuscous, nearly unicolor, clothed with scattered grayish hairs; underparts

heavily washed with pinkish cinnamon. *Worn pelage* (July specimens, Jico, Vera Cruz): Underparts somewhat paler; ears and tail blacker.

Skull.—Larger than that of *R. fulvescens difficilis*, with longer and relatively slenderer rostrum; braincase usually subglobular (occasionally moderately flattened); nasals long and narrowed posteriorly to a point, ending about on a line with premaxillæ; zygomata moderately contracted anteriorly; audital bullæ relatively small; palatal foramina long, reaching to or beyond plane of first molars. Enamel pattern of upper molars in some specimens simple, in others showing incomplete subsidiary loops and small accessory tubercles.

Measurements.—Average of 10 adults from Jico and Jalapa, Vera Cruz: Total length, 176 (168–182); tail vertebræ, 98 (93–104); hind foot, 20 (18–21). Skull: (See table, p. 81).

Remarks.—This subspecies is one of the darkest forms in the genus. It has a rather limited range in the humid mountainous parts of eastern Mexico, intergrading with *luteolus* in Oaxaca and Guerrero. Its range overlaps slightly that of *R. fulvescens difficilis* (both species occurring at Jalapa, Vera Cruz), but it does not intergrade with any member of the *fulvescens* group. It is readily distinguished from them by its dark tawny coloration and unicolor tail.

In dental characters this species is quite inconstant, as pointed out above; it is considered an aberrant member of the subgenus *Reithrodontomys*, bridging the gap between it and *Aporodon* in much the same way that *levipes* does.

Specimens examined.—Total number, 15, from the following localities in Mexico:

Vera Cruz: Jalapa, 10;¹ Jico, 8.

Puebla: Huauchinango, 3.

Queretaro: Pinal de Amoles, 1.

Oaxaca: Reyes, 1.

REITHRODONTOMYS RUFESCENS LUTEOLUS subsp. nov.

YELLOW HARVEST MOUSE.

(Pl. II, fig. 6; Pl. V, fig. 6.)

Type from Juquila, Oaxaca, Mexico (altitude 5,000 feet). No. 71558, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, Feb. 28, 1895; E. W. Nelson and E. A. Goldman. Original No. 7579.

Distribution.—Mountains of Oaxaca and Guerrero.

Characters.—Similar to *rufescens* but colors brighter and less blackish; ears larger and tail longer; skull with flattened braincase; molars without accessory cusps.

Color.—Upperparts and sides rich ochraceous-buff, varying to pinkish cinnamon, more or less darkened on the back with blackish

¹ Collection Am. Mus. Nat. Hist.

brown; underparts light pinkish cinnamon; tail usually bicolor, fuscous above, soiled whitish below; fore and hind feet whitish, tinged with buff; ankles dusky; ears fuscous on both surfaces.

Skull.—Similar to that of *rufescens* but averaging broader; brain-case very flat; nasals decidedly narrow posteriorly, ending on a line with premaxillæ; audital bullæ rather small (as in *rufescens*).

Measurements.—Average of 8 adults from type locality: Total length, 181 (169–199); tail vertebrae, 103 (92–112); hind foot, 20.4 (20–21). Skull: (See table, p. 81).

Remarks.—This subspecies is a well-marked race of *rufescens*, occupying the mountains of the west coast of southern Mexico. It closely resembles *R. colimæ nerterus* in color, but differs from it

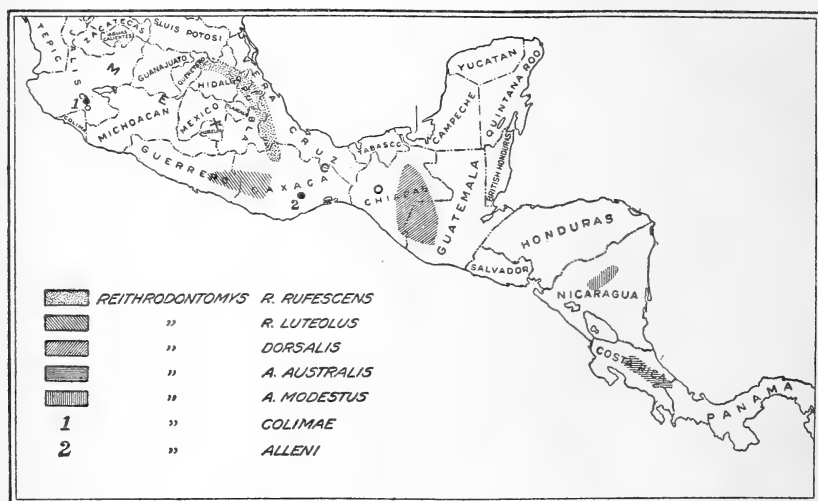


FIG. 4. Distribution of *Reithrodontomys rufescens*, *R. dorsalis*, *R. australis*, *R. colimæ*, *R. alleni*, and subspecies.

in skull characters. Additional material, however, may show that *nerterus* intergrades with the present form.

Specimens from Omilteme, Guerrero, are slightly darker than the type series and one of them has a unicolor tail, as in *rufescens*. These specimens, as also one from the mountains west of Oaxaca City, are considered intermediate between *rufescens* and *luteolus*. Specimens from the type locality of this form show no approach to the subgenus *Aporodon*, but in the series from Omilteme is one specimen having well-developed subsidiary tubercles, as is frequently seen in the subspecies *rufescens*.

Specimens examined.—Total number, 15, from the following localities in Mexico:

Oaxaca: Juquila, 11; mountains 15 miles west of Oaxaca, 1.

Guerrero: Omilteme, 3.

REITHRODONTOMYS ALLENI sp. nov.

ALLEN HARVEST MOUSE.

Type from mountains near Ozolotepec, Oaxaca, Mexico (altitude 10,000 feet). No. 71563, U. S. Nat. Mus., Biological Survey Collection, ♂ adult, Mar. 27, 1895; E. W. Nelson and E. A. Goldman. Original number 7749.

Distribution.—Known only from the type locality.

Characters.—Externally similar to *R. c. colimæ* but back darker, underparts whiter, and tail longer; skull apparently nearest to that of *R. rufescens luteolus*.

Color.—Upperparts mixed black and light pinkish cinnamon; darkest along the median line; sides without a lateral line, less richly colored than in *colimæ* and much less so than in *luteolus*; underparts white; ears pale fuscous; tail fuscous above, slightly paler beneath; front feet buffy white; hind feet grayish white, washed with hair-brown; ankles dusky.

Skull.¹—Apparently similar to that of *luteolus*, but smaller; bullæ similar; rostrum short and broad; nasals longer than premaxillæ and narrowed to a point at posterior end; zygomata standing out rather squarely; molars without accessory enamel loops.

Measurements.—Type: Total length, 182; tail vertebræ, 100; hind foot, 19. Skull: (See table, p. 81).¹

Remarks.—This species, although living at a high altitude and somewhat resembling in color one of the members of the *chrysopsis* group, nevertheless seems to be most nearly related to *R. rufescens luteolus*, which occupies the lower foothill country below the range of *alleni*. The skull of *alleni* resembles that of *luteolus* in having small bullæ and long nasals narrowed posteriorly. Externally *alleni* is paler than *luteolus* and has white underparts. Additional material may show it to be a subspecies of the latter. The species is named for Dr. J. A. Allen, in recognition of his extensive work on the genus.

Specimen examined.—One, the type.

REITHRODONTOMYS COLIMÆ COLIMÆ Merriam.

COLIMA VOLCANO HARVEST MOUSE.

(Pl. II, fig. 5; Pl. V, fig. 5.)

Reithrodontomys colimæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 551.

Type locality.—Sierra Nevada de Colima, Jalisco, Mexico (altitude, 12,000 feet).

Distribution.—Known only from the type locality.

Characters.—Externally similar to *R. c. chrysopsis*, with long, woolly pelage, but smaller and paler; skull similar to that of *R. c. toluçæ*, but smaller and with simple enamel pattern.

¹ Type and only specimen badly broken; shape of braincase not known.

Color.—Upperparts dull ochraceous-buff (slightly paler than in *chrysopsis*), sparingly mixed with black on the back, the median dorsal band only faintly indicated; sides paler but without lateral line of buff; ears fuscous; underparts pinkish buff; fore feet buffy white, washed with brownish; hind feet hair-brown, becoming white toward the toes; tail pale fuscous above, grayish white beneath.

Skull.—Similar in shape to that of *R. c. tolucae*, but slightly smaller, with less inflated braincase; rostrum a little shorter and broader; zygomata standing out a little more squarely anteriorly; nasals long, ending on plane of premaxillæ; interpterygoid fossa rather wide (as in *chrysopsis*); bullæ intermediate in size between those of *chrysopsis* and *tolucae*; palatal foramina short and widely open; enamel pattern of upper molars simple, with only a trace of a subsidiary enamel loop.

Measurements.—Average of 2 specimens from type locality: Total length, 165.5; tail vertebræ, 90; hind foot, 20. Skull: (See table, p. 81).

Remarks.—This species resembles externally the members of the *chrysopsis* group, but the absence of subsidiary loops on the upper molars makes it necessary to place it in the *rufescens* group in the typical subgenus. It is apparently a connectant species between the two subgenera.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS COLIMÆ NERTERUS Merriam.

COLIMA HARVEST MOUSE.

Reithrodontomys colimæ nerterus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 551.

Type locality.—Sierra Nevada de Colima, Jalisco, Mexico (altitude, 6,500 feet).

Distribution.—Known only from the type locality.

Characters.—Similar to *colimæ*, but ochraceous color more intense, pelage shorter, and tail longer; skull slightly smaller.

Color.—Upperparts deep ochraceous-buff, nearly pure on sides, mixed with black on median dorsal area; underparts heavily washed with light ochraceous-buff; ears fuscous, shading to fuscous-black; tail indistinctly bicolor, pale fuscous above, dusky drab below; feet buffy white, shaded with dusky; ankles dark hair-brown.

Skull.—Slightly smaller than that of *colimæ* but of essentially similar shape; nasals considerably shorter; interpterygoid fossa relatively wide; enamel pattern of upper molars simple. Compared with *luteolus*: Braincase narrower and higher; rostrum slenderer; nasals broader at posterior end; bullæ smaller but more inflated (rounder); palatal foramina shorter. Compared with *R. r. rufescens*: Braincase higher; rostrum and nasals shorter; bullæ more inflated.

Measurements.—Type (♀ ad.): Total length, 190; tail vertebræ, 110; hind foot, 20; ear from notch, 14.5; topotype (♂ ad.): 182; 99; 21. Skull: (See table, p. 81).

Remarks.—This form closely resembles *R. rufescens luteolus*, both in color and in the character of the pelage, which is shorter and less woolly than in *R. colimæ colimæ*, which lives at higher altitudes. Compared with *luteolus* the present form is a slightly paler shade of ochraceous-buff. Its skull characters indicate close relationship to *colimæ* and necessitate its separation from *luteolus*, but additional material may serve to connect the two groups, making *luteolus* a subspecies of *colimæ*.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS DORSALIS Merriam.

BLACK-BACKED HARVEST MOUSE.

(Pl. II, fig. 4; Pl. V, fig. 4.)

Reithrodontomys dorsalis Merriam, Proc. Wash. Acad. Sci, III, 1901, p. 557.

Type locality.—Calel, Guatemala.

Distribution.—Highlands of Chiapas and Guatemala.

Characters.—Smaller than *R. rufescens luteolus*, with blacker back and paler sides; skull with higher braincase.

Color.—*Fresh pelage* (January): Upperparts ochraceous-buff, mixed with black, with a well-defined median band or stripe of black; sides varying from ochraceous-buff to pinkish cinnamon, sometimes with a rather pronounced lateral line next to the belly; underparts washed with light ochraceous-buff; ears fuscous-black, darker than in *luteolus*; tail bicolor, fuscous above, grayish white beneath; hind feet grayish white; front feet buffy with a dusky stripe reaching half-way to the toes. *Worn pelage*: General tone redder (pinkish cinnamon to pale tawny); black dorsal area much less clearly defined.

Skull.—Resembling that of *R. r. rufescens* in general shape, but averaging smaller, with larger bullæ. Compared with *R. r. luteolus*: Smaller; braincase decidedly more inflated; interpterygoid fossa much narrower. Compared with *saturatus*: Larger, with heavier rostrum and more widely expanded zygomata. The upper molars in a majority of the specimens examined have a simple enamel pattern, but some specimens show an incomplete subsidiary loop and well-developed accessory tubercles on the outer border, thus completely bridging the gap between the two subgenera.

Measurements.—Average of 10 specimens (adult and subadult) from type locality: Total length, 167.5 (160–175); tail vertebræ, 90 (82–96); hind foot, 19.3 (19–20). Skull: (See table, p. 81).

Remarks.—This species, although clearly belonging to the *rufescens* group, seems not to intergrade with *luteolus*, its nearest neighbor on

the north. The low country on the Isthmus of Tehuantepec apparently is an effective barrier separating the ranges of these two mountain-loving species.

The species exhibits considerable individual and seasonal variation in color. Specimens in worn pelage very much resemble similar specimens of *rufescens*, but the ears and tail are paler.

Specimens examined.—Total number, 154, from the following localities:

Guatemala: Calel, 23; Hacienda Chancol, 29; Jacaltenango, 1; Todos Santos, 10; Volcan Santa Maria, 4; Zunil, 3.

Chiapas: Canjob, 2; Comitán, 27; Pinabete, 8; San Cristobal, 5; Tenejapa, 3; Teopisca, 6; Tumbala, 33.

REITHRODONTOMYS AUSTRALIS AUSTRALIS Allen.

IRAZU HARVEST MOUSE.

(Pl. II, fig. 3; Pl. V, fig. 3.)

Reithrodontomys australis Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 328.

Reithrodontomys australis vulcanius Bangs, Bull. Mus. Comp. Zool., XXXIX, 1902, p. 38 (Volcan de Chiriqui, Panama).

Type locality.—Volcan de Irazu, Costa Rica.

Distribution.—Mountains of Costa Rica and western Panama.

Characters.—Similar to *R. dorsalis*, but slightly smaller, with smaller ears; tail less sharply bicolor; ochraceous colors slightly deeper and black dorsal band less clearly defined.

Color.—Upperparts ochraceous-buff, varying to pale orange-cinnamon, rather heavily mixed on back with black; median dorsal band usually very indistinct; underparts washed with light pinkish cinnamon; ears pale fuscous to fuscous-black; tail fuscous above, grayish white beneath; feet buffy white, shaded with hair-brown; wrists and ankles hair-brown.

Skull.—Slightly smaller than that of *dorsalis*, with flatter braincase; bullæ rather flat, averaging smaller than in *dorsalis*; ascending arms of premaxillæ projecting a little beyond end of nasals; upper molars simple, without accessory tubercles.

Measurements.—Type: Total length, 169 (160–179); tail vertebrae, 84.5 (82–92); hind foot, 18.5 (18–19). Skull: (See table, p. 81).

Remarks.—This species belongs in the *rufescens* group, being apparently the most southerly ranging member of the group and of the subgenus. It closely resembles *dorsalis* both in color and cranial characters, and additional material from Central America may make it necessary to unite the two as a single species.

The type of "*vulcanius*" from Panama has been examined and found to agree closely with topotypes of *australis* in the Biological Survey Collection.

Specimens examined.—Total number, 18, from the following localities:

Costa Rica: Volcan de Irazu, 17.

Panama: Volcan de Chiriqui, 1.¹

REITHRODONTOMYS AUSTRALIS MODESTUS Thomas.

NICARAGUA HARVEST MOUSE.

Reithrodontomys modestus, Thomas, Ann. Mag. Nat. Hist., Ser. 7, XX, 1907, p. 163.

Type locality.—Jinotega, Nicaragua.

Distribution.—Known only from vicinity of type locality.

Characters.—Closely similar to *australis*, but underparts whiter and tail darker.

Color.—Upperparts mixed black and dull ochraceous-buff, with a fairly well-defined median band of blackish; underparts grayish white, rarely with a faint tinge of light ochraceous-buff and a pectoral spot of the latter color; tail distinctly bicolor, except at the tip, fuscous above, soiled whitish below; ears fuscous; hind feet grayish white; ankles dusky; front feet buffy, with a dusky stripe.

Skull.—Not seen. Apparently slightly smaller than that of *australis*, with smaller audital bullæ.

Measurements.—Type: "Head and body, 59; tail, 70; hind foot (s. u.), 16.5; ear, 12.5." Skull: (See table, p. 81).

Remarks.—This form appears to be very closely related to *australis*, but the material at hand is too scanty to show clearly its characters. The color description above is from specimens taken by Mr. William B. Richardson at San Rafael del Norte and kindly loaned by Dr. J. A. Allen of the American Museum of Natural History. These differ from Thomas's description of the type in having ochraceous instead of "drabby" sides and pectoral spot, and tail distinctly whiter beneath. The Richardson specimens are without complete skulls, so a study of the cranial characters has not been possible. Mr. W. H. Osgood, who compared the type specimen with material from the Biological Survey Collection, notes that its skull is slightly smaller than that of *australis*, the premaxillæ shorter, and the audital bullæ somewhat smaller.

Specimens examined:

Nicaragua: San Rafael del Norte, 8.²

Subgenus APORODON nobis.

Type.—*Reithrodontomys tenuirostris* Merriam.

Subgeneric characters.—Upper molars with subsidiary enamel loops in the outer primary reëntrant angles, these loops in most species reaching the outer border of the tooth and appearing, when viewed

¹ Collection Mus. Comp. Zool.

² Collection Am. Mus. Nat. Hist.

in profile, as prominent accessory tubercles; in other species (*chrysoptis* group) the enamel loops sometimes do not reach the outer border of the tooth and the accessory tubercles are often absent or much reduced.

Remarks.—The subgenus *Aporodon*, while not sharply set off from *Reithrodontomys* by any constant external characters, differs so widely in the molar pattern as described above that its segregation seems desirable.

It includes several well-marked groups, some of which possess striking characters, both cranial and external, while other species resemble the typical subgenus in all but the tooth characters.

The *tenuirostris-microdon* group (including also *creper*) and the *mexicanus* group (including *milleri*, *söderströmi*, and *gracilis*) show the greatest amount of differentiation from typical *Reithrodontomys*. These agree in having the outer wall of the anteorbital foramen relatively narrow (usually much narrower than width of interpterygoid fossa), broad interpterygoid fossa, short palatal foramina, unicolor tail, and dense pelage (rather woolly in most species) of a uniform tawny or ochraceous color, without pronounced darker grizzling. In all species in these groups the subsidiary enamel loops of the upper molars are well-developed and in unworn specimens appear as prominent tubercles.

The *chrysoptis* group approaches the typical subgenus in having the outer wall of anteorbital foramen broader, interpterygoid fossa narrower and palatal foramina longer. The subsidiary enamel loops of the upper molars are always well developed, but are usually (except in *perotensis*) not continuous to the outer edge of the tooth and the accessory tubercles are absent or much reduced. The pelage is long and full, and somewhat more silky than in *tenuirostris*; the upperparts are more or less varied with black, and the tail is bicolor.

R. levipes and *R. hirsutus* seem to be aberrant members of the subgenus, agreeing in the character of the pelage with the members of the typical subgenus, but having the subsidiary enamel loops of the upper molars well developed.

REITHRODONTOMYS LEVIPES GROUP.

REITHRODONTOMYS LEVIPES Merriam.

SAN SEBASTIAN HARVEST MOUSE.

(Pl. III, fig. 2; Pl. VI, fig. 2; Pl. VII, figs. 3, 5.)

Reithrodontomys levipes Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 554.

Type locality.—San Sebastian, Jalisco, Mexico.

Distribution.—Known only from the type locality.

Characters.—About the size of *R. fulvescens toltecus*; color more decidedly tawny than any members of the *fulvescens* group; skull relatively short and broad.

Color.—Upperparts ochraceous-salmon, sparingly mixed on back with black; general tone of sides between ochraceous-salmon and ochraceous-orange; underparts strongly suffused with light pinkish cinnamon; fore and hind feet grayish white, sometimes tinged with the color of the sides; ears pale fuscous, with ochraceous hairs on inner surface; tail pale fuscous above, grayish white below. Compared with *toltecus*, the ochraceous color is more intense, there is much less darkening on the middle of the back, and the underparts are more intensely buffy.

Skull.—About the size of that of *R. f. toltecus* but shorter and broader; braincase rather flat; zygomata narrowed anteriorly; nasals short; ascending arms of premaxillæ extending about 1 mm. beyond end of nasals; audital bullæ very small; interpterygoid fossa broad; palatal foramina short and widely open. First and second upper molars with accessory enamel loops in primary reëntrant angles.

Measurements.—Average of 3 adults from type locality: Total length, 190 (188–192); tail vertebræ, 110.5 (110–111); hind foot, 20.8 (20.5–21). Skull: (See table, p. 81).

Remarks.—This species is remarkable not only for its peculiar characters but because of its (seemingly) restricted range. It resembles somewhat in color and character of pelage certain members of the *fulvescens* group, but its skull characters place it in the subgenus *Aporodon*. It seems to be most nearly related to the much larger *hirsutus*, known only from Ameca, Jalisco.

At the type locality of *levipes* occurs another much smaller species—*R. fulvescens tenuis*—a member of the typical subgenus. In the series referred to this species are three specimens which combine in a remarkable manner the characters of the two species. Externally they differ very little from *levipes* except in being somewhat less intensely ochraceous, both above and below, and in having rather shorter tails (103 and 104 mm.). Their skulls, however, are decidedly narrower than those of *levipes* and about intermediate in size between skulls of the latter and of *tenuis*. The upper molars have small accessory tubercles present in the principal angles, but the enamel pattern is practically the same as in *tenuis*. Another much smaller (adult) skull in the series shows a strong tendency to develop the accessory enamel loop characteristic of the subgenus *Aporodon*. This skull (No. 88056, U. S. Nat. Mus.) is smaller than those of typical *tenuis*. Anomalous as this situation may be, there seems to be no other explanation than that these specimens are hybrids between *levipes* and *tenuis*.

Specimens examined.—Three, from type locality.

REITHRODONTOMYS HIRSUTUS Merriam.

GIANT HARVEST MOUSE.

(Pl. III, fig. 1; Pl. VI, fig. 1.)

Reithrodontomys hirsutus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 553.*Type locality*.—Ameca, Jalisco, Mexico.*Distribution*.—Known only from the type locality.*Characters*.—Size very large; colors much as in *R. f. tenuis*, paler than in *R. levipes*.*Color*.—Upperparts ochraceous-buff, brightest on sides, sparingly mixed on the back with blackish brown; underparts grayish white, usually with a distinct tinge of light buff; fore feet whitish, washed with light buff; hind feet grayish white, tinged with dusky; ankles fuscous; tail pale fuscous above, grayish white below; ears brownish drab.*Skull*.—Large and robust with a well-defined supra-orbital bead which extends back to the parietals; braincase rather flat and somewhat narrowed posteriorly; zygomata contracted anteriorly; rostrum and nasals short; ascending arms of premaxillæ extending back of end of nasals; audital bullæ very small; palatal foramina short and wide; upper molars with subsidiary enamel loops.*Measurements*.—Average of 5 adults from type locality: Total length, 211 (203–233); tail vertebræ, 127 (122–143); hind foot, 21.8 (21–22). Skull: (See table, p. 81).*Remarks*.—This species is one of the largest in the genus, being exceeded in size of skull only by *R. tenuirostris*, a widely different species. So far as known, it has no near relative except *levipes*, and from that it differs both in size and color. It agrees with it, however, in every important cranial character—heavy rostrum, short and wide palatal foramina, broad interpterygoid fossa, and small bullæ.*Specimens examined*.—Six, from type locality.

REITHRODONTOMYS CHRYSOPSIS GROUP.

REITHRODONTOMYS CHRYSOPSIS CHRYSOPSIS Merriam.

VOLCANO HARVEST MOUSE.

(Pl. III, fig. 3; Pl. VI, fig. 3; Pl. VII, fig. 6.)

Reithrodontomys chrysopsis Merriam, Proc. Biol. Soc. Wash., XIII, 1900, p. 152.*Type locality*.—Mount Popocatepetl, Mexico (altitude 11,500 feet).

Distribution.—High mountains around the valley of Mexico; Mount Patamban and Mount Tancitaro in Michoacan. Altitudinal range from 9,000 feet to 13,500 feet (timber line).

Characters.—Size large (almost equaling *R. hirsutus*); tail long; pelage very long, soft, and silky; ears black or blackish; tail bicolor; skull with rounded and much inflated braincase; bullæ large.

Color.—Upperparts a rich shade of ochraceous, between ochraceous-buff and orange-buff, rather heavily mixed on back with black, the latter color usually forming an indistinct median band; general tone of sides near pinkish cinnamon; ears fuscous-black; tail sharply bicolor, fuscous above, grayish white beneath; feet grayish white; ankles fuscous; underparts strongly suffused with light pinkish cinnamon.

Skull.—Of large size (considerably exceeding that of *R. r. rufescens*); braincase subglobular, usually much inflated, sometimes moderately

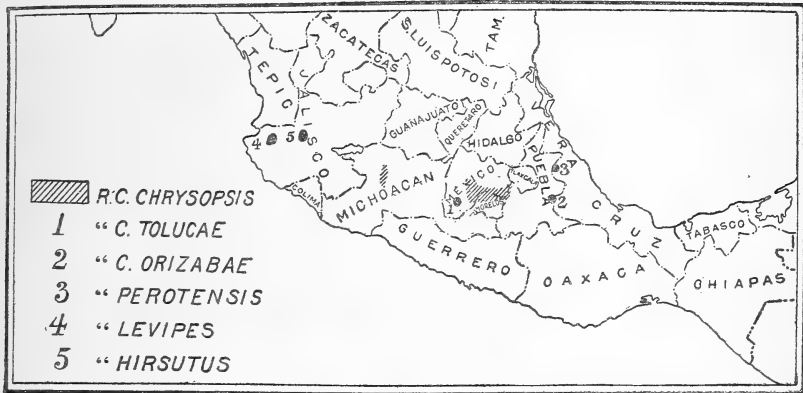


FIG. 5.—Distribution of *Reithrodontomys chrysopsis*, *R. perotensis*, *R. levipes*, *R. hirsutus*, and subspecies.

flattened; zygomata slender, strongly contracted anteriorly; outer wall of anteorbital foramen broad; rostrum slender, narrowing gradually to the tip; audital bullæ very large and moderately inflated; interpterygoid fossa relatively narrow (compared with *R. levipes*); palatal foramina long (as in *rufescens*); upper molars with subsidiary enamel loops in primary angles, but these usually not reaching outer border of tooth; accessory tubercles absent or much reduced.

Measurements.—Type: Total length, 194; tail vertebræ, 108; hind foot, 21. Average of 5 specimens from Ajusco, Salazar, and Huitzilac: Total length, 185 (177–188); tail vertebræ, 106 (98–111); hind foot, 20.8 (20–21). Skull: (See table, p. 81).

Remarks.—This handsome and striking species is an inhabitant of the upper slopes of the mountains about the valley of Mexico and on more or less isolated mountains in western Michoacan. It is the first-described and best-known member of a subalpine group of species found on most of the higher mountains of southern Mexico

and is apparently the only form having an extensive range. Specimens from Mount Tancitaro and Patamban show no characters to distinguish them from the typical form. From *R. f. toltecus*, which occupies the valley of Mexico, *chrysopsis* differs in larger size, richer colors, longer pelage, and blacker ears, as well as in cranial characters.

On Mount Popocatepetl, Nelson and Goldman found this species occurring sparingly in grassy places in the open forest from the base of the mountain up to 12,000 feet. On Mount Patamban it was most numerous at about 11,000 feet in the upper part of the Canadian Zone, a few ranging to the extreme summit above 12,000 feet. In the upper part of its range it was found among grass and brush.

Specimens examined.—Total number, 25, from the following localities in Mexico:

Mexico: Ajusco (11,000 feet), 3; Mount Iztaccihuatl (13,500 feet), 1; Mount Popocatepetl (11,500 feet), 3; Salazar (9,000 feet), 1.

Morelos: Huitzilac (10,000 feet), 1.

Michoacan: Mount Tancitaro (10,000–12,000 feet), 7; Patamban (11,000 feet), 9.

REITHRODONTOMYS CHRYSOPSIS TOLUCÆ Merriam.

TOLUCA HARVEST MOUSE.

Reithrodontomys chrysopsis toluæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 549.

Type locality.—North slope of Volcan Toluca, Mexico (altitude, 11,500 feet).

Distribution.—Known only from the type locality.

Characters.—Similar to *chrysopsis*, but slightly smaller and much less intensely ochraceous; skull slenderer.

Color.—*Worn pelage*: Upperparts mixed black and ochraceous-tawny with a well-defined black median band, as in *chrysopsis*, but lacking almost entirely the bright golden color shown by the latter; ears fuscous; front feet buffy white, with a band of hair-brown reaching half way to the toes; hind feet soiled whitish, tinged with dusky; ankles fuscous; ring around eye blackish; underparts grayish with scarcely a trace of buff; tail hair-brown above, grayish white below.

Skull.—Slightly smaller than that of *chrysopsis*; braincase narrower; rostrum slenderer, much narrowed at the tip; bullæ much smaller; subsidiary enamel loops of upper molars low and slightly developed; accessory tubercles absent.

Measurements.—Type: Total length, 180; tail vertebræ, 98; hind foot, 21. Skull: (See table, p. 81).

Remarks.—This form, known from only a single specimen, has rather pronounced characters. On account of the worn condition of the type specimen, the colors can not be satisfactorily described. Specimens in fresh pelage will doubtless prove less different from

chryopsis than is this worn individual, but the underparts apparently are distinctly whiter.

Specimen examined.—One, the type.

REITHRODONTOMYS CHRYSOPSIS ORIZABÆ Merriam.

MOUNT ORIZABA HARVEST MOUSE.

Reithrodontomys orizabæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 550.

Type locality.—Mount Orizaba, Puebla, Mexico (altitude, 9,500 feet).

Distribution.—Known only from the type locality.

Characters.—Externally the same as *chryopsis*; skull narrower and bullæ smaller.

Color.—As in *chryopsis*.

Skull.¹—Apparently smaller than that of *chryopsis*, but length of skull and shape of zygomata not known; braincase narrower, audital bullæ decidedly smaller; molar series and nasals shorter; subsidiary enamel loops of m^2 well developed, of m^1 present but shorter. Compared with *tolucæ*: Braincase and bullæ similar; rostrum broader.

Measurements.—Type: Total length, 182; tail vertebræ, 105; hind foot, 20. Skull: (See table, p. 81).

Remarks.—This form so closely resembles *chryopsis* in color that it seems best to consider it a subspecies of the latter; in cranial characters it more nearly resembles *tolucæ*. Additional material is necessary to determine its true relationship.

Specimen examined.—One, the type.

REITHRODONTOMYS PEROTENSIS Merriam.

PEROTE HARVEST MOUSE.

Reithrodontomys perotensis Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 550.

Type locality.—Cofre de Perote, Vera Cruz, Mexico (altitude, 9,500 feet).

Distribution.—Known only from the type locality.

Characters.—Externally similar to *chryopsis*, but color of upperparts less intensely ochraceous; skull smaller with much smaller bullæ.

Color.—Upperparts cinnamon with strong tinge of ochraceous, extensively mixed with black and with a distinct median band of the latter color; ears fuscous, somewhat paler than in *chryopsis*; underparts strongly washed with light pinkish cinnamon; tail pale fuscous above, slightly whitened beneath.

Skull.—Smaller than that of *R. c. chryopsis*, with flatter braincase and smaller bullæ; zygomata squarely spreading anteriorly, nearly

¹ The type and only known specimen is badly broken.

parallel to axis of skull; subsidiary enamel loops in upper molars well developed, reaching outer border of tooth.

Measurements.—Type: Total length, 176; tail vertebræ, 119; hind foot, 19. Skull: (See table, p. 81).

Remarks.—This species differs widely in cranial characters from the other members of the *chrysoptis* group. Indeed, its skull somewhat resembles that of *R. megalotis saturatus* (which occupies the low country around the base of the Cofre de Perote), especially in the widely spreading zygomata and in the shape and size of the audital bullæ. It differs from *saturatus*, however, in having a much broader and flatter braincase, longer and slenderer rostrum, buffy instead of white underparts, and in dental characters.

Specimen examined.—One, the type.

REITHRODONTOMYS MEXICANUS GROUP.

REITHRODONTOMYS MEXICANUS MEXICANUS (De Saussure).

SAUSSURE HARVEST MOUSE.

(Pl. III, fig. 4; Pl. VI, fig. 4; Pl. VII, figs. 4, 9, 10, 11.)

Reithrodon mexicanus De Saussure, Rev. Mag. Zool., 2d ser., XII, 1860, p. 109.

Ochetodon mexicanus Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186.

Reithrodontomys costaricensis jalapæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 552 (Jalapa, Vera Cruz).

Reithrodontomys cherriei jalapæ Miller, Bull. 79, U. S. Nat. Mus., 1912, p. 130.

Type locality.—Mountains of Vera Cruz, Mexico.

Distribution.—From Jalapa, Vera Cruz, south to Chiapas and Guatemala.

Characters.—Size rather large (about like *R. f. toltecus*); tail long, concolor; color uniform tawny above, white below; hind feet, ears, and tail dark; skull short, broad, and flat.

Color.—Upperparts varying from tawny to pinkish cinnamon, sparingly darkened on the back with blackish hairs; general tone of back varying from cinnamon-brown to Prout's brown; an indistinct blackish ring around eye; tail nearly unicolor, fuscous or clove-brown to fuscous-black, in some specimens slightly paler beneath; upper surfaces of both fore and hind feet dark hair-brown; toes usually buffy or grayish white; ears fuscous or fuscous-black; sides of nose, upper lips, and underparts white.

Skull.—Short and relatively broad, with very short, broad rostrum and short nasals; braincase squarish, rather flat, depressed posteriorly; zygomata slender, contracted anteriorly; nasals ending behind rather squarely, on a line with ends of premaxillæ or slightly anterior to them; outer wall of anteorbital foramen narrow; interpterygoid fossa broad; palatal foramina short, ending at or slightly in front of plane of first molars; audital bullæ small.

Measurements.—Adult male (Jalapa, Vera Cruz): Total length, 197; tail vertebrae, 119; hind foot, 21. Average of 2 adults from Toton-tepec, Oaxaca: 193; 117; 21. Average of 3 adults from Jacalte-nango, Guatemala, and Tumbala, Chiapas: 194; 117; 20.2. Skull: (See table, p. 81).

Remarks.—This species, although described over 50 years ago, is still imperfectly known, and the name *mexicanus* has been misapplied by all authors since De Saussure. Three distinct species of *Reithrodontomys* occur in the mountains of Vera Cruz and a fourth (*R. megalotis saturatus*) not far away on the table-land. These (using the modern names) are *R. rufescens rufescens*, *R. fulvescens difficilis*, and *R. "cherrii jalapæ."*¹

The original description² is so complete and agrees so perfectly with the last of these that there appears to be not the slightest doubt that the species now known as "*jalapæ*" should be referred to *mexicanus*. The combination of tawny upperparts, white belly, dark feet, and unicolor tail is possessed by no other species in this region.

Through the kindness of M. Maurice Bedot, director of the Geneva Museum, who has furnished the Biological Survey with photographs and measurements of the type skull, I am able to present additional evidence corroborative of the above decision. The photographs clearly show the relatively narrow outer wall of the anteorbital foramen and the broad interpterygoid fossa, characteristic of the subgenus *Aporodon*, and the measurements agree closely with those of specimens of "*jalapæ*" from Jalapa, Vera Cruz.

The type of *R. mexicanus*, with the skull inside the skin, was borrowed in 1890 from the Geneva Museum and examined in Washington by Drs. Allen, Merriam, and True. Comparison was made with a specimen³ (No. 7007a, U.S. Nat. Mus.) from Tehuacan, Puebla, at that time practically the only available specimen from southern Mexico. Dr. Allen in referring this specimen to *mexicanus* stated that it agreed with the type.⁴ Dr. Merriam's notes, however, taken at the same time, indicate some important differences. These are as follows:

No. $\frac{44}{100}$. This specimen is the type of De Saussure's description. *Measurements.*—Hind foot, 18.5. Ear from crown, 10; from anterior base, 13. The upper-

¹ All of these have been taken at Jalapa, Vera Cruz.

² Following is a translation of the pertinent portions:

"The size of this animal is nearly exactly that of the European field-mouse (*Mus silvaticus*), though its forms are somewhat more thick set. * * * Tail very long, its length exceeding that of the body and head. The color of the pelage is tawny brown, on the sides becoming absolutely tawny, or even orange-tawny. The tawny color becomes fainter toward the line where it comes in contact with the white of the belly. The lips, lower part of cheeks, chin, throat, and entire underparts are almost pure white, here and there slightly washed with a tawny tint, especially on the breast and throat. * * * The hairs are slate gray, the tips only passing into russet, or white. The ears are brown * * *. The fore feet are white, except above, as far as the root of the digits, where they are gray. The tail is blackish, scaly, unicolor, and covered with rather dark gray hairs; it is especially hairy toward the tip; at its base the hairs are scanty and very short; but they become longer toward the tip."

³ Referred by the writer to *R. fulvescens difficilis*.

⁴ Bull. Am. Mus. Nat. Hist., VII, 1895, p. 136.

parts are so thoroughly suffused with fulvous that it can almost be called a "red mouse." The upper surface of the hind foot is dark brown to base of toes. The toes are whitish. The skull has never been removed from the skin. There is a skin of this species or a closely related subspecies in the United States National Museum (No. 7007a) collected at Tehuacan, Puebla, Mexico, by Sumichrast. Upperparts rusty fulvous, but not quite so deep or bright as in the mounted specimen [the type]. The only departure of importance from the type is the color of the upper surface of the hind foot, which is soiled whitish instead of dark brown, and the color of the underside of the tail, which is whitish instead of being concolor with the upper surface.

These differences—whiter feet and bicolor tail—are sufficient to show that the Tehuacan specimen can not be referred to *mexicanus*. No mention is made, either by Allen or Merriam, of the color of the underparts, but taking into consideration the soiled and faded condition of the Tehuacan specimen (and probably, also, of the type) this omission is not strange.

On the evidence of this determination the name *mexicanus* was used by Allen for the dark form of the *fulvescens* group later described from Orizaba by Merriam as *R. difficilis*, but, as shown above, it properly applies to the species now under consideration—a member of the subgenus *Aporodon*.

The species exhibits considerable individual variation in color. One specimen from Totontepec, Oaxaca, is fairly typical, while another from the same place is considerably darker, with darker ears and tail. A specimen from Jacaltenango, Guatemala, is considerably paler than Vera Cruz specimens, but agrees with them in other characters.

Intergradation with *goldmani* on the north and with *cherrii* in Central America seems fairly certain to be established.

Specimens examined.—Total number, 10, from the following localities in Mexico and Guatemala:

Vera Cruz: Jalapa, 2.¹

Oaxaca: Totontepec, 2.

Chiapas: Comitán, 1; Tenejapa, 1; Tumbala, 3.

Guatemala: Jacaltenango, 1.

REITHRODONTOMYS MEXICANUS GOLDMANI Merriam.

GOLDMAN HARVEST MOUSE.

(Pl. III, fig. 6; Pl. VI, fig. 6.)

Reithrodontomys goldmani Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 552.

Type locality.—Metlatoyuca, Puebla, Mexico (altitude 800 feet).

Distribution.—Known only from northern Puebla.

Characters.—Similar to *mexicanus*, but smaller and paler.

Color.—Upperparts pinkish cinnamon, faintly darkened on top of head and back with brownish hairs; general tone of back about snuff-brown; sides of nose, upper lips, and underparts white, the

¹ One in Collection Am. Mus. Nat. Hist.

latter with a faint tinge of pale buff; ears dark hair-brown; tail fuscous, nearly unicolor or slightly paler beneath; fore and hind feet grayish white, tinged with dusky; ankles hair-brown.

Skull.—Longer and relatively narrower than that of *mexicanus*; braincase flattened, and narrowed posteriorly; rostrum and nasals longer, the latter narrowed to a point posteriorly; audital bullæ slightly larger; palatal foramina wide.

Measurements.—Type: Total length, 190; tail vertebræ, 109; hind foot, 21.5. Skull: (See table, p. 81).

Remarks.—This subspecies is the most northerly ranging member of the group. It occupies the low, arid, coast region of northern Puebla and probably adjacent States. It is distinctly paler than *mexicanus* and the skull of the type shows pronounced characters,

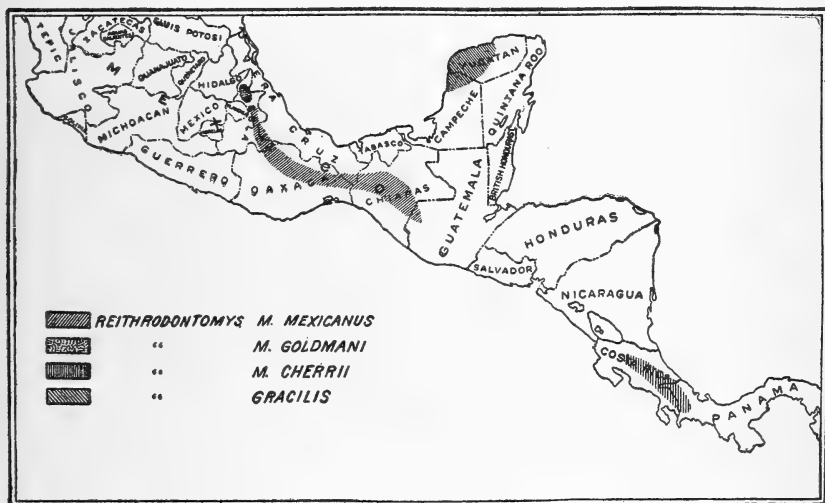


FIG. 6.—Distribution of *Reithrodontomys mexicanus*, *R. gracilis*, and subspecies.

some of which, however, may not prove to be constant. Two specimens from Huauchinango, Puebla (altitude 5,000 feet) are intermediate between *goldmani* and *mexicanus*, the skulls being nearer to the latter form, the skins nearer *goldmani*.

Specimens examined.—Total number, 3, from the following localities in Mexico:

Puebla: Huauchinango, 2; Metlaltoyuca, 1.

REITHRODONTOMYS MEXICANUS CHERRII (Allen).

CENTRAL AMERICAN HARVEST MOUSE.

(Pl. III, fig. 5; Pl. VI, fig. 5.)

Hesperomys (Vesperimus) cherrii Allen, Bull. Am. Mus. Nat. Hist., III, 1891, p. 211.

Sitomys cherriei Allen, Ibid., V, 1893, p. 238.

Reithrodontomys costaricensis Allen, Ibid., VII, 1895, p. 139 (La Carpintera, Costa Rica).

Reithrodontomys cherriei Osgood, Proc. Biol. Soc. Wash., XX, 1907, p. 50 (type fixed).

Type locality.—San Jose, Costa Rica.

Distribution.—Costa Rica and Chiriqui, Panama.

Characters.—Similar to *mexicanus*, but colors brighter (more tawny, less blackish); ears paler; skull larger.

Color.—Upperparts varying from bright tawny to hazel, more or less mixed with black on dorsal area; ears dusky hair-brown, scantily haired; underparts white (rarely washed with yellowish buff); tail fuscous, unicolor, clothed with short, bristly hairs; fore and hind feet pale sepia, broadly edged with whitish; toes buffy white.

Skull.—Larger than that of *mexicanus*, with longer rostrum; brain-case more inflated.

Measurements.—Average of 7 adults from Costa Rica (San Pedro and La Carpintera): Total length, 191 (182–198); tail vertebræ, 111 (103–123); hind foot, 20 (19.5–20.5). Average of 13 adults from Boquete, Chiriqui: Total length, 207 (192–227); tail vertebræ, 126 (115–140); hind foot, 20 (19–22). Skull: (See table, p. 81).

Remarks.—Through an unfortunate mixing of skulls this species was originally described as a *Hesperomys* [= *Peromyscus*] and a few years later, before the mistake was discovered, redescribed as *Reithrodontomys* "*costaricensis*," by which name it has usually been known. Osgood has shown the pertinence of the original description to the present species and has selected a type specimen from the original series.¹

The species is one of the larger members of the genus, though not so large as *R. t. tenuirostris* and *R. hirsutus*. Intergradation with *mexicanus* seems probable, though not perfectly shown by the material at hand. A specimen from Jacaltenango, Guatemala, is somewhat intermediate in characters, but apparently nearest to *mexicanus*. Specimens from Boquete, Chiriqui, have somewhat longer tails than the series from Costa Rica. A single specimen from Nicaragua is much less tawny than the type series, somewhat resembling the Guatemala specimen.

Specimens examined.—Total number, 21, from the following localities:

Costa Rica: La Carpintera, 3;² San Jose, 2;² San Pedro, 3.²

Panama: Boquete, Chiriqui, 13.³

REITHRODONTOMYS MILLERI Allen.

COLOMBIAN HARVEST MOUSE.

Reithrodontomys milleri Allen, Bull. Am. Mus. Nat. Hist., XXXI, 1912, p. 77.

Type locality.—Munchique, Cauca, Colombia (altitude, 8,325 feet).

Distribution.—Known only from Colombia (altitude 6,000 to 10,300 feet).

¹ Proc. Biol. Soc. Wash. XX, 1907, p. 50.

² Eleven in Collection Mus. Comp. Zool.

³ Collection Am. Mus. Nat. Hist.

Characters.—Paler and less tawny than *R. m. cherrii*; tail shorter.

Color.—Upperparts varying from light ochraceous-salmon, extensively mixed with brownish to nearly pure tawny, with slight admixture of brown; lateral line only faintly indicated; underparts white, sometimes with a faint tinge of light buff; ears and tail dark hair-brown, the latter almost unicolor, but slightly paler beneath; feet hair-brown, sometimes edged with grayish white.

Skull.—Very similar to that of *R. m. cherrii*, with short, heavy rostrum, broad frontals, and short palatal foramina.

Measurements.—Ten adults: Total length, 181 (169–190); tail vertebræ, 107 (98–116); hind foot, 19 (18–20). Skull: (See table, p. 81).

Remarks.—This species is rather closely related to *R. m. cherrii*, from which it differs in browner, less tawny coloration and shorter tail. No intermediate specimens are known, but further collecting in Panama may result in securing such.

Specimens examined.—Total number, 7, from the following localities:¹

Colombia: Cocal, 1; El Roble (7,000 feet), 5; La Guneta, 1; Munchique, 5; San Augustin, Huila (10,300 feet), 1.

REITHRODONTOMYS SÖDERSTRÖMI Thomas.

ECUADOR HARVEST MOUSE.

Reithrodontomys söderströmi Thomas, Ann. Mag. Nat. Hist., ser. 7, I, 1898, p. 451.

Type locality.—Quito, Ecuador.

Distribution.—Known only from the type locality and from Valle de las Papas, southern Colombia.

Characters.—Apparently in the *cherrii* group and closely related to *milleri*; colors less tawny above and more buffy or fawn-colored below; hind foot, ear, and skull larger.

Color.—"Dull grayish fawn, not nearly so rufous as in *costaricensis* [*cherrii*]. Brighter lateral line little developed. Under surface not sharply defined, its color much less bright than in *costaricensis*, the tips of the hairs more or less buffy or fawn-colored. Ears thinly haired, brown, little darker than the general color. Hands and feet white, without darker markings on the metapodials. Tail pale brown above and below, the tip white."² A series of 4 specimens from Valle de las Papas, central Andes, Huila, Colombia,³ may be described as follows: Upperparts mixed blackish brown and ochraceous-salmon; ears clove-brown; tail dark mummy-brown; hind feet soiled whitish, with a broad band of mummy-brown reaching nearly to the toes;

¹ All in Collection Am. Mus. Nat. Hist.

² Thomas, loc. cit.

³ Compared by Dr. J. A. Allen and Mr. Oldfield Thomas with the type and 12 topotypes in the British Museum and said to agree perfectly with them.

front feet similar, but with less brown; underparts white, strongly tinged with pale ochraceous-salmon. With regard to the color of the hind feet in the typical series, Mr. Thomas writes me as follows:

Of 20 specimens, 12 have large metapodial patches [of brown], 7 have smaller ones down to quite minute ones (often not the same on both sides) and the type has practically none at all—though even there a few hairs are dark on each foot, making a minute spot.

Skull.—Similar to that of *milleri*, but larger. “Low, with a flat superior profile. Palatal foramina short, barely reaching backward to the level of the front of *m*¹.”¹ More recently Mr. Thomas has compared the topotype series with specimens of *R. m. cherrii* and states:² “I can find no skull difference of any importance or constancy.”

Measurements.—Type (from dry skin): “Head and body, 72; tail (tip doubtfully perfect), 83; hind foot (wet) without claws, 19; ear (wet), 14. Skull: Back of parietal to nasal tip, 21.1; greatest breadth, 11.5; nasals 8.9 x 2.6; interorbital breadth, 3.7; palate from hensation, 9.2; diastema, 5.9; palatal foramina, 4.1 x 1.6; upper molar series, 3.8.”³ Skull of fully adult topotype (measured by Mr. Thomas): Greatest length 24.2; breadth of braincase, 11.5; length of nasals, 9.1; width of outer wall of anteorbital foramen, 1.9.

Remarks.—This species, so far as known, is the most southerly ranging member of the genus. I have not been able to examine the type series of 20 specimens in the British Museum, but I have seen a small series from southern Colombia, kindly loaned by Dr. Allen, and which both he and Mr. Thomas consider typical of this species. From an examination of this series it is clear that *söderströmi* is a member of the *mexicanus* group and rather closely related to *milleri*, but whether it is connected with the latter by intermediate forms can not at present be determined.

Its habits are described by Mr. L. Söderström, the collector of the type series, as follows: “Feeds on flowers and seeds in the gardens. Comes out from among the climbing plants every evening at about 7 p. m.”

Specimens examined.—Four, from Valle de las Papas, Huila, Colombia (central Andes, altitude 10,000 feet).⁴

REITHRODONTOMYS GRACILIS Allen & Chapman.

YUCATAN HARVEST MOUSE.

(Pl. III, fig. 7; Pl. VI, fig. 7.)

Reithrodontomys mexicanus gracilis Allen and Chapman, Bull. Am. Mus. Nat. Hist., IX, 1897, p. 9.

Type locality.—Chichen Itza, Yucatan, Mexico.

Distribution.—Yucatan and Campeche.

¹ Original description by Thomas.

² In epistle, Oct. 21, 1913.

³ Thomas, loc. cit.

⁴ Collection Am. Mus. Nat. Hist.

Characters.—Size small; similar in color to *R. m. goldmani*, but brighter; skull much smaller with narrow braincase.

Color.—Upperparts pinkish cinnamon, sparingly lined on dorsal surface with blackish brown; color brightest on sides next to the belly, sometimes forming an indistinct lateral line (as in the *fulvescens* group); ears dark hair-brown; tail fuscous, slightly paler beneath; fore feet buffy white; hind feet grayish white; ankles fuscous; underparts white, sometimes with a slight yellowish cast; less white on sides of nose than in *mexicanus* and *goldmani*.

Skull.—Decidedly smaller than that of either *mexicanus* or *goldmani*; similar in size and general proportions to that of *difficilis*, but differing in the characters of the subgenus; rostrum short and broad; braincase narrow and moderately flat; nasals short; zygomata nearly parallel to axis of skull (much less contracted anteriorly than in *mexicanus*); palatal foramina very short; bullæ rather small.

The outer wall of the anteorbital foramen, although much narrower than in skulls of *R. fulvescens difficilis*, is relatively broader than in the other members of the subgenus and may slightly exceed the width of the interpterygoid fossa. The subsidiary enamel loops are present on the upper molars, but the accessory tubercles are rather low.

Measurements.—Type (immature): Total length, 165; tail vertebrae, 98; hind foot, 16. Average of 2 topotypes (immature): 169; 100; 18. A somewhat older (subadult) specimen from Yohaltun, Campeche: 191; 113; 20. Skull: (See table, p. 81).

Remarks.—This is the smallest member of the *mexicanus* group. Externally it bears a striking resemblance to *R. fulvescens tenuis*, differing chiefly in darker and more nearly unicolor tail and more uniform ochraceous color (less grizzled with black) on the upperparts. In skull characters the two differ widely, *gracilis* clearly belonging in the subgenus *Aporodon*.

From *R. m. mexicanus*, its nearest relative, it differs in much smaller size, paler coloration, and narrower skull. Judging from the very limited material at hand, it seems to be specifically distinct from the other members of the group. One specimen from Yohaltun, Campeche, differs from the type series in being somewhat darker, with blacker, more nearly unicolor tail.

Specimens examined.—Total number, 9, from the following localities in Mexico:

Yucatan: Chichen Itza, 6;¹ Progreso, 1.

Campeche: Apazote, 1; Yohaltun, 1.

¹ Four in Collection Am. Mus. Nat. Hist.

REITHRODONTOMYS TENUIROSTRIS GROUP.

REITHRODONTOMYS TENUIROSTRIS TENUIROSTRIS Merriam.

WOOLY HARVEST MOUSE.

Reithrodontomys tenuirostris Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 547.

Type locality.—Todos Santos, Guatemala (altitude 10,000 feet).

Distribution.—Known only from the type locality.

Characters.—Size very large (equaling *R. hirsutus*, except in length of tail); pelage long, soft, and wooly; color rich tawny; tail unicolor; skull with much swollen braincase and narrow rostrum.

Color.—*Adults*: Upperparts deep tawny, darkest on the dorsal area where the color becomes hazel; an indistinct blackish ring around eye; underparts light pinkish cinnamon; ears and tail fuscous; ankles and hind feet clove-brown; tips of toes whitish; upper surface of fore feet hair-brown; toes buffy. *Young*: Upperparts Prout's brown, with a tinge of tawny; underparts paler than in the adult; toes buffy white.

Skull.—Braincase broad, much inflated, depressed posteriorly; anterior portion of frontals abruptly depressed, forming a shallow sulcus at posterior end of nasals; rostrum long and narrow; nasals narrowed to a point posteriorly, ending on a line with premaxillæ; zygomata slender, slightly contracted anteriorly; palatal foramina relatively short, not reaching plane of first molars; interpterygoid fossa broad (about as wide as outer wall of anteorbital foramen); bullæ small and rather flat.

Measurements.—Type (σ ad.): Total length, 210; tail vertebræ, 124; hind foot, 23. Skull: (See table, p. 81).

Remarks.—This is one of the largest and most striking members of the genus. Resembling *R. m. mexicanus* in the color of the upperparts, it is readily distinguished by its cinnamon belly. Its skull is so peculiar that it is placed in a different group from the latter.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS TENUIROSTRIS AUREUS Merriam.

CALEL HARVEST MOUSE.

(Pl. III, fig. 8; Pl. VI, fig. 8; Pl. VII, fig. 2.)

Reithrodontomys tenuirostris aureus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 548.

Type locality.—Calel, Guatemala (altitude 10,200 feet).

Distribution.—Known only from the type locality.

Characters.—Slightly smaller and paler than *tenuirostris*.

Color.—*Adults*: Upperparts ochraceous-tawny moderately darkened on dorsal area with black; underparts light ochraceous-buff (a little yellower than in *tenuirostris*); ears fuscous-black; tail fuscous, slightly paler beneath; fore feet dark hair-brown; hind feet clove-brown, both edged with white; toes whitish. *Young*: Upper-

parts Prout's brown, faintly tinged with ochraceous; underparts white.

Skull.—Slightly smaller than that of *tenuirostris*, with flatter braincase and more inflated bullæ; palatal foramina longer and slightly broader, extending behind plane of first molars.

Measurements.—Adult female: Total length, 196; tail vertebræ, 112 hind foot, 22.5. Skull: (See table, p. 81).

Remarks.—This subspecies lives at about the same altitude as does *tenuirostris* and only a short distance away. With the very limited amount of material at hand, it is impossible to say whether the characters distinguishing the two forms will prove to be constant.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS CREPER Bangs.

CHIRIQUI HARVEST MOUSE.

Reithrodontomys creper Bangs, Bull. Mus. Comp. Zool., XXXIX, 1902, p. 39.

Type locality.—Volcan de Chiriqui, Panama (altitude, 11,000 feet).

Distribution.—Known only from the type locality.

Characters.—Size large; colors very dark (similar to *R. a. australis* above, but darker beneath); skull similar to that of *R. t. tenuirostris*, but smaller.

Color.¹—Type: Upperparts mummy-brown, varying on sides to Mars brown; sides of face blackish; underparts russet; ears dark sepia; tail dusky—almost clove-brown—all around, except terminal fourth which is whitish; feet whitish, palest on toes.

Skull.—Similar in shape to that of *R. t. tenuirostris*, but smaller; braincase narrowed posteriorly; palatal foramina expanded in the middle, narrowing anteriorly; zygomata much contracted anteriorly. Compared with *R. t. aureus*: Skull slightly shorter and much narrower; bullæ smaller.

Measurements.—Type (♀ ad.): Total length, 215; tail vertebræ, 130; hind foot, 23. Skull: (See table, p. 81).

Remarks.—This very distinct species is known only from a single specimen, "caught on the cold barren summit of the Volcan de Chiriqui".² It seems to be nearest related to *R. tenuirostris*, from Guatemala.

Specimen examined.—One, the type.³

¹ Comparisons with Ridgway's "Nomenclature of Colors" (1886).

² Bangs, loc. cit.

³ Collection Mus. Comp. Zool.

REITHRODONTOMYS MICRODON MICRODON Merriam.

SMALL-TOOTHED HARVEST MOUSE.

(Pl. III, fig. 9; Pl. VI, fig. 9.)

Reithrodontomys microdon Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 548.*Type locality*.—Todos Santos, Guatemala.*Distribution*.—Highlands of Guatemala; limits unknown.*Characters*.—Closely similar in color to *R. t. tenuirostris*, but very much smaller.*Color*.—*Adults*: Upperparts tawny, brighter on the sides next to the belly, darkened on back and head with black, where the tone becomes hazel; blackish ring around eye; underparts light pinkish cinnamon; ears and tail fuscous, the latter slightly paler beneath; hind feet dark hair-brown edged with whitish; toes white; fore feet buffy white with a patch of dusky. *Subadults*: Upperparts browner (about Prout's brown) and less mixed with tawny; underparts white.*Skull*.—Similar in general shape to that of *R. t. tenuirostris*, but very much smaller; braincase moderately inflated, narrowed and depressed posteriorly; zygomata slender, decidedly contracted anteriorly; rostrum narrow; palatal foramina ending on plane of front molars; interpterygoid fossa very broad; bullæ rather large and inflated; outer wall of anteorbital foramen very narrow.*Measurements*.—Type (♀ ad.): Total length, 185; tail vertebræ, 113; hind foot, 21. Topotype (♂ subadult): 180; 112; 21. Skull: (See table, p. 81).*Remarks*.—This little species is in every way a miniature of the large *tenuirostris*, which lives in the same region.*Specimens examined*.—Total number, 3, from the following localities:

Guatemala: Todos Santos, 2; Volcan Santa Maria 1.

REITHRODONTOMYS MICRODON ALBILABRIS Merriam.

WHITE-LIPPED HARVEST MOUSE.

Reithrodontomys microdon albilabris Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 549.*Type locality*.—Cerro San Felipe, Oaxaca, Mexico (altitude, 10,000 feet).*Distribution*.—Known only from the type locality.*Characters*.—Similar to *microdon*, but paler; underparts white; closely similar in color to *R. mexicanus goldmani*.*Color*.—Upperparts pinkish cinnamon, darkened on dorsal area with black, where the tone becomes snuff-brown; blackish ring around eye; ears, tail, and hind feet fuscous, the last edged with whitish; toes whitish; fore feet buffy, with a dusky patch; underparts white.*Skull*.—Very similar to that of *microdon*; braincase slightly broader and more inflated; interpterygoid fossa narrower; bullæ slightly smaller; nasals ending on a line with premaxillæ; zygomata decidedly

contracted anteriorly; palatal foramina short, not reaching plane of molars.

Measurements.—Type (♀ ad.): Total length, 187; tail vertebræ, 117; hind foot, 20. Skull: (See table below).

Remarks.—This form is closely related to *microdon*, differing chiefly in paler coloration.

Specimen examined.—One, the type.

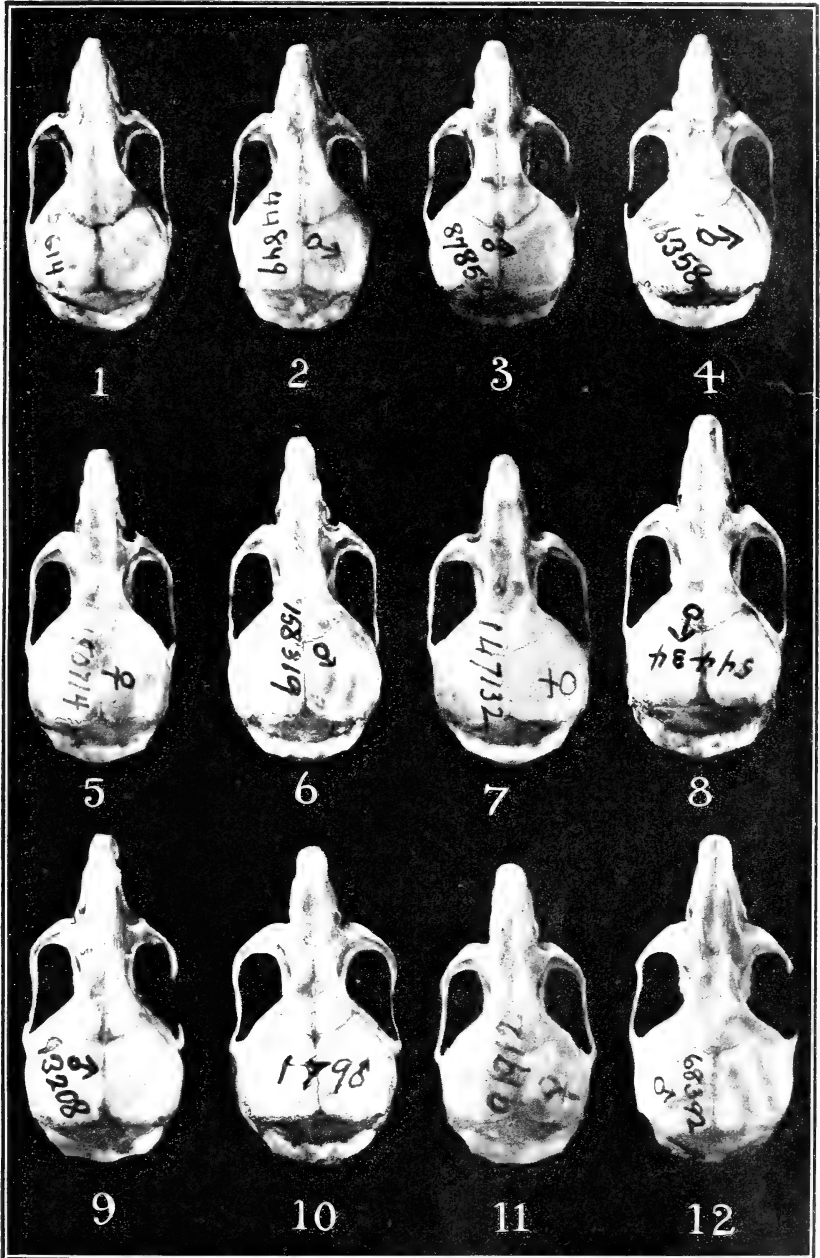
Average cranial measurements of Reithrodontomys.

Species.	Number averaged.	Localities.	Greatest length.	Breadth of brain-case.	Length of nasals.	Width of outer wall of anteorbital foramen.
<i>R. humulis humulis</i>	8	North Carolina; South Carolina; Georgia...	10.4	9.3	6.4	1.9
<i>R. humulis impiger</i>	4	West Virginia; White Sulphur Springs.....	19.4	9.2	6.4	1.7
<i>R. humulis merriami</i>	6	Texas: Austin Bayou; Louisiana: Lafayette.	19	9.3	6.9	2.1
<i>R. albescens albescens</i>	5	Nebraska; South Dakota.....	19.5	9.6	7.3	2.2
<i>R. albescens griseus</i>	4	Texas: San Antonio, San Angelo.....	19.3	9.3	7.2	1.9
<i>R. montanus</i>	4	Colorado: San Luis Valley.....	20	9.4	7.9	2.1
<i>R. megalotis megalotis</i>	6	New Mexico (southern); Chihuahua.....	20.7	9.9	7.5	2.1
<i>R. megalotis aztecus</i>	4	New Mexico: La Plata, Aztec, Guadalupita.	22.1	10.5	8.5	2.2
<i>R. megalotis dychei</i>	11	Kansas: Lawrence, Onaga.....	20.6	10.1	7.8	2.1
<i>R. megalotis nigrescens</i>	6	Idaho: Payette, Weiser, Nampa.....	20.8	9.9	8	1.9
<i>R. megalotis longicaudus</i>	12	California: Vicinity of San Francisco Bay.	20.2	9.8	7.7	2
<i>R. megalotis peninsulæ</i>	4	Lower California: San Quintin, Rosario.	20.7	10.2	8.1	1.9
<i>R. megalotis cinereus</i>	4	Puebla: Chalchicomula.....	21.6	10.3	8.2	2.2
<i>R. megalotis saturatus</i>	8	Vera Cruz: Las Vigas.....	22.5	10.4	8.7	2.2
<i>R. megalotis alicolicus</i>	1	Oaxaca: Cerro San Felipe.....	22.4	10.5	8.5	2.3
<i>R. megalotis arizonensis</i>	2	Arizona: Chiricalhua Mountains.....	20.4	9.9	7.5	1.9
<i>R. megalotis zacatecæ</i>	3	Zacatecas: Valparaiso Mountains.....	20.5	9.9	8.2	1.9
<i>R. amoles</i>	1	Queretaro: Pinal de Amoles.....	19.8	9.5	7.6	1.7
<i>R. catalina</i>	5	California: Catalina Island.....	21.9	10.3	8.8	2.3
<i>R. raviventris raviventris</i>	6	California: San Francisco Bay.....	21.2	10.2	7.6	2.1
<i>R. raviventris haliacates</i>	7	California: Petaluma (marshes).....	20.8	10.1	7.5	2
<i>R. fulvescens fulvescens</i>	3	Sonora: Oposura, Providencia Mines.....	21.6	10.3	8.2	2
<i>R. fulvescens tenuis</i>	6	Sinaloa: Mazatlan, Sinaloa, Escuinapa.....	21.9	10.2	8.3	2
<i>R. fulvescens intermedius</i>	6	Texas: Brownsville; Tamaulipas.....	21.9	10.3	8.5	2
<i>R. fulvescens aurantius</i>	7	Texas and Louisiana.....	22.2	10.5	8.5	2.2
<i>R. fulvescens difficilis</i>	6	Vera Cruz: Orizaba, Jalapa.....	21.8	10.5	7.8	1.9
<i>R. fulvescens toltecus</i>	2	Mexico: Tlalpam, D. F.....	23.4	10.7	9.4	2.1
<i>R. fulvescens helvolus</i>	7	Oaxaca: Oaxaca.....	22.4	10.6	8.5	2.1
<i>R. fulvescens chiapensis</i>	4	Chiapas: Canjob.....	22.4	10.7	8.1	2
<i>R. fulvescens nelsoni</i>	4	Colima: Colima.....	21.2	10	8	1.8
<i>R. fulvescens mustelinus</i>	1	Oaxaca: Llano Grande.....	22.3	10.4	9	2.2
<i>R. amoenus</i>	2	Oaxaca: Reforma.....	19.5	10.3	7.7	1.8
<i>R. otus</i>	1	Jalisco: Sierra Nevada de Colima.....	23.8	11	9.3	2.1
<i>R. rufescens rufescens</i>	8	Vera Cruz: Jalapa, Jico.....	23.6	10.9	9	2.1
<i>R. rufescens luteolus</i>	3	Oaxaca: Juquila.....	23.9	11.1	9.1	2.2
<i>R. alleni</i>	1	Oaxaca: Mountains near Ozolotepec.....	.....	.....	9	2.1
<i>R. colimæ colimæ</i>	1	Jalisco: Sierra Nevada de Colima.....	23.2	11.3	10.1	1.9
<i>R. colimæ nerterus</i>	1	.....do.....	22.6	11	8.4	2.2
<i>R. dorsalis</i>	4	Guatemala: Cael.....	23	10.6	9	2.1
<i>R. australis australis</i>	5	Costa Rica: Volcan Irazu.....	22.5	10.7	8.2	1.8
<i>R. australis modestus</i>	1	Nicaragua: Jinotega.....	21	10.5	7.8	1.8
<i>R. leupes</i>	3	Jalisco: San Sebastian.....	22.7	11.4	7.9	1.9
<i>R. hirsutus</i>	4	Jalisco: Ameza.....	24.9	11.8	8.9	2
<i>R. chrysopsis chrysopsis</i>	5	Mexico (State) and Morelos.....	24.3	11.7	9.3	2.2
<i>R. chrysopsis tolucæ</i>	1	Mexico: Volcan Toluca.....	24	11.5	9.3	2.2
<i>R. chrysopsis orizabæ</i>	1	Puebla: Mount Orizaba.....	.....	10.7	9	2
<i>R. perotensis</i>	1	Vera Cruz: Cofre de Perote.....	23.2	11	9.1	2
<i>R. mexicanus mexicanus</i>	5	Vera Cruz; Oaxaca; Guatemala.....	23.1	11.3	8.7	1.8
<i>R. mexicanus goldmani</i>	1	Puebla: Metlatoyuca.....	24	11.5	9.5	1.7
<i>R. mexicanus cherrii</i>	6	Costa Rica: La Carpintera, San Pedro.....	23.7	11.7	8.1	1.7
<i>R. milleri</i>	1	Colombia: Munchique.....	22.5	11.2	7.6	1.4
<i>R. söderströmi</i>	2	Ecuador: Quito.....	24.2	11.5	9	1.8
<i>R. gracilis</i>	3	Yucatan: Chichen Itza; Campeche: Yohaltun.	21.6	10.5	7.5	1.7
<i>R. tenuirostris tenuirostris</i>	1	Guatemala: Todos Santos.....	25.7	12.5	9.1	1.7
<i>R. tenuirostris aureus</i>	1	Guatemala: Cael.....	25.2	12.1	9.6	1.7
<i>R. creper</i>	1	Panama: Volcan de Chiriqui.....	25.4	11.6	8.8	1.9
<i>R. microdon microdon</i>	3	Guatemala: Todos Santos, Volcan Santa Maria.	22.3	11.1	8.5	1.3
<i>R. microdon albilabris</i>	1	Oaxaca: Cerro San Felipe.....	22.3	11.4	7.8	1.3

PLATE I.

[Twice natural size.]

- FIG. 1. *Reithrodontomys humulis humulis*. Raleigh, N. C. (No. 189304, U. S. Nat. Mus., Merriam Coll.)
2. *Reithrodontomys humulis merriami*. Austin Bayou, Tex. (No. 44849, U. S. Nat. Mus., Biological Survey Coll.)
3. *Reithrodontomys albescens griseus*. Type, San Antonio, Tex. (No. 87852, U. S. Nat. Mus., Biological Survey Coll.)
4. *Reithrodontomys albescens albescens*. Type, Kennedy, Nebr. (No. 116358, U. S. Nat. Mus., Biological Survey Coll.)
5. *Reithrodontomys montanus*. Medano Ranch, Costilla County, Colo. (No. 150714, U. S. Nat. Mus., Biological Survey Coll.)
6. *Reithrodontomys megalotis megalotis*. Dry Creek, Socorro County, N. Mex. (No. 158319, U. S. Nat. Mus., Biological Survey Coll.)
7. *Reithrodontomys megalotis dychei*. Onaga, Kans. (No. 147132, U. S. Nat. Mus., Biological Survey Coll.)
8. *Reithrodontomys megalotis saturatus*. Las Vigas, Vera Cruz. (No. 54434, U. S. Nat. Mus., Biological Survey Coll.)
9. *Reithrodontomys raviventris raviventris*. Berkeley, Cal. (No. 93208, U. S. Nat. Mus., Biological Survey Coll.)
10. *Reithrodontomys raviventris halicætes*. Type, Petaluma, Cal. (No. 7146, Mus. Vert. Zool., Univ. California.)
11. *Reithrodontomys megalotis zacatecæ*. Valparaiso Mountains, Zacatecas. (No. 91912, U. S. Nat. Mus., Biological Survey Coll.)
12. *Reithrodontomys megalotis alticolus*. Type, Cerro San Felipe, Oaxaca. (No. 68392, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

- 1. *R. h. humulis*.
- 2. *R. h. merriami*.
- 3. *R. a. griseus*.
- 4. *R. a. albescens*.

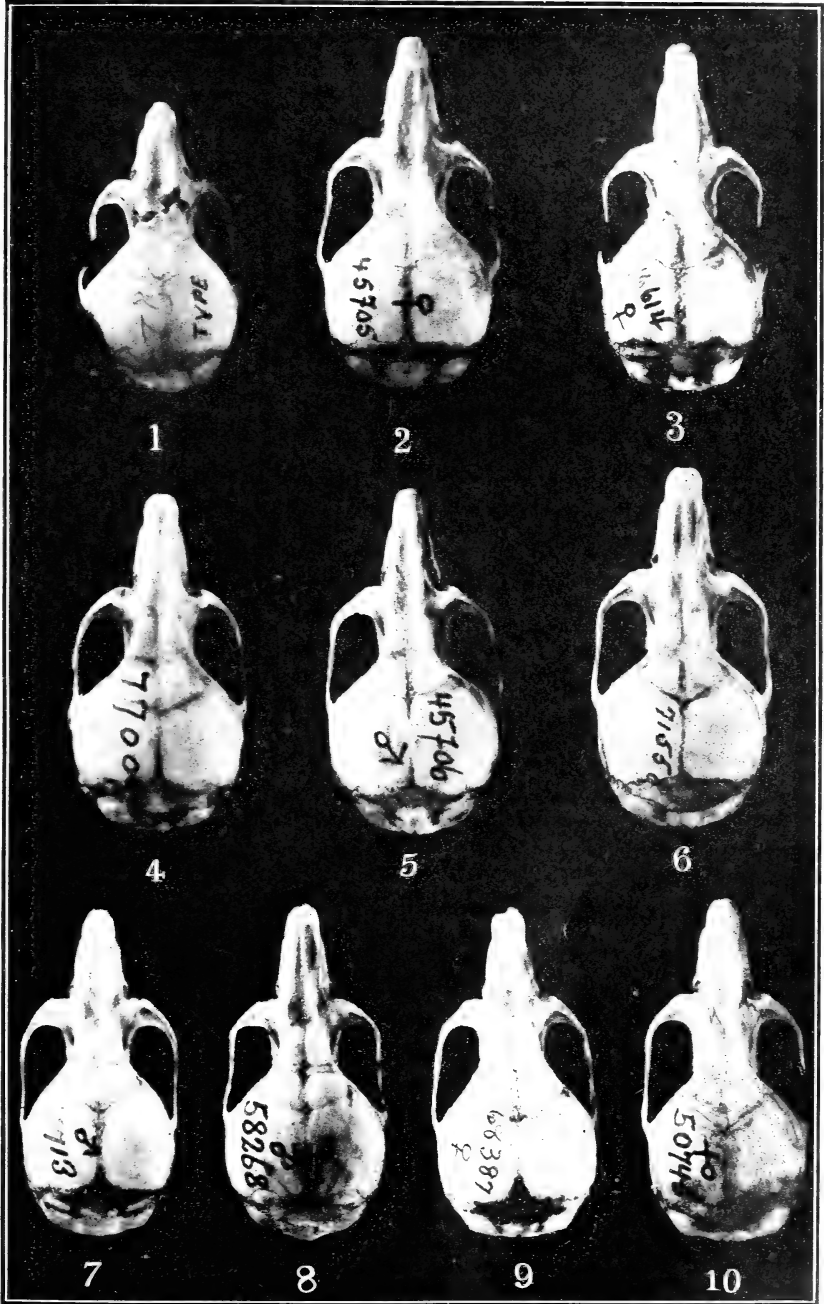
- 5. *R. montanus*.
- 6. *R. m. megalotis*.
- 7. *R. m. dychei*.
- 8. *R. m. saturatus*.

- 9. *R. r. raviventris*.
- 10. *R. r. hallicetes*.
- 11. *R. m. za'atecae*.
- 12. *R. m. alticola*.

PLATE II.

[Twice natural size.]

- FIG. 1. *Reithrodontomys amoenus*. Type, Reforma, Oaxaca. (No. 14064, Field Mus. Nat. Hist.)
2. *Reithrodontomys otus*. Type, Sierra Nevada de Colima, Jalisco. No. 45705, U. S. Nat. Mus., Biological Survey Coll.)
3. *Reithrodontomys australis australis*. Volcan Irazu, Costa Rica. (No. 116614, U. S. Nat. Mus., Biological Survey Coll.)
4. *Reithrodontomys dorsalis*. Type, Calel, Guatemala. (No. 77009, U. S. Nat. Mus., Biological Survey Coll.)
5. *Reithrodontomys colimæ colimæ*. Type, Sierra Nevada de Colima, Jalisco. (No. 45706, U. S. Nat. Mus., Biological Survey Coll.)
6. *Reithrodontomys rufescens luteolus*. Type, Juquila, Oaxaca. (No. 71558, U. S. Nat. Mus., Biological Survey Coll.)
7. *Reithrodontomys fulvescens tenuis*. Mazatlan, Sinaloa. (No. 96713, U. S. Nat. Mus., Biological Survey Coll.)
8. *Reithrodontomys fulvescens difficilis*. Orizaba, Vera Cruz. (No. 58268, U. S. Nat. Mus., Biological Survey Coll.)
9. *Reithrodontomys fulvescens kelvolus*. Type, Oaxaca, Oaxaca. (No. 68387, U. S. Nat. Mus., Biological Survey Coll.)
10. *Reithrodontomys fulvescens toltecus*. Type, TlaIpam, D. F., Mexico. (No. 50746, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

- 1. *R. amoenus*.
- 2. *R. otus*.
- 3. *R. a. australis*.
- 4. *R. dorsalis*.

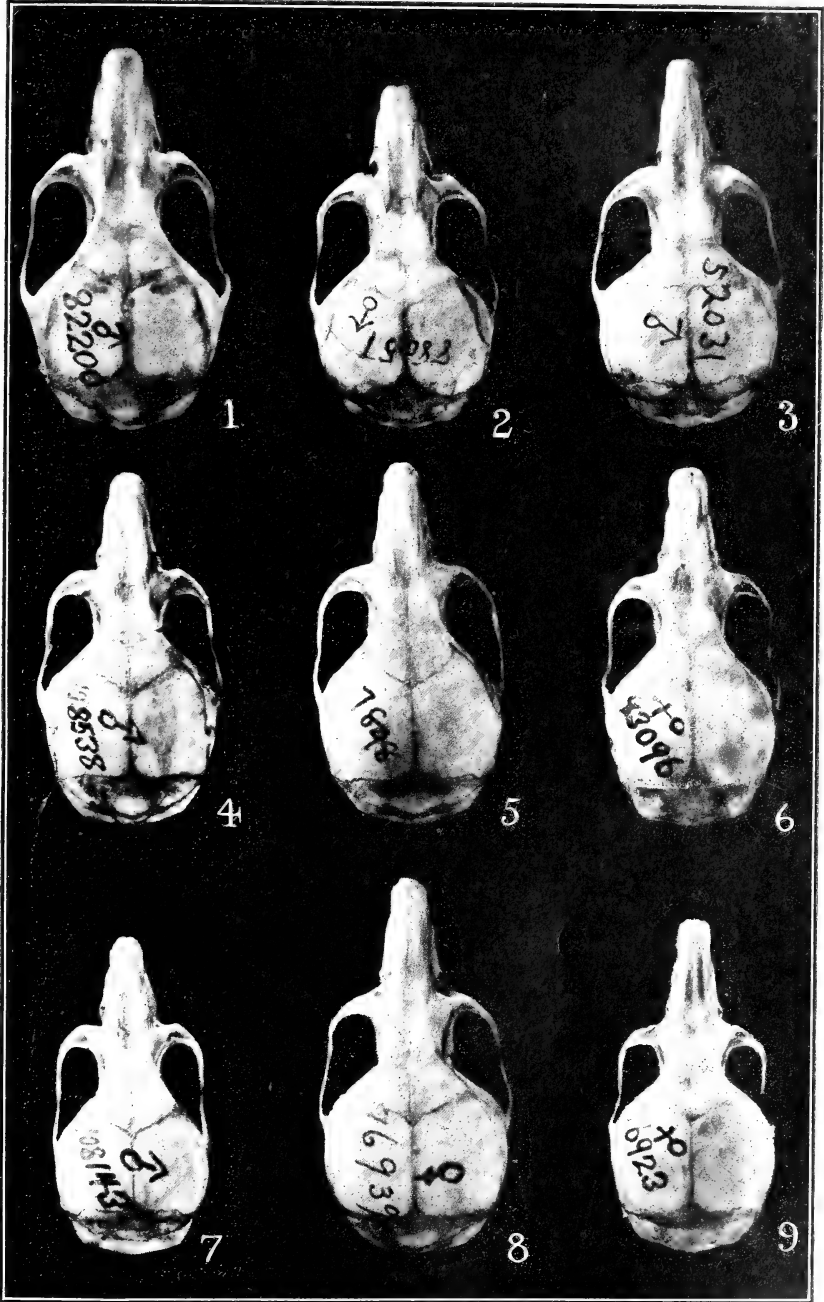
- 5. *R. e. colima*.
- 6. *R. r. luteolus*.
- 7. *R. f. tenuis*.

- 8. *R. f. dimidiellus*.
- 9. *R. f. helvolus*.
- 10. *R. f. toltecus*.

PLATE III.

[Twice natural size.]

- FIG. 1. *Reithrodontomys hirsutus*. Type, Ameca, Jalisco. (No. 82200, U. S. Nat. Mus., Biological Survey Coll.)
2. *Reithrodontomys levipes*. Type, San Sebastian, Jalisco. (No. 88057, U. S. Nat. Mus., Biological Survey Coll.)
3. *Reithrodontomys chrysopsis chrysopsis*. Type, Mount Popocatepetl, Mexico. (No. 52031, U. S. Nat. Mus., Biological Survey Coll.)
4. *Reithrodontomys mexicanus mexicanus*. Jalapa, Vera Cruz. (No. 108538, U. S. Nat. Mus., Biological Survey Coll.)
5. *Reithrodontomys mexicanus cherrii*. La Carpintera, Costa Rica. (No. 7898, Am. Mus. Nat. Hist.)
6. *Reithrodontomys mexicanus goldmani*. Type, Metlatoyuca, Puebla. (No. 93096, U. S. Nat. Mus., Biological Survey Coll.)
7. *Reithrodontomys gracilis*. Chichen Itza, Yucatan. (No. 108143, U. S. Nat. Mus., Biological Survey Coll.)
8. *Reithrodontomys tenuirostris aureus*. Type, Calel, Guatemala. (No. 76939, U. S. Nat. Mus., Biological Survey Coll.)
9. *Reithrodontomys microdon microdon*. Type, Todos Santos, Guatemala. (No. 76923, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

- 1. *R. hirsutus*.
- 2. *R. levipes*.
- 3. *R. c. chrysoptis*.

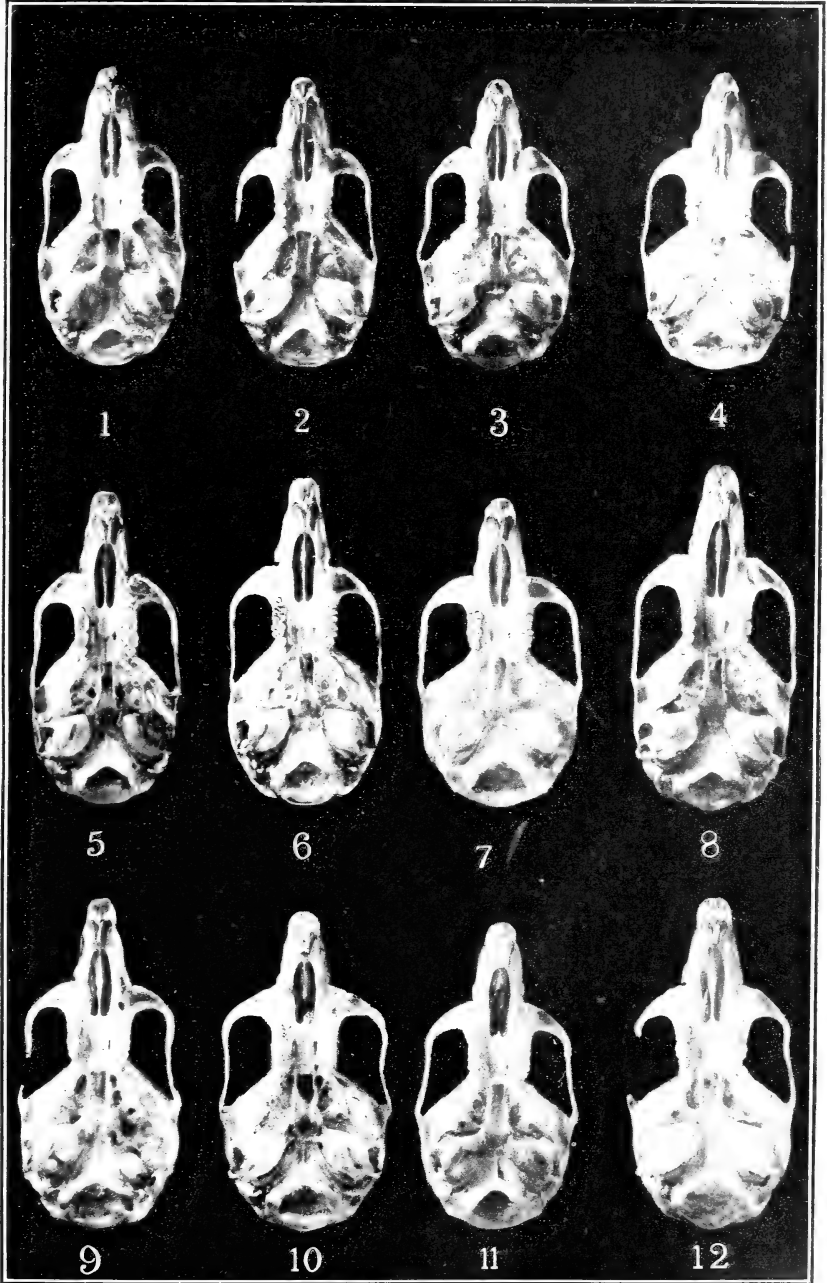
- 4. *R. m. mexicanus*.
- 5. *R. m. cherrii*.
- 6. *R. m. goldmani*.

- 7. *R. gracilis*.
- 8. *R. t. aureus*.
- 9. *R. m. microdon*.

PLATE IV.

[Twice natural size.]

1. *Reithrodontomys humulis humulis*. Raleigh, N. C. (No. 189304, U. S. Nat. Mus., Merriam Coll.)
2. *Reithrodontomys humulis merriami*. Austin Bayou, Tex. (No. 44849, U. S. Nat. Mus., Biological Survey Coll.)
3. *Reithrodontomys albescens griseus*. Type, San Antonio, Tex. (No. 87852, U. S. Nat. Mus., Biological Survey Coll.)
4. *Reithrodontomys albescens albescens*. Type, Kennedy, Nebr. (No. 116358, U. S. Nat. Mus., Biological Survey Coll.)
5. *Reithrodontomys montanus*. Medano Ranch, Costilla County, Colo. (No. 150714, U. S. Nat. Mus., Biological Survey Coll.)
6. *Reithrodontomys megalotis megalotis*. Dry Creek, Socorro County, N. Mex. (No. 158319, U. S. Nat. Mus., Biological Survey Coll.)
7. *Reithrodontomys megalotis dychei*. Onaga, Kans. (No. 147132, U. S. Nat. Mus., Biological Survey Coll.)
8. *Reithrodontomys megalotis saturatus*. Las Vigas, Vera Cruz. (No. 54434, U. S. Nat. Mus., Biological Survey Coll.)
9. *Reithrodontomys raviventris raviventris*. Berkeley, Cal. (No. 93208, U. S. Nat. Mus., Biological Survey Coll.)
10. *Reithrodontomys raviventris haliçetes*. Type, Petaluma, Cal. (No. 7146, Mus. Vert. Zool., Univ. California.)
11. *Reithrodontomys megalotis zacatecæ*. Valparaiso Mountains, Zacatecas. (No. 91912, U. S. Nat. Mus., Biological Survey Coll.)
12. *Reithrodontomys megalotis alticolus*. Type, Cerro San Felipe, Oaxaca. (No. 68392, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

- 1. *R. h. humulis.*
- 2. *R. h. merriami.*
- 3. *R. a. griseus.*
- 4. *R. a. albescens.*

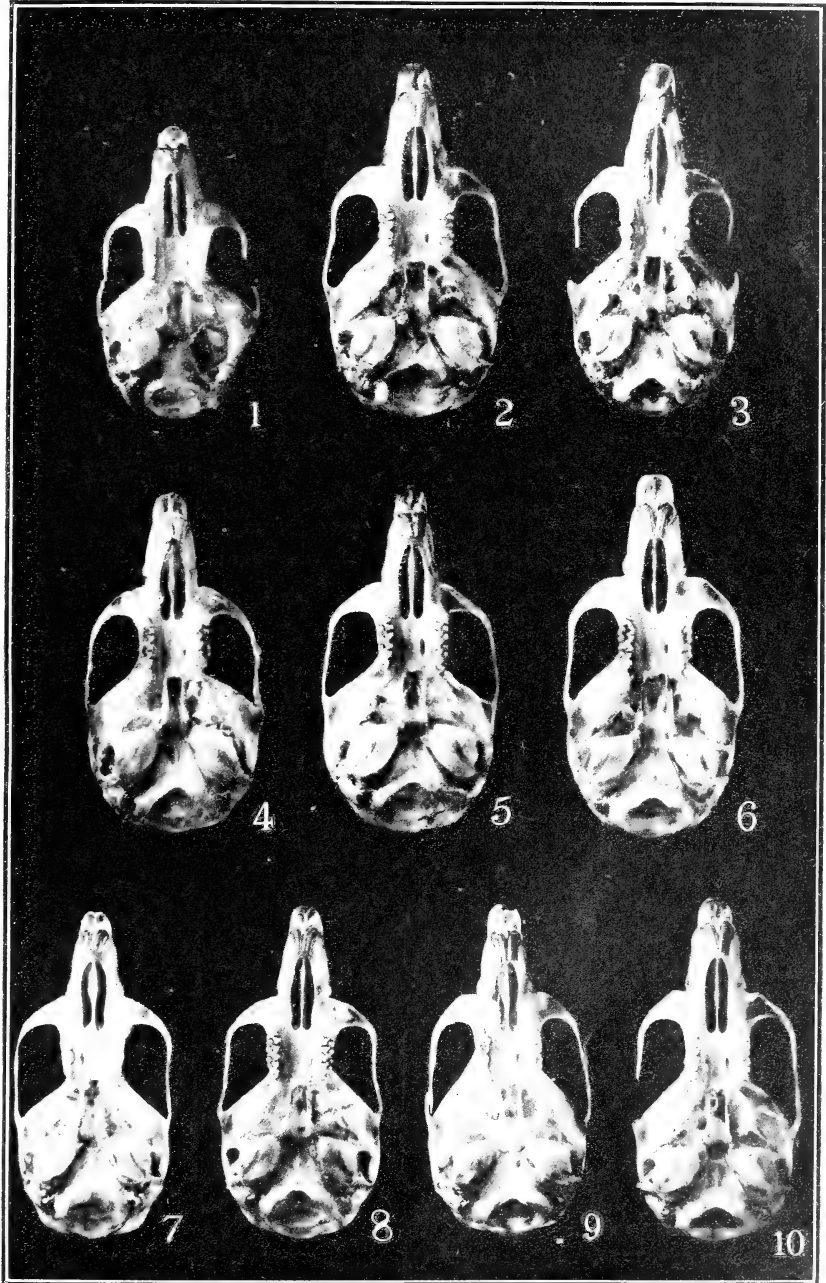
- 5. *R. montanus.*
- 6. *R. m. megalotis.*
- 7. *R. m. dychei.*
- 8. *R. m. saturatus.*

- 9. *R. r. raviventris.*
- 10. *R. r. salicetes.*
- 11. *R. m. zacatecae.*
- 12. *R. m. alticolaus.*

PLATE V.

[Twice natural size.]

- FIG. 1. *Reithrodontomys amœnus*. Type, Reforma, Oaxaca. (No. 14064, Field Mus. Nat. Hist.)
2. *Reithrodontomys otus*. Type, Sierra Nevada de Colima, Jalisco. (No. 45705, U. S. Nat. Mus., Biological Survey Coll.)
3. *Reithrodontomys australis*. Volcan Irazu, Costa Rica. (No. 116614, U. S. Nat. Mus., Biological Survey Coll.)
4. *Reithrodontomys dorsalis*. Type, Calel, Guatemala. (No. 77009, U. S. Nat. Mus., Biological Survey Coll.)
5. *Reithrodontomys colimæ colimæ*. Type, Sierra Nevada de Colima, Jalisco. (No. 45706, U. S. Nat. Mus., Biological Survey Coll.)
6. *Reithrodontomys rufescens luteolus*. Type, Juquila, Oaxaca. (No. 71558, U. S. Nat. Mus., Biological Survey Coll.)
7. *Reithrodontomys fulvescens tenuis*. Mazatlan, Sinaloa. (No. 96713, U. S. Nat. Mus., Biological Survey Coll.)
8. *Reithrodontomys fulvescens difficilis*. Orizaba, Vera Cruz. (No. 58268, U. S. Nat. Mus., Biological Survey Coll.)
9. *Reithrodontomys fulvescens helvolus*. Type, Oaxaca, Oaxaca. (No. 68387, U. S. Nat. Mus., Biological Survey Coll.)
10. *Reithrodontomys fulvescens toltecus*. Type, Tlalpam, D. F., Mexico. (No. 50746, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

1. *R. amoenus*.
2. *R. otus*.
3. *R. australis*.
4. *R. dorsalis*.

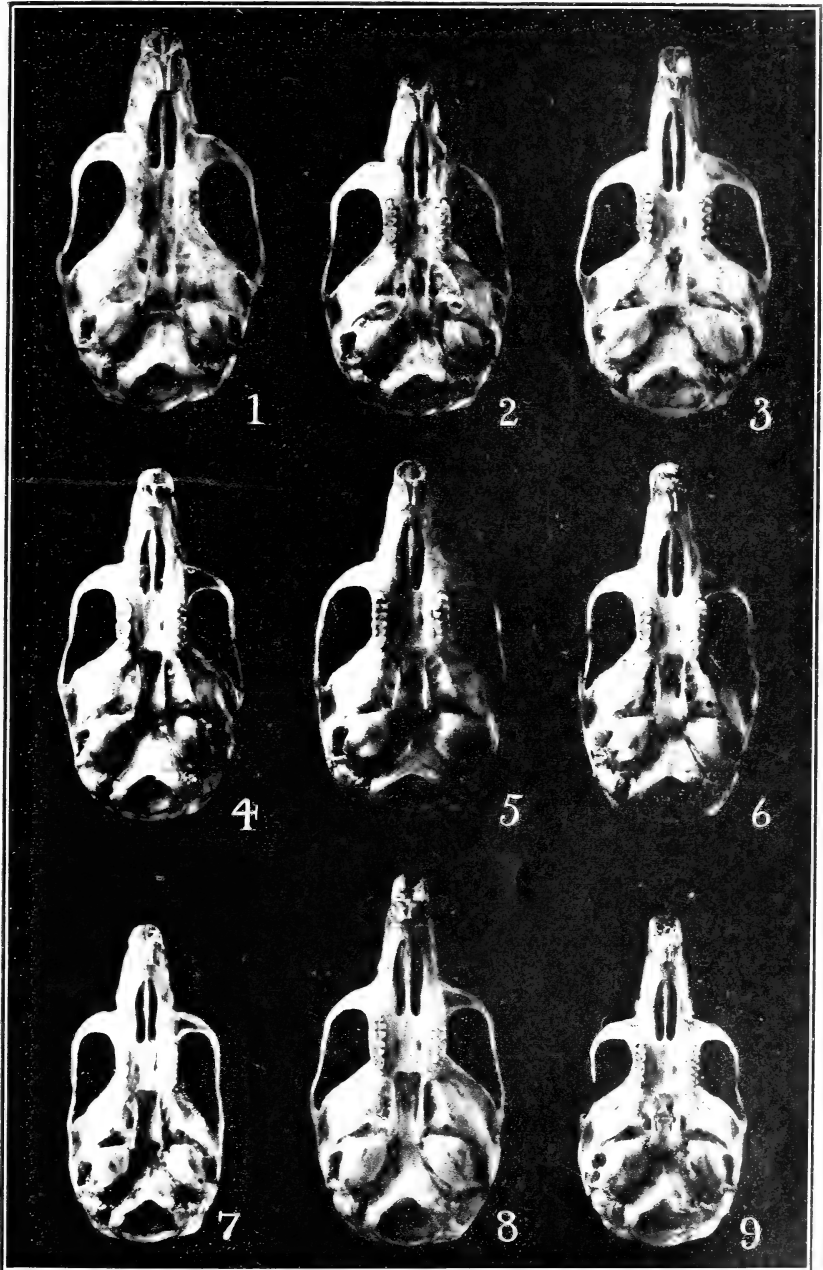
5. *R. c. colima*.
6. *R. r. lutosus*.
7. *R. f. tenuis*.

8. *R. f. dipilellis*.
9. *R. f. helyvols*.
10. *R. f. toltecus*.

PLATE VI.

[Twice natural size.]

- FIG. 1. *Reithrodontomys hirsutus*. Type, Ameca, Jalisco. (No. 82200, U. S. Nat. Mus., Biological Survey Coll.)
2. *Reithrodontomys levipes*. Type, San Sebastian, Jalisco. (No. 88057, U. S. Nat. Mus., Biological Survey Coll.)
3. *Reithrodontomys chrysopsis chrysopsis*. Type, Mount Popocatepetl, Mexico. (No. 52031, U. S. Nat. Mus., Biological Survey Coll.)
4. *Reithrodontomys mexicanus mexicanus*. Jalapa, Vera Cruz. (No. 108538, U. S. Nat. Mus., Biological Survey Coll.)
5. *Reithrodontomys mexicanus cherrii*. La Carpintera, Costa Rica. (No. 7898, Am. Mus. Nat. Hist.)
6. *Reithrodontomys mexicanus goldmani*. Type, Metlatoyuca, Puebla. (No. 93096, U. S. Nat. Mus., Biological Survey Coll.)
7. *Reithrodontomys gracilis*. Chichen Itza, Yucatan. (No. 108143, U. S. Nat. Mus., Biological Survey Coll.)
8. *Reithrodontomys tenuirostris aureus*. Type, Calel, Guatemala. (No. 76939, U. S. Nat. Mus., Biological Survey Coll.)
9. *Reithrodontomys microndon microndon*. Type, Todos Santos, Guatemala. (No. 76923, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

- 1. *R. hirsutus*.
- 2. *R. levipes*.
- 3. *R. c. chrysoptis*.

- 4. *R. m. mexicanus*.
- 5. *R. m. cherrii*.
- 6. *R. m. goldmani*.

- 7. *R. gracilis*.
- 8. *R. t. aureus*.
- 9. *R. m. microdon*.

PLATE VII.

[Teeth about 10 times natural size; skulls twice natural size.]

Figs. 1, 7. *Reithrodontomys (Reithrodontomys) megalotis megalotis*.

Fig. 1. Side view of upper molars. (No. 167353, U. S. Nat. Mus., Biological Survey Coll.)

Fig. 7. Worn crowns of upper molars. (No. 58090, U. S. Nat. Mus., Biological Survey Coll.)

2. *Reithrodontomys (Aporodon) tenuirostris aureus*. Side view of upper molars. (No. 77008, U. S. Nat. Mus., Biological Survey Coll.)

3, 5. *Reithrodontomys (Aporodon) levipes*.

Fig. 3. Worn crowns of lower molars. (No. 88057, U. S. Nat. Mus., Biological Survey Coll.)

Fig. 5. Worn crowns of upper molars. (No. 88057, U. S. Nat. Mus., Biological Survey Coll.)

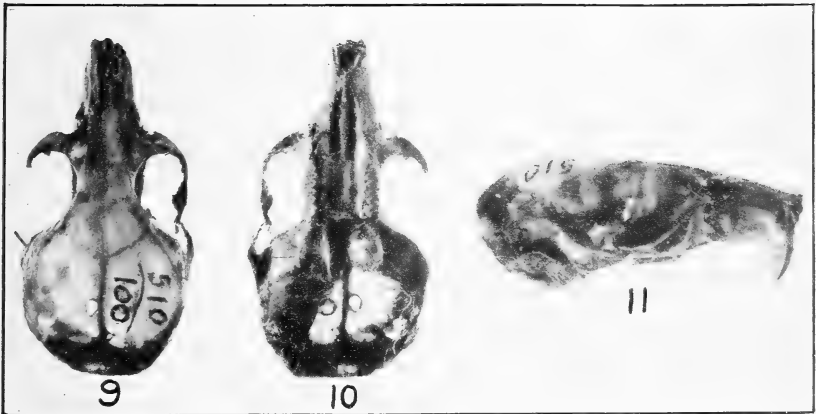
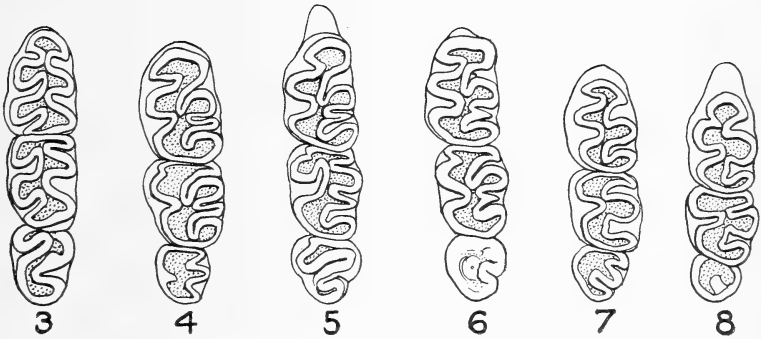
4, 9, 10, 11. *Reithrodontomys (Aporodon) mexicanus mexicanus*.

Fig. 4. Worn crowns of upper molars. (No. 68684, U. S. Nat. Mus., Biological Survey Coll.)

Figs. 9, 10, 11. Skull of type. (No. $\frac{510}{100}$, Geneva Museum.)

6. *Reithrodontomys (Aporodon) chrysopsis chrysopsis*. Worn crowns of upper molars. (No. 125883, U. S. Nat. Mus., Biological Survey Coll.)

8. *Reithrodontomys (Reithrodontomys) humulis merriami*. Worn crowns of upper molars. (No. 178261, U. S. Nat. Mus., Biological Survey Coll.)



MOLAR TEETH AND SKULLS OF REITHRODONTOMYS.

1. *R. m. megalotis*.
2. *R. t. aureus*.
3. *R. levipes*.

4. *R. m. mexicanus*.
5. *R. levipes*.
6. *R. c. chrysoptis*.

7. *R. m. megalotis*.
8. *R. h. merriami*.
9, 10, 11. *R. m. mexicanus*.

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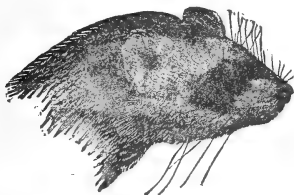
U. S. DEPARTMENT OF AGRICULTURE

BUREAU OF BIOLOGICAL SURVEY

HENRY W. HENSHAW, *Chief*

NORTH AMERICAN FAUNA
No. 37

[Actual date of publication, April 7, 1915]



REVISION OF THE AMERICAN MARMOTS

BY

ARTHUR H. HOWELL

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY



WASHINGTON
GOVERNMENT PRINTING OFFICE

1915



GOLDEN-MANTLED MARMOT (*MARMOTA FLAVIVENTRIS NOSOPHORA*).

[From life; Florence, Mont., April, 1910.]

U. S. DEPARTMENT OF AGRICULTURE

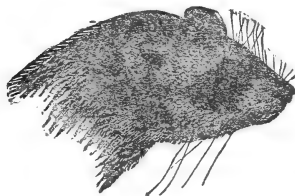
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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., October 21, 1914.

SIR: I have the honor to transmit herewith for publication as North American Fauna No. 37 a revision of the American marmots, by Arthur H. Howell, assistant biologist of the Biological Survey.

Although marmots are found over most of the United States and Canada, the relationships and ranges of the several species until now have been very imperfectly known. The present report furnishes descriptions of 26 forms and contains a series of maps showing their geographic distribution. In many localities marmots are a decided pest to agriculture, especially in the East, both because they are destructive to crops and because their burrows seriously interfere with farming operations. Moreover, marmots are known to carry the germs of Rocky Mountain spotted fever and other diseases. The animals are hence of considerable economic importance.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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REVISION OF THE AMERICAN MARMOTS.

By ARTHUR H. HOWELL.

INTRODUCTION.

The American marmots, more often called woodchucks or ground hogs, are among the best known of our native wild mammals. They naturally divide into three distinct groups: (1) The woodchucks (*Marmota monax* group) of eastern United States and Canada; (2) the yellow-footed marmots (*M. flaviventris* group) of western United States and southern British Columbia; and (3) the hoary marmots (*M. caligata* group), chiefly restricted to the higher mountains of western North America. The present paper is a revision of the American species only, as it was not possible at this time to include a discussion of the Eurasian forms of the genus.

HISTORY AND NOMENCLATURE.

Widely distributed, in many places abundant, diurnal in habit, and frequently destructive to crops, the eastern species (*monax*) quickly attracted the attention of the early settlers, and through the medium of skins or captive animals sent to Europe soon became known to naturalists.

The first reference in literature to the American marmots dates from 1703, when Baron La Hontan published a very brief account of the woodchuck of eastern Canada, based on his observations in the region about Lake Champlain.¹ The name "siffleur" which he applied to the animal was carried by the French voyageurs throughout the northwestern fur countries and still is current among the French Canadians of the Eastern Provinces.

Catesby, in 1743, gave a brief description of the eastern woodchuck under the name of "The Monax,"² and a few years later, in 1747, Edwards published a more extended account with a very inaccurate figure of the animal under the title of "The Monax or Marmotte of America."³ Edwards's description and figure were copied by many subsequent authors and furnished also the basis of the first technical

¹ La Hontan, Baron de. Voyages dans l'Amerique, 1703, p. 81.

² Catesby, Mark. Nat. Hist. of Carolina, etc., II, 1743, App., p. xxviii.

³ Edwards, George. Nat. Hist. Uncommon Birds, II, 1747, p. 104, pl. civ.

name applied to the species—*Mus monax* Linnaeus.¹ While the figure is wholly unrecognizable, the description is sufficiently clear to warrant the use of the name bestowed by Linnaeus.

Erxleben, in 1777, named the Canadian woodchuck (now recognized as a subspecies of *monax*) "*Glis*" *canadensis*,² and Pallas in the following year renamed it "*Mus*" *empetra*,³ both descriptions being based on the "Quebec marmot" of Pennant.⁴ Blumenbach, in 1779, named the genus *Marmota*,⁵ and Schreber the following year introduced the name *Arctomys monax* on a plate evidently copied from Edwards's figure of "The Monax."⁶ Schreber's generic name, though of later date than Blumenbach's, received general acceptance and continued in common use for the marmots until the early years of the present century, when the name *Marmota* was restored as the proper appellation of the genus.⁷ In 1788, Gmelin proposed the name *Arctomys pruinosa*,⁸ based on the hoary marmot of Pennant, and this name was used for that animal until 1888, when Tyrrell showed that it had been incorrectly applied and proposed to use in its place *Arctomys caligata* Eschscholtz, first described in 1829.⁹

Sabine, in 1822, published an account of the American marmots, recognizing three species: *monax*, *empetra* (= *canadensis*), and *pruinosa* (= *caligata*).¹⁰ His descriptions of *monax* and *pruinosa* were copied from previous authors, but that of *empetra* was drawn from a specimen in the British Museum, and furnished apparently the first correct description of any American marmot. The first accurate drawing of an American species is that of the Canadian woodchuck published by Richardson in the *Fauna Boreali-Americana* (1829).

In 1836 King, recognizing clearly that *pruinosa* of Gmelin was not applicable to the hoary marmot, but overlooking Eschscholtz's name *caligata*, proposed the name *Arctomys okanaganus* for a marmot of this group obtained in southern British Columbia, and gave a very full and accurate description and a good figure of the animal, drawn from a living specimen which he sent to the Zoological Gardens in London.¹¹ His name, however, was not accepted by zoologists, and *pruinosa* continued in use for many years. The specimen taken by King was seen by Audubon in London, and furnished the basis of his

¹The use of the name "monax" by both Catesby and Edwards independently (Edwards states that he had never seen an account of the animal) indicates that it came from the vernacular—a theory which is strengthened by the fact that the animal is still called "moonack" in parts of southern Virginia.

²Erxleben, J. C. P. *Syst. Anim., Mamm.*, 1777, p. 363.

³Pallas, P. S. *Nov. Spec. Glir.*, 1778, p. 74.

⁴Pennant, Thomas. *Syn. Quad.*, 1771, p. 270, Plate 24, fig. 2.

⁵Blumenbach, J. F. *Handb. der Naturgesch.*, I, 1779, p. 79.

⁶Schreber, J. C. D. von. *Säugethiere*, pl. cviii, 1780; text, IV, 1782, p. 737.

⁷Trouessart, E. L. *Cat. Mamm., Suppl.*, 1904, p. 343.

⁸Gmelin, J. F. *Syst. Nat.*, I, 1788, p. 144.

⁹Tyrrell, J. B. *Proc. Can. Inst.*, 3d Ser., VI, 1888, p. 88.

¹⁰Sabine, Joseph. *Trans. Linn. Soc. London*, XIII, 1822, pp. 579-591.

¹¹King, R. *Narr. Journ. to Shores of Arctic Ocean*, II, 1836, pp. 232-248.

figure of the hoary marmot in the "Quadrupeds of North America," but the illustration is colored much too brown to represent the animal correctly. In the work referred to¹ the authors gave also an extended account and a good drawing of the eastern woodchuck, and a shorter account, with a figure, of the yellow-bellied marmot of western North America, first described by them in 1841 under the name *Arctomys flaviventer*. This is the first appearance in literature of the widely distributed group of yellow-footed marmots, and the work of Audubon and Bachman was the first treatise in which all three groups of American species were recognized.

Little advance in knowledge of the genus was made for nearly half a century, and the three groups (*monax*, *flaviventris*, and *caligata*) continued to be known by only a single species in each. The Canadian woodchuck, so clearly described by Sabine and Richardson, was considered by both Baird and Allen to be identical with *monax* (of which it is, indeed, a subspecies) and the names based on it (*canadensis* Erxleben, *empetra* Pallas, *melanopus* Kuhl) were placed by them in synonymy, but were later revived by several authors.²

In 1889 Merriam described *dacota*, a member of the *flaviventris* group, from the Black Hills, S. Dak.; and in 1898, *olympus*, a member of the hoary marmot group, from the Olympic Mountains, Wash. In 1899 Bangs named *ignava* from Labrador and *avara* from southern British Columbia; in 1905 J. A. Allen described *engelhardti* from Utah; in 1909 Heller proposed *vigilis* for a hoary marmot from Alaska; in 1911 Swarth named *ochracea* from Alaska and *vancouverensis* from British Columbia; and in 1912 Hollister proposed the name *sibila* for a hoary marmot from the northern Rocky Mountains, but as this name was found to be preoccupied the species was renamed by him *oxytona* in 1914. The present writer, after making a preliminary study of the group, added, in 1914, 10 new forms to the 13 currently recognized.³ Two additional new races are here described and one old name (*okanagana*) is revived, making a total of 26 forms recognized in this revision.

VERNACULAR NAMES.

The marmots of the *monax* group are known in the Northern States as woodchucks, and in the Southern States as ground hogs, the European name marmot being practically unknown in eastern North America. In eastern Canada, among the French Canadians, the name "siffleur" is current, and in central Canada the Cree Indian

¹ Audubon & Bachman. Quad. N. Am., I, 1841, pp. 16-24, pl. ii; III, 1854, pp. 17-20, pl. ciii; pp. 160-162, pl. cxxxiv.

² Rhoads, S. N., Proc. Acad. Nat. Sci. Phila., 1897, p. 30; Allen, J. A., Bul. Amer. Mus. Nat. Hist., X, 1898, p. 456; Preble, E. A., N. Am. Fauna No. 22, 1902, p. 47; Ibid., No. 27, 1908, p. 159.

³ Howell, A. H. Proc. Biol. Soc. Washington, XXVII, 1914, pp. 13-18.

name "wenusk" is generally used. In southern Virginia, as I am informed by Edward A. Preble, the woodchuck is locally known as "moonack," which is probably a corruption of the original name "monax" used by both Catesby and Edwards.

The yellow-footed marmots (*flaviventris* group) are commonly called woodchucks or rockchucks, more rarely ground hogs or marmots.

The hoary marmots (*caligata* group) are most often known as ground hogs, whistlers or "siffleurs," sometimes as whistling "pigs," whistling marmots, or "badgers."

HABITS.

The eastern woodchucks live for the most part in pairs or family groups, the yellow-footed marmots in more or less scattered colonies, while the hoary marmots are more strongly gregarious. All the species live in burrows which they dig for themselves. In regions where rock piles, rock ledges, or stone walls occur the burrows are usually excavated underneath or among rocks, but natural openings in cliffs are often utilized for dens.

Eastern woodchucks (*monax* group), while preferring rocky bluffs or stone walls for a habitation, often live in meadows devoid of rocks and where the burrows are surrounded by an abundant growth of grass or clover.

Yellow-footed marmots (*flaviventris* group) usually live either on rocky hillsides, in the crevices of cliffs, or beneath rock piles in meadows. They frequently make their burrows beneath unoccupied buildings, but are never found far from hills, and are often abundant in the higher parts of mountains.

Hoary marmots (*caligata* group), when living at timber line in the mountains, as is their invariable habit in the southern part of their range, are always found in or about rock slides, but in Alaska and northern British Columbia, where they frequently descend to low altitudes, they often make their burrows in grassy flats or on open hillsides.

All the species are mainly terrestrial, but the eastern woodchucks occasionally climb into trees and bushes. They are not at home, however, in such situations, and as a rule may easily be dislodged. The tree-climbing habit appears to be more strongly marked in the woodchucks of the Mississippi Valley than in those inhabiting the Atlantic States. Charles Aldrich, of Webster City, Iowa, has recorded an instance of a woodchuck ascending an oak tree to a height of 40 feet,¹ and Dr. F. W. Langdon states that in Ohio he has seen one descend the perpendicular trunk of a large sugar maple, *head first*.² In Minnesota and Wisconsin, as I am informed by Vernon

¹ Aldrich, Charles. Am. Naturalist, XV, 1881, p. 737.

² Langdon, F. W. Journ. Cincinnati Soc. Nat. Hist., III, 1880, p. 305.

Bailey and H. H. T. Jackson, it is a common occurrence for woodchucks to take to trees when pursued by dogs.

The eastern woodchuck is mainly diurnal, but occasionally is found abroad at night also, especially by moonlight. Merriam says of it:

In summer, throughout the farming districts, they commonly leave their burrows early in the morning, late in the afternoon, and during moonlight nights, but may sometimes be found abroad at all hours. As autumn approaches, and they become more and more fat and sleepy, they usually appear only in fine weather, and then but for a few hours in the hottest part of the afternoon.¹

The yellow-footed and hoary marmots are fond of sunning themselves on projecting points of rock where they are safe from attack and may overlook a wide stretch of country. During cloudy and stormy weather they are less active and spend a larger part of the time in their burrows.

All the American marmots when alarmed utter a loud, shrill whistle, a habit apparently most pronounced in the hoary marmot, whose notes are much stronger than those of the smaller species and capable of being heard at a distance of more than a mile. This habit has given the name "whistler" to the hoary marmot and "siffleur" to the woodchuck of eastern Canada.

BURROWS.

Although originally living in the woods, the eastern woodchuck prefers clearings for its abode, and, as a result of an abundance of easily obtained food, is now probably much more numerous than in primitive times. Its burrows are commonly excavated in the face of a bluff, in a grassy meadow, or underneath a stone wall, a stump, or the roots of a tree.

Merriam states that the burrows are of two principal types—

* * * the first slopes at a moderate angle from the surface and has a mound of dirt near its entrance; the other is more or less vertical for several feet (often a metre or more) immediately below the surface, and no loose earth can be found in its neighborhood. * * * As a rule they [the galleries] slant abruptly downward from the entrance to a depth of from three to four feet * * * , whence inclining slightly upward and usually curving to one side, they extend horizontally for a varying distance (commonly from 10 to 25 feet) * * *. Two or more short lateral branches are generally given off from the main gallery, and lead, sloping upward and then downward, to the more or less circular chambers that contain the animals' nests. It has been my invariable experience to find these chambers above the level of the bottom of the entrance incline, and I have seen one that was within a foot and a half * * * of the surface. The nest itself is usually composed of dry grasses and leaves and rarely exceeds a foot in diameter. * * * The main gallery or one of its branches commonly terminates in a slight excavation, which is found to contain the animal's excrement.²

¹ Merriam, C. H. *Mamm. of the Adirondacks*, Trans. Linn. Soc. N. Y., II, 1884, p. 146.

² *Ibid.*, pp. 148-149.

William Hubbell Fisher excavated and measured nine burrows of the woodchuck in Lewis County, N. Y., and has published a detailed description of them, with diagrams. The longest burrow which he examined measured (including side branches) 44 feet 9½ inches; the shortest, 6 feet 8¼ inches; the deepest burrow was 49 inches below the surface; the shallowest, 23 inches.¹

No description of the burrows of the yellow-footed marmot has come to the writer's notice, and the only known account of those of the hoary marmots is that given by William H. Wright in his work on the grizzly bear. Describing the manner in which a grizzly had opened up a den of these marmots, he says:

The den ran in under several layers of loose flat rocks, some of which were two or three feet long by half as many wide, and several inches thick. These he had ripped out easily and thrown down hill, and the dirt and small bowlders had been hurled out and now covered the snow all about for a space of ten or twelve feet.

On the rocks and snow were large spots and blotches of blood, telling of the feast that had rewarded his labors, and that there had been more than one marmot was shown by the numerous tracks. These animals had burrowed down some six or seven feet into the side of the mountain, and under a large flat stone they had scooped out a little cave, some three feet in diameter, where they had a soft bed of grasses that they had carried in. When the grizzly broke his way into their home there had been a great rush for freedom.

The marks in the snow indicated that all the marmots had been devoured by the bear.²

HIBERNATION.

All the species hibernate for periods varying from 4 to 6 months. Merriam states that in New York, along the western border of the Adirondacks, the woodchuck usually goes into winter quarters between the 18th and 25th of September and reappears the middle or latter part of March; in early springs following mild winters, he adds, "woodchucks occasionally appear in February, but reenter their burrows and again become dormant if the temperature falls."³ Bachman states that he once observed a woodchuck in New York State on October 23 sunning himself at the mouth of his burrow, and also in the same State saw one killed by a dog on March 1.⁴ Extreme dates of occurrence for this region are: February 22, Adirondack Mountains, N. Y., specimen in the Merriam collection; and November 20, Fort Miller, N. Y., one seen by Dr. E. A. Mearns.⁵ In the more southern States, hibernation covers a shorter period, as indicated by the occurrence of the animals at the base of Roan Mountain, N. C., as early as February 7 and as late as October 23. Other dates

¹ Fisher, W. H. Jour. Cincinnati Soc. Nat. Hist., XVI, 1893, pp. 105-123.

² Wright, W. H. The Grizzly Bear, London, 1909, p. 82.

³ Merriam, C. H. Mamm. of the Adirondacks, Trans. Linn. Soc. N. Y., II, 1884, pp. 143-144.

⁴ Audubon & Bachman. Quad. N. Am. I, 1849, p. 20.

⁵ Mearns, E. A. Bul. Amer. Mus. Nat. Hist., X, 1893, p. 337.

of late occurrence are as follows: October 6, Teslin Lake, Yukon; October 17, Dowagiac, Mich.; October 25, Johnson County, Iowa. Hahn states that in southern Indiana woodchucks usually retire about the middle of October and begin to clean out and enlarge their burrows during the last days of February.¹

The yellow-footed marmots go into hibernation between the middle of August and the first of October, the date varying with the altitude and local conditions. Individuals living in the valleys retire earlier than those living higher up in the mountains. Warren states that in Gunnison County, Colo., this species dens up about the first of October, but individuals are sometimes seen much later.² Allan Brooks states (in epistle) that at Okanogan Landing, British Columbia, practically all these marmots disappear before the middle of August, but he has occasionally seen their tracks as late as early October. In the mountains of Montana and Wyoming this species usually enters hibernation during the last of August or the first of September; Biological Survey field parties have never found the animals later than the first week in September. In the Bitterroot Valley, Mont., the first one seen in the spring in 1910 was on March 24, and by April 1 they were numerous; in 1911 one was seen there by Bernard Bailey, on March 13. In western Oregon extreme dates of occurrence are: February 4 (Klamath Lake), and September 25 (Mount Hood).

The hibernating period of the hoary marmot begins the last of September or first of October. Near Tatletuey Lake, British Columbia, Edward A. Preble found the species still active a few hundred feet above timber line on September 23 and 25, but none was seen after the latter date. Like the yellow-footed species, the hoary marmots retire earlier in the valleys than in the mountains. Heller states that at Valdez Narrows, Alaska, the species went into hibernation about the middle of September.³

Bachman thus described his observations of a pair of hibernating marmots:

In the summer of 1814, in Rensselaer County, in the State of New York, we marked a burrow which was the resort of a pair of marmots. In the beginning of November the ground was slightly covered with snow, and the frost had penetrated to the depth of about an inch. We now had excavations made in a line along the burrow or gallery of the marmots, and at about twenty-five feet from the mouth of the hole; both of them were found lying close to each other in a nest of dried grass, which did not appear to have been any of it eaten or bitten by them. They were each rolled up, and looked somewhat like two misshapen balls of hair, and were perfectly dormant. We removed them to a haystack, in which we made an excavation to save them from the cold. One of them did not survive the first severe weather of the winter, having,

¹ Hahn, W. L. *Mamm. of Indiana*, 1909, pp. 481-482.

² Warren, E. R. *Mamm. of Colorado*, 1910, p. 148.

³ Heller, Edmund. *Univ. of California Pub. Zool.*, V, 1910, p. 339.

as we thought on examining them, been frozen to death. The other, the male, was now removed to a cellar, where he remained in a perfectly dormant state until the latter part of February, when he escaped before we were aware of his reanimation. We had handled him only two days previously, and could perceive no symptoms of returning vivacity.¹

The following account of a yellow-footed marmot (*Marmota flaviventris* subsp.) found in midwinter in the Silver Mountain tunnel at Ophir, Colo., probably indicates a common method of hibernation in that species:

* * * [He] had packed in grass for a nest, and taken up his winter quarters. He was rolled up like a ball, with his forepaws over his eyes; we pulled his paws away, and his eyes were closed; all our efforts to awake him were futile; he would yawn like a boy that had been disturbed when sleeping soundly, return his paws to his eyes, and curl himself up in his original position.²

BREEDING.

The eastern woodchuck usually produces from 4 to 6 young at a birth. Bachman states, however, that on two occasions he counted 7 and on another 8 young in a litter, and H. H. T. Jackson informs me that he once saw a litter of 9. In New York State, according to Merriam, this species brings forth its young the last of April or first of May. In the Southern States they are born somewhat earlier.

The yellow-footed marmots breed at about the same season as their eastern relatives and produce from 3 to 8 young at a birth. In the Bitterroot Valley, Montana, 5 females collected between April 8 and April 16 were pregnant, the number of embryos being in most cases 5 or 6 (in one case 3). Young marmots were out in numbers in that region on May 30. Warren states that an individual of this species collected at Sulphur Springs, Colo., on May 4, contained 8 embryos.³

The hoary marmots probably breed somewhat later than their smaller relatives, but little information on this point is available. A female specimen of *Marmota caligata nivaria*, taken May 27, 1895, near St. Marys Lake, Mont., contained 5 embryos. Swarth states that in southern Alaska young individuals of *M. c. caligata* were seen running about in the middle of June, but on Vancouver Island, during the first three weeks of July, no young ones [of *M. vancouverensis*] had yet emerged from the burrows.⁴

FOOD.

The principal food of the eastern woodchuck is clover, alfalfa, and grass, and the animals do considerable damage to these crops both

¹ Audubon & Bachman. Quad. N. Am., I, 1849, p. 22.

² Osborn, S. E. The Observer, III, 1892, p. 32.

³ Warren, E. R. Mamm. of Colorado, 1910, p. 148.

⁴ Swarth, H. S. Univ. of California Pub. Zool., X, 1912, p. 90.

by consuming the forage and by trampling down much that they do not eat. Cultivated crops and orchard trees are occasionally injured by them, but the damage usually is not serious. Evermann and Clark state that in Indiana woodchucks—

* * * sometimes damage young corn plants and occasionally feed on the leaves of pumpkin, squash, and bean vines. They sometimes visit the kitchen garden and do more or less damage to the cabbage heads and celery.¹

Brooks, writing of the woodchuck in West Virginia, says:

* * * Feeds on corn in the roasting-ear, which it procures by breaking down the stalks; is also fond of pumpkins, young beans, grass and other cultivated crops. Frequently gnaws and scratches the bark of young fruit trees.²

Hahn mentions capturing a woodchuck in a sassafras tree and finding its stomach gorged with sassafras leaves.³ Dr. Witmer Stone states that the woodchuck sometimes eats cantaloupes.

The food of yellow-footed marmots is similar to that of eastern woodchucks, but probably includes a larger proportion of wild plants and less grass and clover. Vernon Bailey found in the stomachs of the Black Hills marmot flowers, leaves, and green seeds of various plants, including *Astragalus bisulcatus* and *Sedum douglasii*. In dry excrement of marmots at Spokane Bridge, Wash., he found the seeds of *Amelanchier alnifolia* and *Rubus nutkanus*. Birdseye states that the marmots in the Bitterroot Valley, Montana, feed on timothy, clover, alfalfa, dandelions, and other native plants. He says:

In hayfields they consume a very considerable amount of feed; and beans, carrots, potato vines, cabbage, and other garden truck are almost sure to suffer whenever woodchucks have access to them.⁴

Little is known definitely concerning the food habits of hoary marmots, but they doubtless feed, like the other species, on grass and the tender leaves and stems of native plants.

ECONOMIC STATUS.

As already shown, the food habits of the American marmots make the animals a decided pest wherever they occur about cultivated lands. In this respect the woodchucks of the Eastern States are the chief offenders, and the farmers of that region wage constant warfare on the animals, with indifferent success. Where the woodchucks occupy mowing lands they not only consume considerable grass and tread down much more which can not be cut by a mowing machine, but their burrows and mounds make it difficult and dangerous to operate a mower. Horses sometimes are injured by stepping into the holes made by woodchucks, and the knives of

¹ Evermann & Clark. Proc. Washington Acad. Sci., XVII, 1911, p. 13.

² Brooks, F. E. Report W. Va. Board Agr. for 1910 (1911), p. 15.

³ Hahn, W. L. Mamm. of Indiana, 1909, p. 482.

⁴ Birdseye, Clarence. Farmers' Bul. 484, U. S. Dept. Agr., 1912, p. 28.

the machines are liable to be dulled or broken by running into piles of earth or rocks. Vernon Bailey states that he has seen an acre of oats on a hillside in New York State almost ruined by a family of woodchucks, their trails having broken down most of the grain which they had not cut to eat.

The fur of the American marmots is not at present used commercially, but the hides of hoary marmots are employed to some extent by the Indians of western Canada for making robes. The fur of this animal is fully as good as that of the European and of some of the Asiatic species, all of which figure extensively in the fur trade. Furthermore, the American animal is larger than most of the Eurasian species, and the color pattern of its skin is such as to make a very handsome natural fur. If a sufficient number of these pelts could be secured in late autumn when they are in prime condition there would seem to be every reason for utilizing them in the fur trade. In parts of Alaska and northern British Columbia the animals are very abundant, and Indians of that region annually capture large numbers both for fur and flesh. The yellow-footed marmots are considerably smaller than the hoary marmots, but their pelage is long, full, and silky, and could readily be made into a very attractive fur. The pelage of the eastern woodchuck is much coarser and thinner and has never been considered of much value for fur; the hides, however, are tough and durable and might be utilized for some kinds of leather. Farmers' boys often tan the skins of the eastern woodchuck and make them into shoe strings, whip lashes, ball covers, or mit facings.

The flesh of marmots is said to be palatable and in certain regions of the Northwest furnishes an important food supply for the native Indians.

MARMOTS AS CARRIERS OF DISEASE.

For many years the opinion has generally prevailed that the marmots of central Asia are in some way concerned in the spread of the plague, and this theory was accepted even as late as 1911 by the members of the International Plague Conference held at Mukden in April of that year. Accounts have frequently been published in medical literature of the appearance of the disease among "targan"¹ hunters under circumstances pointing strongly to the possibility of infection from handling the animals or consuming their flesh, but unfortunately none of these accounts shows bacteriological evidence of the existence of the plague among marmots, nor do they demonstrate conclusively that the disease is contracted in any way from the animals.²

¹ This is the name applied in medical literature to the marmots of Asia. It is said to be of Mongolian origin. The Russian name of the animal is "churok."

² See especially an article by Dr. Frank G. Clemow, *Jour. Trop. Medicine*, February, 1900, pp.169-174.

The last great outbreak of pneumonic plague in Manchuria, during the winter of 1910-11, was supposed to have started among tarbagan hunters in the town of Manchouli, a station on the Trans-Siberian Railway, whence it spread rapidly southward along the railway to Harbin and Mukden. Efforts were made during the progress of this epidemic to locate the disease among the native marmots,¹ and a number of individuals captured near Mukden were inoculated experimentally by Prof. Zabolotny and found susceptible to plague infection. One individual suffering from the disease was brought to him, this being the only known instance of the natural appearance of plague among marmots.² More recently a systematic effort has been made by the Chinese Government to discover the disease in nature, but the evidence obtained is wholly of a negative character.³

The experimental evidence just mentioned and the close relationship of marmots to ground squirrels, which are known to carry plague on the Pacific coast of North America, warrant looking upon these animals with suspicion whenever they occur in a plague-infested region.

One American species—the golden-mantled marmot (*Marmota flaviventris nosophora*)—is known to assist in spreading the deadly spotted fever by serving as host for the fever tick (*Dermacentor venustus*), both in adult and nymphal stages. Over 200 ticks have been taken from a single wild marmot, and when in captivity the species has been shown to be susceptible to spotted fever.⁴ Since this marmot is not utilized for fur there is relatively little danger of the spread of the disease to other regions through the medium of the animals, but every effort should be made to exterminate them where they occur about cultivated lands or in the vicinity of dwellings. Suggestions for destroying marmots are given in Farmers' Bulletin 484, United States Department of Agriculture.

EXTERNAL CHARACTERS.

In the American marmots the body is thickset and clumsy; the head short and broad; the legs short and stout; and the tail rather short (about one-fifth to one-third of the total length), densely haired, and slightly flattened. The nose is broad and blunt, covered with hair to the edge of the nostrils, and the ears are short, broad, rounded, and well-haired. Tufts of long black bristles grow from the side of the head, one directly behind the nose, another underneath and between the eye and ear, and a third shorter tuft over the eye; small scattered bristles also are found under the chin. The eyes are rather

¹ The marmot of Manchuria, although generally referred to in plague literature as *Arctomys bobac*, is in all probability *Marmota sibirica*, specimens of which, collected at Urga, Mongolia, are in the U. S. National Museum.

² Strong, R. P. Rept. Intern. Plague Conference held at Mukden, April, 1911. Manila, 1912.

³ Dr. Wu Lien Teh (G. L. Tuck). *The Lancet*, London, Aug. 23, 1913, pp. 529-535.

⁴ Birdseye, Clarence. *Farmers' Bul.* 484, U. S. Dept. Agr., 1912, p. 28.

small and nearly or quite circular. The feet are robust, with stout, slightly curved fossorial claws, those on the fore feet somewhat heavier; the thumb of the front foot (in the American species) is rudimentary and often very small, but bears a broad, flat nail; the third digit is the longest, the second and fourth subequal, the fifth decidedly shorter; the palm is naked, bearing 3 pads at the bases of the digits and 2 larger posterior ones; on the hind foot the third digit is slightly longer than the subequal second and fourth, the fifth and first successively much shorter; the sole is naked except at the heel and bears 6 pads, 4 at the bases of the digits and 2 posterior to them. The mammae number 5 pairs, except in the *monax* group, in which there are usually but 4 pairs. In *M. monax*, according to Baird, "there is a short, shallow cavity between the muscles of the jaw and the cheek, attaining a depth perhaps of half an inch or less and occupying the place of the internal pouch of *Tamias* and *Spermophilus* [*Citellus*]." ¹

PELAGE AND MOLT.

The pelage of the American marmots consists of hairs of two kinds—a dense, soft, and somewhat woolly underfur, confined chiefly to the back and sides; and longer, somewhat coarser hairs covering the whole body, intimately mixed on the back with the underfur and projecting beyond the tips of the latter. The underfur is of two colors, usually some shade of gray or dark brown tipped with a lighter color, generally a shade of gray, buff, cinnamon, or reddish brown. The long hairs are also of two colors, usually a shade of brown, hazel, or black, tipped with a lighter shade—buff or white. The tips of the underfur usually show through the long hairs, and form an important element in the general color tone of the pelage. The hairs on the head and feet are shorter than on the rest of the body, and are unicolor to the roots; those on the tail are long and coarse, their bases of a darker shade than the tips. The hair on the underparts is shorter and sparser than on the back and is without underfur.

The pelage is renewed annually in summer, usually in August, sometimes in July or even June. Individuals taken in early spring, soon after emerging from hibernation, are usually in full, long pelage, but by midsummer the pelage often becomes very much worn and faded. There seems to be no uniform method of molting, the new pelage sometimes appearing in patches on various parts of the body. In a specimen of *Marmota olympus*, taken August 28, the new pelage was coming in in large patches, the molt being farthest advanced on the middle of the back, with streaks of new hair along the sides of the neck and body. (See Pl. II.) In another individual of the same species, taken August 18, new hair was coming in on the rump and

¹ Baird, S. F. Mamm. N. Am., Rept. Expl. and Surv. R. R. Pacif., VIII, 1857, p. 340. The author has had no opportunity to examine specimens of any of the groups in the flesh, so does not know whether this character is possessed by all.

hinder back, the old intimately mixed with the new. In an immature individual of *M. caligata cascadiensis*, taken August 5, new pelage covered all of the body except the rump and tail. A somewhat similar condition is shown by an adult individual of *M. monax preb-lorum*, taken July 11, the new pelage coming in over the entire upperparts, farther advanced on the fore back and shoulders. In a specimen of *M. flaviventris nosophora*, taken June 7, the molt was just beginning in two patches on the hinder back. In a specimen of *M. f. obscura*, taken July 27, new pelage appears in the form of a band on the middle of the back reaching from the top of the head to the rump. (See Pl. II.)

MELANISM.

Melanism is most strongly developed in the subspecies *Marmota caligata vigilis*, occupying the region around Glacier Bay, Alaska. In this race some individuals are entirely black except for a few grayish hairs on the sides and neck, and small whitish patches on the underparts and nose. No purely black specimens of *M. monax* have been seen, but a melanistic phase is rather common in New York and New England. The darkest specimen seen (from Lake George, N. Y.) is dark blackish brown all over, except the head and face, which are mixed mummy brown and benzo brown. Other specimens from New York State are dark chestnut-brown. Vernon Bailey states that he has seen a very few black individuals in Minnesota.

A dark phase occurs also in *M. flaviventris luteola*, but this can hardly be said to be melanistic (see description under that species). A curious specimen of *M. f. avara* from Pullman, Wash., has the tips of the hairs of the head, fore back, and most of the underparts dark blackish brown, the hinder back being pale grayish mixed with dark brown.

MATERIAL EXAMINED AND ACKNOWLEDGMENTS.

The present revision is based on a study of 1,051 specimens, 722 of which are contained in the U. S. National Museum, including the Biological Survey and the Merriam collections; the remainder (329 specimens) have been borrowed from other museums and from private collections. For the loan of this material I desire to extend my thanks to the following: Dr. J. A. Allen, of the American Museum of Natural History; Messrs. Samuel Henshaw and Outram Bangs, of the Museum of Comparative Zoology; Dr. Witmer Stone, of the Academy of Natural Sciences, Philadelphia; Dr. W. J. Holland and Mr. W. E. Clyde Todd, of the Carnegie Museum; Dr. A. G. Ruthven, of the University of Michigan; Messrs. Charles B. Cory and W. H. Osgood, of the Field Museum of Natural History; Mr. C. D. Bunker, of the Kansas University Museum; Prof. C. C. Nutting, of the University of Iowa; Mr. J. D. Figgins, of the Colorado Museum of Natural

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EXPLANATION OF CRANIAL MEASUREMENTS.

Measurements of skulls of marmots, in millimeters, have been taken as follows:

Condyllo-basal length.—From posterior border of condyle to most anterior point of premaxillae.

Palatal length.—From posterior border of palate (disregarding median process) to most anterior point of premaxillae.

Postpalatal length.—From posterior border of palate to inferior lip of foramen magnum.

Length of nasals.—From most anterior point to most posterior point.

Zygomatic breadth.—Greatest breadth across zygomata.

Breadth across mastoids.—Greatest breadth across mastoid processes.

Least interorbital breadth.—Shortest distance across frontals in front of postorbital processes.

Breadth of rostrum.—Greatest breadth of rostrum at most anterior points of maxillae.

Maxillary tooth row.—Alveolar length of maxillary molar-premolar tooth row.

Genus **MARMOTA** Blumenbach.

Glis Erxleben, Syst. Regni Anim., I, 1777, p. 358 (part). (Not *Glis* Brisson, 1762.)

Marmota Blumenbach, Handb. der Naturgesch., I, 1779, p. 79. Type, *Marmota alpina* [= *Mus marmota* Linnaeus].

Arctomys Schreber, Säugthiere, 1780, Plate CCVIII. Type, *Mus monax* Linnaeus.

GROUPS.

The American marmots embrace three very distinct groups as follows: (1) The *monax* group—all the eastern woodchucks, the Canada woodchuck, the British Columbia woodchuck and the ochraceous woodchuck of Alaska and northern British Columbia; (2) the *flaviventris* group—all the yellow-footed marmots; and (3) the *caligata* group—the hoary marmots, including the species *caligata*, *olympus*, and *vancouverensis*. The characters of the various groups are given in connection with the technical descriptions of the species.

A detailed study of Old World forms was not possible in the present revision, but, so far as known, none of the American species has any very near relative in Eurasia.¹ Several groups are represented there, some of the species resembling the *caligata* group in certain skull characters, others apparently being more nearly related to the *monax*

¹ The species living in eastern Siberia has not been seen.

group. *Marmota marmota*, the type of the genus, though widely differing from the American species in the greater depth and convexity of the cranium, resembles *monax* in the characters of the basioccipital, the shape of the postorbital processes, the relatively wide interorbital region, and the nearly parallel maxillary tooth rows. Most of the Asiatic species, however, apparently are more closely related to *M. caligata* than to either of the other American groups. The skulls of all American species, contrasted with those of the Eurasian species, show a marked flattening of the cranium, the dorsal outline of the skull being decidedly more convex in practically all Old World forms than in those of America. All the Eurasian species differ also in coloration from the American forms. All the American species possess a small rudimentary thumb bearing a flat nail—a character present in most of the Asiatic species, but absent in *M. marmota* of Europe.

List of American Species and Subspecies, with Type Localities.

Marmota monax group:

<i>Marmota monax monax</i> (Linnaeus).....	Maryland.
<i>monax rufescens</i> Howell.....	Elk River, Minn.
<i>monax preblorum</i> Howell.....	Wilmington, Mass.
<i>monax ignava</i> (Bangs).....	Black Bay, Labrador.
<i>monax canadensis</i> (Erxleben).....	"Canada et ad fretum Hudsonis"— fixed at Quebec, Quebec.
<i>monax petrensis nobis</i>	Revelstoke, British Columbia.
<i>monax ochracea</i> Swarth.....	Head of Fortymile Creek, Alaska.

Marmota flaviventris group:

<i>Marmota flaviventris flaviventris</i> (Audu- bon & Bachman).....	"Mountains between Texas and Cali- fornia"—fixed on Mount Hood, Oreg.
<i>flaviventris avara</i> (Bangs).....	Okanogan, British Columbia.
<i>flaviventris sierrae nobis</i>	Mount Whitney, Cal.
<i>flaviventris parvula</i> Howell.....	Jefferson, Toquima Range, Nev.
<i>flaviventris engelhardti</i> Allen.....	Beaver Mountains, Utah.
<i>flaviventris nosophora</i> Howell.....	Willow Creek, 7 miles east of Corvallis, Mont.
<i>flaviventris dacota</i> (Merriam).....	Custer, S. Dak.
<i>flaviventris luteola</i> Howell.....	Woods P. O., Medicine Bow Mountains, Wyo.
<i>flaviventris warreni</i> Howell.....	Crested Butte, Colo.
<i>flaviventris obscura</i> Howell.....	Wheeler Peak, N. Mex.

Marmota caligata group:

<i>Marmota caligata caligata</i> (Eschscholtz).....	Bristol Bay, Alaska.
<i>caligata vigilis</i> Heller.....	Glacier Bay, Alaska.
<i>caligata sheldoni</i> Howell.....	Montague Island, Alaska.
<i>caligata oxytona</i> Hollister.....	Head of Smoky River, Alberta.
<i>caligata okanagana</i> (King).....	Gold Range, British Columbia.
<i>caligata nivaria</i> Howell.....	Mountains near St. Marys Lake, Mont.
<i>caligata cascadenis</i> Howell.....	Mount Rainier, Wash.
<i>Marmota olympus</i> (Merriam).....	Olympic Mountains, Wash.
<i>Marmota vancouverensis</i> Swarth.....	Mount Douglas, Vancouver Island, Brit- ish Columbia.

Key to American Species and Subspecies.

[Based on typical adults.]

- a. Upperparts mainly black and white (shaded with cinnamon-buff on rump).
- b. Underparts mainly white.
- c. Size small; condylo-basal length of ♀ skull less than 90 mm....*sheldoni* (p. 62).
- c'. Size large; condylo-basal length of ♀ skull more than 90 mm.
- d. Skull shorter; condylo-basal length in ♀ less than 98 mm....*caligata* (p. 59).
- d'. Skull longer; condylo-basal length in ♀ more than 98 mm....*nivaria* (p. 66).
- b'. Underparts dusky (blackish brown, soiled whitish, or clay color).
- c. Skull relatively short and broad; condylo-basal length in ♂ less than 101 mm.; in ♀ less than 98 mm.
- d. Nasals shorter, rarely extending back of posterior ends of premaxillae.
okanagana (p. 64).
- d'. Nasals longer, always extending back of posterior ends of premaxillae.
vigilis (p. 61).
- c'. Skull relatively long and narrow; condylo-basal length in ♂ more than 101 mm.; in ♀ more than 95 mm.
- d. Upperparts whiter; skull relatively broader (ratio of zygomatic breadth to condylo-basal length 64-67).....*cascadensis* (p. 67).
- d'. Upperparts blacker; skull relatively narrower (ratio of zygomatic breadth to condylo-basal length 62-64).....*oxytona* (p. 63).
- a'. Upperparts mainly brownish, yellowish, drab, or buffy.
- b. Upperparts of solid colors (not grizzled).
- c. Upperparts brownish drab, buffy, or russet.....*olympus* (p. 69).
- c'. Upperparts dark vandyke brown, blackish brown, or black.
- d. Posterior border of nasals deeply emarginate; color dark vandyke brown.
vancouverensis (p. 70).
- d'. Posterior border of nasals not deeply emarginate; color blackish brown or black.....*vigilis* (p. 61).
- b'. Upperparts of mixed colors (grizzled).
- c. Sides of neck with conspicuous buffy patches.
- d. Underparts distinctly reddish.
- e. Crown chestnut.....*warreni* (p. 52).
- e'. Crown blackish brown.
- f. Long hairs on fore back with a subterminal band of black or brown.
nosophora (p. 46).
- f'. Long hairs on fore back without a subterminal band of black or brown.
dacota (p. 49).
- d'. Underparts not distinctly reddish.
- e. Size smaller; condylo-basal length of ♀ skull 71-80 mm.; of ♂ skull 85-87.¹
- f. Fore back with a distinct buffy mantle.
- g. Underparts darker; size smaller.....*parvula* (p. 44).
- g'. Underparts paler; size larger.....*avara* (p. 41).
- f'. Fore back without a distinct buffy mantle.....*engelhardti* (p. 45).
- e'. Size larger; condylo-basal length of ♀ skull 77-90 mm.; of ♂ skull 84-97 mm.
- f. Face markings and neck patches reduced.....*obscura* (p. 53).
- f'. Face markings and neck patches prominent.
- g. Hind feet darker (hazel or chestnut-brown).....*luteola* (p. 50).
- g'. Hind feet lighter (tawny to light buff).
- h. Larger; condylo-basal length of ♂ skull more than 90 mm.; of ♀ more than 84 mm.....*flaviventris* (p. 39).
- h'. Smaller; condylo-basal length of ♂ skull less than 90 mm.; of ♀ less than 84 mm.....*sierrae* (p. 43).

¹ Adult male of *parvula* and *engelhardti* unknown.

- c'*. Sides of neck without conspicuous buffy patches.
- d*. Tail cinnamon.....*ochracea* (p. 34).
- d'*. Tail dark brown or black.
- e*. Colors pale (underfur on back light pinkish cinnamon to light gray at tips; belly not deep red).
- f*. Skull larger; condylo-basal length more than 90 mm.....*monax* (p. 22).
- f'*. Skull smaller; condylo-basal length less than 90 mm.....*preblorum* (p. 27).
- e'*. Colors dark (underfur on back pinkish cinnamon to orange-cinnamon at tips; belly deep red).
- f*. Size smaller; condylo-basal length of ♂ skull less than 82 mm.; of ♀ less than 80 mm.....*canadensis* (p. 30).
- f'*. Size larger; condylo-basal length of ♂ skull more than 82 mm.; of ♀ more than 80 mm.
- g*. Nasals relatively short and wide; width at posterior end in males more than 11 mm.....*ignava* (p. 29).
- g'*. Nasals relatively long and narrow; width at posterior end in males less than 11 mm.
- h*. Size larger; nasals longer, extending considerably back of posterior end of premaxillae.....*rufescens* (p. 25).
- h'*. Size smaller; nasals shorter, extending little, if any, back of posterior end of premaxillae.....*petrensis* (p. 33).

DESCRIPTIONS OF AMERICAN SPECIES AND SUBSPECIES.

Marmota monax Group.

[Characters under species.]

MARMOTA MONAX (LINNÆUS).

[Synonymy under subspecies.]

External characters.—Size medium;¹ tail relatively short (about 20 to 25 per cent of total length); ears large; posterior pad on sole of hind foot oval in shape and situated near middle of sole (see Pl. III, fig. 3); mammae—P. $\frac{2}{2}$, A. $\frac{1}{1}$, I. $\frac{1}{1}$ =8; head without white markings (except around nose); sides of neck same color as upper-parts; feet black or dark brown; fore legs overlaid with deep reddish-colored hairs (hazel to burnt sienna); tail black, dark brown, or (in *ochracea*) pinkish cinnamon.

Cranial characters.—Skull with superior outline nearly straight, the occipital region slightly depressed and rostrum considerably but not abruptly depressed from about posterior border of premaxillae; brain-case broad and noticeably flattened; interorbital region relatively broad; postorbital processes heavy, projecting nearly at right angles to axis of skull or slightly forward; width of nasals at posterior end usually decidedly greater than width of nasal branches of premaxillae; temporal ridges often not meeting in old age, or sometimes meeting but not united (rarely fused into a sagittal crest); floor of basi-occipital nearly flat, bordered on each side by low processes which converge posteriorly and sometimes meet near inferior lip of foramen magnum;

¹Audubon and Bachman give the weight of one as 9 pounds 11 ounces; a writer in *Forest and Stream*, LV, p. 424, gives the average weight of 158 as 10 pounds; heaviest, 13½ pounds.

palate abruptly truncated at posterior border; interpterygoid fossa relatively wide; palatal foramina contracted anteriorly; molar teeth heavy; maxillary tooth rows approximately parallel; anterior face of incisors yellowish white or ivory yellow to pale orange-yellow.

Color.—General tone of upperparts grayish- or reddish-brown, or (in *ochracea*) vinaceous-cinnamon, grizzled with white, light buff, or cinnamon-buff; underfur of upperparts at base dark mouse gray to blackish brown, succeeded by pallid neutral gray, light ochraceous-buff, pinkish-, vinaceous-, or orange-cinnamon; long hairs dark chestnut-brown, blackish brown, or (in *ochracea*) orange-cinnamon, tipped with light buff, pale ochraceous-buff, or white; top of head and face varying from dark hair-brown or benzo brown to vandyke- or clove-brown; sides of face light buff, ochraceous-buff, or white, mixed with brown; borders of nose, lips, and chin, white or buffy white; underparts buffy white, light ochraceous-buff, pinkish cinnamon, tawny, hazel, or burnt sienna, more or less varied with brown, the bases of hairs often blackish brown or black; fore legs and feet black, blackish brown, dark chestnut-brown, fuscous, or hazel (in *ochracea*), the legs and thighs (except in *ochracea*) overlaid with burnt sienna, Sanford's brown, or tawny; hind legs and feet similar, but thighs often paler, sometimes overlaid with pinkish cinnamon; tail black or blackish brown, vandyke- or clove-brown, or (in *ochracea*) pinkish cinnamon, more or less grizzled with buffy white or cinnamon-buff; ears drab-gray on both surfaces, often clothed with fuscous hairs.

Geographic distribution.—From eastern Alaska (Fortymile Creek), Great Slave Lake, York Factory (Hudson Bay), East Main and Hamilton Rivers, Quebec, south to northern Idaho in the Rocky Mountains, and east of the Great Plains to northern Arkansas, northern Alabama, and southern Virginia; west in the United States to eastern parts of North Dakota, Kansas, and Oklahoma. (See fig. 1.)

MARMOTA MONAX MONAX (LINNAEUS).

SOUTHERN WOODCHUCK.

(Pl. IV, fig. 2; Pl. V, fig. 1; Pl. XI, fig. 1.)

[*Mus*] *monax* Linnaeus, Syst. Nat., ed. 10, I, 1758, p. 60.

[*Glis*] *monax* Erxleben, Syst. Regn. Anim., 1777, p. 361.

Arctomys monax Schreber, Säugthiere, IV, 737, 1782; Plate CCVIII, 1780.

[*Marmota*] *monax* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Maryland.

Distribution.—Middle eastern United States from Pennsylvania, New Jersey (?), Ohio, Indiana, Illinois, and Iowa, south to the northern parts of South Carolina, Georgia, Alabama, and Arkansas; west to eastern Kansas.

Characters.—Size large; colors pale, the underfur grayish white; underparts little, if any, darker than upperparts; skull massive.

Color.—General tone grayish brown above, with a faint buffy tinge; underfur blackish brown at base succeeded by pallid neutral gray, faintly (rarely strongly) tinged with light ochraceous-buff, strongest on hinder back; long hairs blackish brown, broadly tipped with white

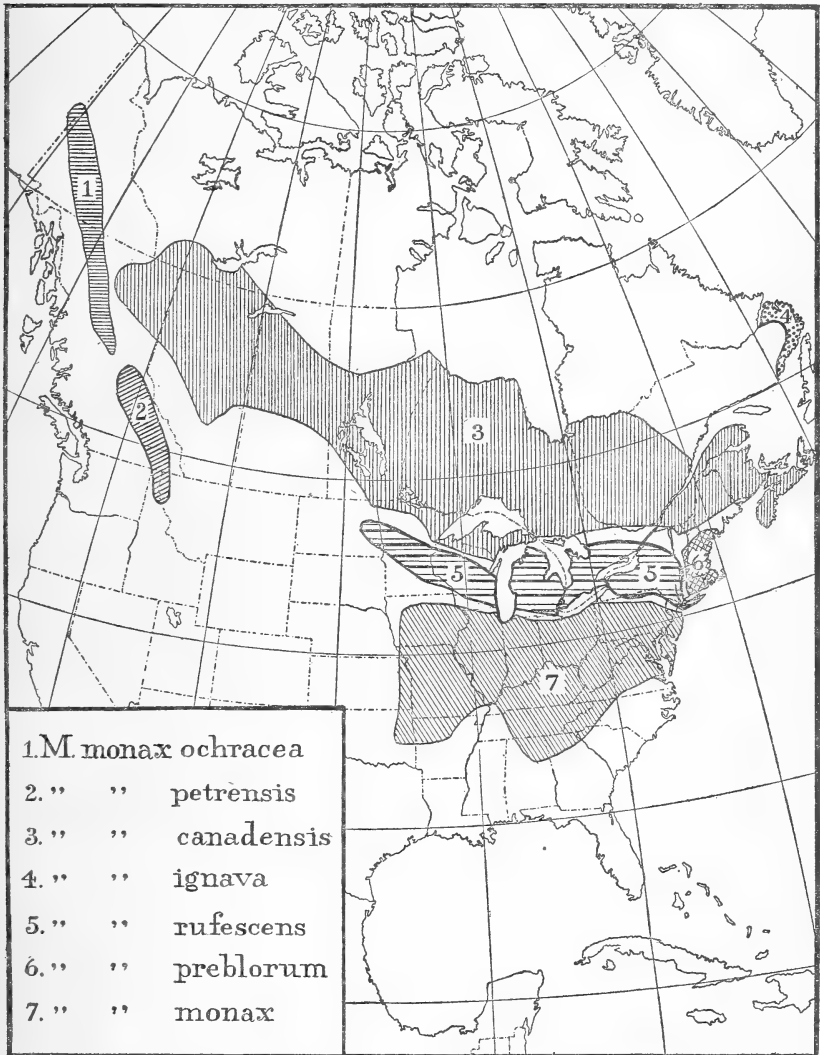


FIG. 1.—Distribution of the *Marmota monax* group. Unshaded areas within the range of the group indicate lack of definite knowledge as to the subspecies occurring there.

or buffy white; top of head and face varying from benzo brown to clove brown; sides of nose and borders of lips and chin buffy white; sides of face mixed brown and buffy white; feet and legs black or blackish brown (rarely fuscous or dark chestnut-brown), the hairs on legs tipped with tawny or hazel; tail blackish brown, sparingly

grizzled with buffy white; underparts buffy white or light ochraceous-buff, the bases of hairs blackish brown.

Skull.—Largest of the group; relatively long and narrow; sagittal crest well developed (in adults); interorbital region broad; nasals long and broad, usually squarely truncated posteriorly; premaxillae narrow; palate long, extending from 2 to 4 mm. behind plane of molars; palatal foramina rather narrow; interpterygoid fossa broad; audital bullae moderately inflated.

Measurements.—Adult male from Gunston, Va: Total length, 665; tail vertebrae, 153; hind foot, 88. Adult male from Sandy Spring, Md.: 573; 145; 82. Average of 4 adult females from District of Columbia and Virginia: 557; 139; 83. *Skull*: Adult male:¹ Condylbasal length, 97.3–102.5 (average 97.8); palatal length, 55–59.5 (57.4); postpalatal length, 34.5–37.7 (36.2); length of nasals, 39.7–41.8 (40.8); zygomatic breadth, 63–69.2 (65.9); breadth across mastoids, 44.5–50.2 (46.9); least interorbital breadth, 25–29.2 (27.1); breadth of rostrum, 20.6–23.7 (21.7); maxillary tooth row, 21–21.9 (21.3). Adult female:² Condylbasal length, 90.4–91.8 (91.2); palatal length 50.2–56 (53.1); postpalatal length, 33.7–36.3 (34.9); length of nasals, 36.8–40.6 (38.7); zygomatic breadth, 59.5–62 (61.2); breadth across mastoids, 44–45.8 (44.7); least interorbital breadth, 23.5–26.5 (24.9); breadth of rostrum, 19.7–21.3 (20.5); maxillary tooth row, 20.5–22.4 (21.2).

Remarks.—The southern woodchuck is a rather large animal of massive skull and pale color. With a wide range in the Middle States, it grades into a smaller and darker form (*rufescens*) in the southern parts of New York, Michigan, and Wisconsin. Specimens from northern Illinois (Lake Forest and Willow Springs) and northern Indiana (Rose Lawn and Lake Maxinkuckee) are typical of *monax*, but those from Delavan, Wis., and southwestern Michigan are intermediate between *monax* and *rufescens*. Specimens from Marble Cave, Mo., and from Johnson County, Iowa, are typical, but a small series from the vicinity of Lawrence, Kans., seems to indicate the presence there of a large form, skulls of females, especially, being much larger than those of females from Maryland and Virginia and equaling in size skulls of males from that region. The hind feet also average about 16 per cent longer in the Kansas animal (3 specimens). Additional material from that region may require naming the form.

Specimens examined.—Total number, 75, as follows:

Alabama: Ardell, 3.

District of Columbia: Washington, 6.

Georgia: Young Harris, 1.

¹ Six specimens from Maryland, Virginia, West Virginia, and Pennsylvania.

² Five specimens from Virginia, District of Columbia, and Pennsylvania.

- Illinois:** Cook County, 1; Lake Forest, 1;¹ Ozark, 2;¹ West Northfield, 1; Willow Springs, 1.¹
- Indiana:** Lake Maxinkuckee, 1; Marion County, 1;² Rose Lawn, 1.
- Iowa:** Iowa City, 4;³ Johnson County, 4;³ Wall Lake, 1; no specific locality, 3.³
- Kansas:** Douglas County (near Lawrence), 6;⁴ Lawrence, 3.⁴
- Kentucky:** Mammoth Cave, 1.
- Maryland:** Plummer Island, 2; Sandy Spring, 1; Simpsonville, 1; near Washington, D. C., 1.
- Michigan:** Cass County, 1;⁵ Dowagiac, 1.⁵
- Missouri:** Marble Cave, 2.
- North Carolina:** Magnetic City (base of Roan Mountain), 7; Roan Mountain (altitude 3,000-4,000 feet), 5.
- Ohio:** Hicksville, 1.¹
- Pennsylvania:** Beaver, 2;⁶ Chester County, 3; Fair Oaks, 1;⁶ Kennett Square, 1;⁷ Landenberg, 1;⁷ Marple, 1;⁷ Meadville, 1; Round Island, Clinton County, 2.⁷
- Tennessee:** Dover, Stewart County, 1; Duck River, 6 miles southwest of Waverly, 2; Highcliff, 1.
- Virginia:** Bluemont, 1; Clarke County, 1; Doswell, 1; Fairfax County (Potomac River), 3; Fincastle, 1; Fredericksburg, 2; Gunston, 1; Peaks of Otter, 1; Washington, 2.
- West Virginia:** Franklin, 3; Jobs Knob, 1; North Mountain, Hardy County, 1; Rowleysburg, 1.

MARMOTA MONAX RUFESCENS HOWELL.

RUFESCENT WOODCHUCK.

(Pl. IV, fig. 5; Pl. V, fig. 2; Pl. XI, fig. 2.)

Marmota monax rufescens Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 13.

Type locality.—Elk River, Minn.

Distribution.—Eastern North Dakota, central and southern Minnesota, Wisconsin, and Michigan, southern Ontario, greater part of New York (including Long Island), and higher parts of western Massachusetts.

Characters.—Similar to *monax* but colors much redder, both above and below, the underfur on back pinkish cinnamon instead of light buff; similar in color to *ignava*, but averaging paler; skull decidedly smaller than that of *monax*, but much larger than that of *canadensis*.

Color.—Underfur of upperparts varying from fuscous-black to dark mouse gray at base, succeeded by a broad area of light pinkish cinnamon shading to pinkish cinnamon on hinder back and to orange-cinnamon on hind legs; long hairs dark chestnut-brown subterminally, tipped with light buff; top of head and face benzo brown to clove brown; sides of face light buff, more or less mixed with brown; fore legs black, overlaid with burnt sienna; hind legs similar but usually less intensely red; feet black or blackish brown; tail vandyke brown

¹ Collection Field Mus. Nat. Hist.

² Collection Amer. Mus. Nat. Hist.

³ Collection Univ. of Iowa.

⁴ Collection Kansas Univ. Mus.

⁵ Collection Univ. of Michigan.

⁶ Collection Carnegie Museum.

⁷ Collection Acad. Nat. Sci. Philadelphia.

to clove brown or black; underparts varying from burnt sienna to Sanford's brown, more or less mixed with tawny, ochraceous-buff, and black (general tone of under parts usually reddish but sometimes mixed brown and buff with little red); tail vandyke brown to clove brown or black. *Variation*: Specimen from Essex County, N. Y.: Very dark chestnut-brown above (the underfur pinkish cinnamon), moderately grizzled on fore back with buffy white; hinder back solid brown.

Skull.—Similar to that of *monax*, but decidedly smaller and relatively broader across zygomata; much larger than that of *canadensis*; slightly larger than that of *ignava*, but narrower across orbits and with narrower nasals.

Measurements.—Adult male:¹ Total length, 520–582 (average, 548); tail vertebrae, 135–155 (143); hind foot, 81–85 (83). Adult female:² Total length, 545–608 (571); tail vertebrae, 145–170 (156); hind foot, 83–89 (85). *Skull*: Adult male:³ Condyllo-basal length, 81.3–94.4 (88.6); palatal length, 50.7–54.5 (51.8); postpalatal length, 32–36.4 (33.5); length of nasals, 33.9–39.8 (36.8); zygomatic breadth, 53.4–64.7 (60.2); breadth across mastoids, 40.3–46 (43.2); least interorbital breadth, 21.7–25.4 (23.8); breadth of rostrum, 18–21.2 (19.4); maxillary tooth row, 18.7–21.8 (20.1). Adult female:⁴ Condyllo-basal length, 84–88.9 (85.8); palatal length, 49.1–52.4 (50.6); postpalatal length, 31.5–31.8 (31.6); length of nasals, 33.4–39.1 (35.6); zygomatic breadth, 57.5–62 (59.9); breadth across mastoids, 40.6–43.8 (42.4); least interorbital breadth, 22.2–26.3 (23.6); breadth of rostrum, 18.2–20.4 (19); maxillary tooth row, 17.5–21 (19.7).

Remarks.—The woodchucks of the Northern States, from Minnesota to New York, differ from typical *monax* of the Middle States in having smaller skulls and darker colors, the underfur especially being more strongly reddish. The race shows a strong tendency toward melanism, particularly in New York and southern Ontario. The New York series differs from the Minnesota series in somewhat longer and relatively narrower skulls, being, therefore, more like *monax*, but the differences between the two extremes are too slight and inconstant to warrant recognition of another form. Specimens from the Catskill Mountains are fairly typical of *rufescens*, but those from the Hudson Valley and Lake George are clearly intermediate, the skulls being almost typical of *monax* and the skins of *rufescens*. These show no approach to the New England form (*prebolorum*). Two skulls (without skins) from Easthampton, Mass., are fairly typical of *rufescens*, indicating that this race probably occupies the higher parts of western Massachusetts. A specimen from Lake of Bays, Ontario (east side of Georgian Bay), considered intermediate between *rufescens* and *canadensis*, is very deep red below—fully

¹ Five specimens from Elk River and Fort Snelling, Minn.

² Five specimens from Fort Snelling, Minn.

³ Eleven specimens from Minnesota.

⁴ Five specimens from Minnesota.

as dark as *ignava*. The northern limit of the range of *rufescens* is assumed to be about the latitude of Ottawa, but no material is available from that part of Ontario, excepting the specimen mentioned above.

Specimens examined.—Total number, 231, as follows:

Massachusetts: Easthampton, 2.

Michigan: Ann Arbor, 3;¹ Au Sable River, Oscoda County, 1;¹ Genesee, 1; Rush Lake, Huron County, 1; ¹ Sand Point, Huron County, 1.¹

Minnesota: Elk River, 10; Fort Snelling, 17;² Princeton, 1.

New York: Adirondack Mountains, Essex County, 76 (skulls only); Ardsley, 1;³ Amber, 2; Brantingham, 1; Croton Lake, 1; Dutchess County, 1;³ Elizabethtown, 2; Essex County, 8; Halcottsville, 10;⁴ Hastings, 1;⁵ Highland Falls, 1; Lake George, 11; Leyden, 2; Locust Grove, 15; Lyons Falls, 5; Miller Place, 4;⁴ Orange County, 1; Owego, 1; Oyster Bay, 2; Peterboro, 4; Piseco, 1; Schroon, 1; Schroon Lake, 4; Sing Sing, 4; Suffolk County, 2;^{3,5} Troy, 3; Tupper Lake, 1;⁶ Wells, 3; no specific locality, 7.

North Dakota: Fargo, 3;⁷ Grafton, 1; Leonard, 1.⁸

Ontario: Lake of Bays, 1; Lorne Park, 7.

Wisconsin: Bridgeport, 1; Delavan, 2; Milton, 2;⁹ Racine, 1.

MARMOTA MONAX PREBLORUM HOWELL.

NEW ENGLAND WOODCHUCK.

(Pl. III, fig. 3; Pl. V, fig. 3; Pl. XI, fig. 3.)

Marmota monax preblorum Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 14.

Type locality.—Wilmington, Mass.

Distribution.—Southern New England, from Connecticut to central Vermont and New Hampshire and southern Maine.

Characters.—Size medium (smaller than *rufescens*, larger than *canadensis*); colors pale (redder than *monax*, but red not so dark as in *canadensis* or *rufescens*); skull smaller and relatively narrower than that of *rufescens*.

Color.—*Adult*: Underfur on upperparts pinkish cinnamon to light pinkish cinnamon, the bases of hairs fuscous-black; long hairs blackish brown, extensively tipped with white or light buff; top of head and face dark hair-brown to clove brown; sides of face light buff; fore legs burnt sienna or Sanford's brown, the bases of hairs often black; hind legs somewhat paler, shading to pinkish cinnamon; feet black or blackish brown; tail clove brown to black, much mixed with cinnamon; underparts pinkish cinnamon or Sanford's brown, varied with light buff. *Young* (specimen from Saun-

¹ Collection Univ. of Michigan.

² Three in collection Field Mus. Nat. Hist.; five in Amer. Mus. Nat. Hist.

³ Collection Amer. Mus. Nat. Hist.

⁴ Collection A. H. Helme, Miller Place, N. Y.

⁵ Collection Field Mus. Nat. Hist.

⁶ Collection Mus. Comp. Zool.

⁷ Two in collection Fargo College; one in N. Dak. Agr. College.

⁸ Collection N. Dak. Agr. College.

⁹ Collection H. H. T. Jackson, Washington, D. C.

derstown, R. I.): General tone, both above and below, pinkish buff (the hairs extensively tipped with that color and the bases of same shade), becoming pinkish cinnamon on hinder back; subterminal band of each hair blackish brown; fore legs Sanford's brown; hind legs tawny; top of head hair-brown.

Skull.—Similar to that of *rufescens*, but smaller and relatively narrower, especially the rostrum and interorbital region; bullae smaller; much larger than that of *canadensis*, with longer, slenderer rostrum and longer nasals.

Measurements.—Adult male:¹ Total length, 418–608 (average 515); tail vertebrae, 105–149 (120); hind foot, 75–80 (77.7). Adult female:² 465–600 (547); 100–157 (141); 69–88 (77). *Skull*: Adult male:³ Condyllo-basal length, 84–89 (86.2); palatal length, 49.9–51.6 (50.7); postpalatal length, 31.2–33.4 (32); length of nasals, 34.3–37.7 (35.9); zygomatic breadth, 57.3–60.4 (58.7); breadth across mastoids, 41.3–44.3 (42.8); least interorbital breadth, 20.7–22.5 (22.1); breadth of rostrum, 17.2–18.6 (18.2); maxillary tooth row, 18.2–20.2 (19.1). Adult female:⁴ Condyllo-basal length, 79.1–86.6 (83); palatal length, 47.7–51.6 (49.5); postpalatal length, 28–31.8 (30.1); length of nasals, 33.7–36.8 (35.6); zygomatic breadth 54–58 (56.6); breadth across mastoids, 37.7–42 (40.3); least interorbital breadth, 19.8–22.6 (21.6); breadth of rostrum, 16–19.5 (18); maxillary tooth row, 18–20.4 (19.3).

Remarks.—The New England woodchuck is noticeably smaller and paler than *rufescens*, and larger and paler beneath than *canadensis*. In skull characters it most resembles *rufescens* and probably intergrades with it where their ranges meet, but no intermediate specimens have been examined. A specimen from Liberty Hill, Conn., has somewhat redder underparts than the Massachusetts series, its skull being fairly typical of *preblorum*. Specimens of *rufescens* from the Hudson Valley, however, approach *monax* rather than *preblorum* in skull characters. Intergradation with *canadensis* also undoubtedly occurs, but material from northern New England is needed to show where the two forms come together. Specimens from Rutland, Vt., agree in skull characters with *preblorum*, but one of the two skins examined is somewhat redder below than in Massachusetts examples.

Specimens examined.—Total number, 38, as follows:

Connecticut: East Wallingford, 1;⁵ Liberty Hill, 1.⁶

Maine: Eliot, 1; Norway, 1.⁶

¹ Seven specimens from eastern Massachusetts.

² Nine specimens from eastern Massachusetts and southern New Hampshire.

³ Five specimens from Wilmington and Wareham, Mass.

⁴ Four specimens from Wilmington and Lunenburg, Mass.

⁵ Collection Am. Mus. Nat. Hist.

⁶ Collection Mus. Comp. Zool.

Massachusetts: Essex County, 1; Haverhill, 1;¹ Lunenburg, 4; Newtonville, 2;¹ Sherborn, 1; Springfield, 2;¹ Wareham, 2;¹ Wayland, 1;¹ Wilmington, 8; Woburn, 1.

New Hampshire: Charlestown, 2; Ossipee, 2; Webster, 3.¹

Rhode Island: Saunderstown, 1.

Vermont: Rutland, 3.²

MARMOTA MONAX IGNAVA (BANGS).

LABRADOR WOODCHUCK.

(Pl. V, fig. 4; Pl. XII, fig. 1.)

Arctomys ignavus Bangs, Proc. New England Zool. Club, I, 1899, p. 13.

[*Arctomys monax*] *ignavus* Elliot, Synop. Mamm. N. Am., Field Columb. Mus., Zool. Ser., II, 1901, p. 105.

[*Marmota monax*] *ignavus* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Marmota ignava Miller, Bul. 79, U. S. Nat. Mus., 1912, p. 292.

Type locality.—Black Bay, Straits of Belle Isle, Labrador.

Distribution.—Known only from vicinity of type locality; probably north to Hamilton Inlet.

Characters.—Size much larger than *canadensis*, nearly equaling *rufescens*; similar in color to *rufescens* (much darker than *canadensis*); skull short and broad with very broad nasals.

Color.—Underfur of upperparts blackish brown at base (a shade darker than in *canadensis*), succeeded by a broad area of orange-cinnamon; long hairs blackish brown subterminally, tipped with pale ochraceous-buff or buffy white; top of head and face vandyke brown or clove brown; sides of nose and borders of lips and chin buffy white; sides of face light ochraceous-buff more or less mixed with brown; feet and legs black, or very dark brown, the legs and thighs overlaid with burnt sienna; tail blackish brown, usually with little or no white grizzling; underparts burnt sienna mixed with black, varying to tawny and in some individuals more or less mixed with pinkish cinnamon or pale buff; in others, mixed blackish brown and buff below without any red.

Skull.—Similar to that of *rufescens*, but shorter and relatively broader; nasals shorter and relatively wider posteriorly; premaxillae averaging narrower; bullae smaller and less inflated; sagittal crest more prominent; incisors with numerous shallow longitudinal grooves on outer face. Compared with *prebblorum*: Skull about same length, but relatively broader; rostrum broader; nasals shorter and broader posteriorly; molars heavier. Compared with *canadensis*: Skull much larger, with decidedly heavier sagittal crest and less inflated bullae.

Measurements.—Adult male:³ Total length, 480–562 (average, 536); tail vertebrae, 111–155 (137); hind foot, 74–86 (80.8). Adult

¹ Collection Mus. Comp. Zool.

² Collection Amer. Mus. Nat. Hist.

³ Seven specimens from vicinity of type locality.

female:¹ 496-556 (528); 102-147 (126); 75-80 (78.6). *Skull*: Adult male:¹ Condyllo-basal length, 82.5-87.4 (85.1); palatal length, 48.5-51.2 (50); postpalatal length, 30.6-33 (31.7); length of nasals, 31.5-35.6 (34.1); zygomatic breadth, 57.5-63.4 (60.5); breadth across mastoids, 40.6-44 (41.7); least interorbital breadth, 24-26.8 (25); breadth of rostrum, 18-20.3 (19.2); maxillary tooth row, 19.9-20.8 (20.4). Adult female:¹ Condyllo-basal length, 79.7-84.4 (82.2); palatal length, 47-49.4 (48.2); postpalatal length, 29.2-31.7 (30.6); length of nasals, 31.3-34.2 (32.6); zygomatic breadth, 55.4-58.7 (57.1); breadth across mastoids, 39-41.5 (40.6); least interorbital breadth, 22.5-25 (23.8); breadth of rostrum, 17.6-19.7 (18.7); maxillary tooth row, 19-20.4 (19.9).

Remarks.—The Labrador woodchuck is a strongly marked form of the *monax* group, much larger and darker than *canadensis*, its nearest neighbor. Indeed, it might be considered a distinct species were it not practically certain that the ranges of *ignava* and *canadensis* are contiguous and that more material from the region between Murray Bay and the Straits of Belle Isle would show intergradation. In color and size the present form more closely resembles *rufescens* than *canadensis* and the skull is more like that of *prebblorum* than that of any other form, but *ignava* is much darker than *prebblorum*. The subspecies is reported to be common on the coast in the vicinity of Black Bay, and is said to be found about the head of Hamilton Inlet,² but the limits of its range are not known. Stearns reports woodchucks "common at Mingan, growing scarce toward Bonne Esperance."³

Specimens examined.—Total number, 15, as follows:

Labrador:⁴ Ailik, Peter's Cove, 1; Black Bay, 4; L'Anse au Loup, 10.

MARMOTA MONAX CANADENSIS (ERXLEBEN).

CANADA WOODCHUCK.

(Pl. VI, fig. 1; Pl. XI, fig. 4.)

[*Glis canadensis* Erxleben, Syst. Regn. Anim., 1777, p. 363.

Mus empetra Pallas, Nov. Spec. Quad., Glir. Ord., 1778, p. 75.

Arctomys sibila Wolf, Linne's Natursyst., II, 1808, p. 481. (Name proposed to include

Arctomys empetra Pallas and *Arctomys pruinosus* Gmelin, supposed to be the same).

Arctomys melanopus Kuhl, Beiträge, 1820, p. 64.

Arctomys marmota canadensis Kuhl, Beiträge, 1820, p. 64.

Arctomys empetra Sabine, Trans. Linn. Soc. London, XIII, 1822, p. 584; Richardson, Fauna Boreali-Americana, I, 1829, p. 147.

Arctomys monax melanopus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1897, p. 30.

Arctomys monax canadensis Allen, Bul. Amer. Mus. Nat. Hist., X, 1898, p. 456.

[*Marmota monax*] *canadensis* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

¹ Six specimens from vicinity of type locality.

² Low, A. P. Ann. Rept. Geol. Surv. Canada, VIII, 1895 (1897), p. 320L.

³ Stearns, W. A. Proc. U. S. Nat. Mus., VI, 1883, p. 115.

⁴ All in collection Mus. Comp. Zool.

Type locality.—"Canada et ad fretum Hudsonis"—here fixed at Quebec, Quebec.

Distribution.—Greater part of interior of Canada, from Great Slave Lake and York Factory south to southern Alberta (Red Deer), central Saskatchewan (Cumberland House), northern Minnesota, northern Wisconsin, northern Michigan, central Ontario, southern Quebec, New Brunswick, and Nova Scotia; northern and eastern limits of range in Quebec unknown.

Characters.—Size small; sexes about same size; colors strongly reddish, above and below; skull small without pronounced sagittal crest.

Color.—Underfur on upperparts blackish brown at base, succeeded by pinkish cinnamon or light pinkish cinnamon; long hairs blackish brown subterminally, tipped with white or pinkish buff; top of head and face hair-brown, sometimes shading to clove brown; sides of face light buff; feet and legs black, blackish brown, or fuscous, the legs and thighs overlaid with burnt sienna; tail blackish brown, considerably grizzled with cinnamon-buff or light buff; underparts deep tawny or burnt sienna sometimes varied with buff and moderately mixed with black. Melanistic specimens are rarely found, but one from Aitkin, Minn., is glossy blackish brown all over.

Skull.—Smallest of any member of the group; shorter and relatively broader than that of *prebolorum*, with short, broad rostrum; much smaller than that of *ignava*, with sagittal crest only slightly developed; nasals narrowed posteriorly; bullae relatively large, smoothly rounded, and considerably inflated.

Measurements.—Adult male: Total length, 510–515 (average 513); tail vertebrae, 108–109 (108.5); hind foot, 74–78 (76);¹ average of three adult males from Mackenzie and Alberta: 500; 124; 75. Adult female:² 508–560 (536); 131–140 (136); 69–76 (73). *Skull:* Adult male:³ Condyllo-basal length, 75–80.8 (78.1); palatal length, 43.7–48.2 (45.7); postpalatal length, 27.5–29.6 (28.7); length of nasals, 29.9–32 (31.3); zygomatic breadth, 53–56.6 (54.1); breadth across mastoids, 36.4–39.4 (38); least interorbital breadth, 18.4–22.7 (20.7); breadth of rostrum, 15.1–18 (16.6); maxillary tooth row, 18.2–19.3 (18.8). Adult female:⁴ Condyllo-basal length, 77.4–80 (78.9); palatal length 45.6–47.2 (46.2); postpalatal length, 28.2–30.5 (29.3); length of nasals, 30.5–34.5 (32.6); zygomatic breadth, 52.8–58.2 (54.8); breadth across mastoids, 36.5–39.8 (37.8); least interorbital breadth, 19.8–22 (20.9); breadth of rostrum, 14.5–17.8 (16.3); maxillary tooth row, 18.1–19.2 (18.6).

Remarks.—The Canada woodchuck has the most extensive distribution of any of the American forms and over the greater part of

¹ Two specimens from Murray Bay, Quebec.

² Three specimens from Quebec and Ontario.

³ Eight specimens from Mackenzie, Alberta, Manitoba, Quebec, Nova Scotia, and northern Wisconsin.

⁴ Seven specimens from Mackenzie, Manitoba, Ontario, Nova Scotia, and Quebec.

its range shows comparatively little variation. Although markedly smaller than *rufescens* it intergrades with that form wherever their ranges meet, intermediate examples having been examined from Tower and Two Harbors, Minn., and Lake of Bays, Ontario. Intergradation with *ignava* seems highly probable, though not shown by the material in hand. Murray Bay specimens have very much smaller skulls than typical *ignava* from the Labrador coast, and no specimens have been examined from the intervening region. Two specimens from Nova Scotia show slight approach to *ignava*, the skins being the same color except that the bases of the hairs on the back are browner. The skull of one of these specimens is typical of *canadensis*, the other is a little larger, with somewhat broader nasals and a well-marked sagittal crest.

A specimen from Porcupine Mountains, Mich., resembles *canadensis* in general coloration, but is extensively mixed with black both above and below. Its skull is slightly longer than skulls of typical specimens from Quebec. A specimen from Mount Mansfield, Vt., and one from Columbia Falls, Me., (both without skulls), are provisionally referred to *canadensis*, the former agreeing in color with the typical form, the latter with the dark Nova Scotia form. Specimens from southern Mackenzie and northern Alberta are practically identical in coloration with the Quebec series, but their skulls average longer and narrower, thus showing approach to *ochracea*. A single young specimen in very worn pelage from near the head of Finlay River, British Columbia, seems referable to *canadensis*, but more material from that region may necessitate its reference to *ochracea*. Woodchucks of this group are reported by Edward A. Preble as occurring at Fort Grahame, on Finlay River, and at Hudson's Hope.

Specimens examined.—Total number, 45, as follows:

Alberta: Athabaska River (near Fort McMurray), 1; McLeod River, 1; Peace River Landing, 2;¹ Red Deer, 1;² South Edmonton, 1.

British Columbia: Finlay River (near head), 1.

Mackenzie: Fort Liard, 1; Fort Simpson, 5; Little Buffalo River, 1.

Maine: Columbia Falls, 1.

Manitoba: Oxford House, 1; Trout Lake, 4; York Factory, 1.

Michigan: Porcupine Mountains, 1;³ Whitefish Point, Chippewa County, 1.³

Minnesota: Aitkin, 1;² Tower, 1; Two Harbors, 1.

New Brunswick: Arthurette, 2;⁴ Scotch Lake, 1.

North Dakota: Pembina, 1.

Nova Scotia: Newport, 2.⁴

Ontario: Devils Portage, Mattagami River, 1;⁵ James Bay, 1; Moose River (near Hudson Bay) 2.⁴

Quebec: Murray Bay, 7.²

Vermont: Mount Mansfield, 1.

Wisconsin: Conover, 1.²

¹ Collection Victoria Mem. Mus.

² Collection Field Mus. Nat. Hist.

³ Collection Univ. of Michigan.

⁴ Collection Amer. Mus. Nat. Hist.

⁵ Collection Carnegie Mus.

MARMOTA MONAX PETRENSIS SUBSP. NOV.

BRITISH COLUMBIA WOODCHUCK.

(Pl. VI, fig. 2.)

Type from Revelstoke, British Columbia. Adult ♂, No. 203532, U. S. Nat. Mus., Biological Survey collection. Collected May 12, 1890, by W. Spreadborough; original number, 170.

Distribution.—Interior ranges of southern British Columbia and adjacent parts of United States, from Barkerville, British Columbia, south to Thompson Pass, Idaho.

Characters.—Similar to *canadensis*, but skull larger and relatively longer.

Color.—Practically the same as *canadensis*.

Skull.—Similar to that of *canadensis*, but larger and relatively longer; nasals rather short, projecting but little back of posterior ends of premaxillae; bullae rather small. Compared with *rufescens*: Smaller with shorter nasals and smaller, rounder bullae.

Measurements.—Adult male (type):¹ Total length, 540; tail vertebrae, 127; hind foot, 76; specimen from Barkerville, British Columbia: 460; 106; 72. Adult female (specimen from Barkerville, British Columbia): 505; 125; 68. *Skull*: Adult male (type): Condyllo-basal length, 86; palatal length, 50.3; postpalatal length, 31.8; length of nasals, 32.5; zygomatic breadth, 57.4; breadth across mastoids, 42; least interorbital breadth, 23; breadth of rostrum, 18.6; maxillary tooth row, 20. Adult female (specimen from Barkerville, British Columbia): Condyllo-basal length, 79; palatal length, 46.5; postpalatal length, 29.5; length of nasals, 32.4; zygomatic breadth, 53.2; breadth across mastoids, 36; least interorbital breadth, 19.4; breadth of rostrum, 17.6; maxillary tooth row, 18.8.

Remarks.—This is a slightly differentiated form of *monax*, occupying an area somewhat segregated from the rest of the species. It is known at present from only a few specimens and the limits of its range can not definitely be determined. It probably occurs sparingly throughout the heavily timbered mountain sides of the northern Rocky Mountains in Montana, Idaho, and British Columbia, but whether confined entirely to the west slope or not (as seems probable) has not yet been ascertained. This subspecies has no direct connection with *monax* or *rufescens*, its range being separated from theirs by an extensive area of plains, but it undoubtedly intergrades with *ochracea* on the north and possibly with *canadensis* through some of the passes of the mountains in southern British Columbia.

Specimens examined.—Total number, 6, as follows:

British Columbia: Barkerville, 2; Glacier, 2; Revelstoke, 1.

Idaho: Thompson Pass, 1.

¹ From dry skin.

MARMOTA MONAX OCHRACEA SWARTH.

OCHRACEOUS WOODCHUCK.

(Pl. VI, fig. 3; Pl. XII, fig. 3.)

Marmota ochracea Swarth, Univ. of California Pub. Zool., VII, 1911, p. 203.

Type locality.—Head of Fortymile Creek, Alaska.

Distribution.—Interior mountain ranges of Yukon and northern British Columbia, from Fortymile Creek south to the Babine Mountains (and Stuart Lake?).

Characters.—Similar to *canadensis*, but paler below and hairs on back extensively tipped with ochraceous, the underfur more vinaceous; tail pinkish cinnamon all around; skull longer and relatively narrower.

Color.—Underfur of upperparts dark mouse gray at base, succeeded by a broad area of vinaceous-cinnamon, the latter shading toward the tips into orange-cinnamon, most intense on hinder back; long hairs orange-cinnamon, then blackish brown, broadly tipped on fore back with ochraceous-buff and on hinder back with light ochraceous-buff; top of head dark hair-brown; sides of nose and face light ochraceous-buff; underparts tawny shading to hazel; legs hazel; feet fuscous or fuscous-black with scattering hazel hairs; tail pinkish cinnamon all around, the tip clove brown. *Variation*: Young specimen from type locality: Darker below than adult, and feet more varied with hazel. Immature specimen from Pike River, British Columbia: Upperparts cinnamon (without plumbeous bases to the hairs), tipped with pinkish buff; underparts cinnamon-rufous.

Skull.¹—Longer and relatively narrower than that of *canadensis*, with narrower rostrum and interorbital region; bullae broader.

Measurements.²—*Skull*: Subadult (male?) from Babine Mountains, British Columbia: Condyllo-basal length, 81.2; palatal length, 48; postpalatal length, 30; length of nasals, 33.4; zygomatic breadth, 52.7; breadth across mastoids, 39.8; least interorbital breadth, 19.8; breadth of rostrum, 17.2; maxillary tooth row, 20.

Remarks.—This subspecies is the most northerly ranging member of the group. It occurs west of the continental divide in Yukon and northern British Columbia, but the limits of its range are not known. Only six skins have been seen. A specimen from near Teslin Lake, southern Yukon, is slightly darker below than the type (being uniform kaiser brown); the fore back is darker ochraceous, and the head blackish brown. Another specimen from Pike River, British Columbia, is dark blackish brown all over. A series of skulls without skins from Stuart Lake, British Columbia, is provisionally referred to this race.

¹ No skulls from the type region available; description based on subadult specimen from Babine Mountains, British Columbia.

² No external measurements available.

Specimens examined.—Total number, 15, as follows:

Alaska: Fortymile Creek (at head), 2.¹

British Columbia: Babine Mountains, 1 (skull); Pike River, Atlin, 2;² Stuart Lake, 8 (skulls); Tacla Lake, 1.

Yukon: Thirty Mile Mountains, near Teslin Lake, 1.³

Cranial Measurements of the *Marmota monax* Group.

No.	Species and locality.	Sex.	Condyllo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
<i>Marmota monax monax.</i>												
114009	Montgomery Co., Md.	♂	102.5	59.5	37.7	41.5	69.2	50.2	27.3	23.7	21.9	Old.
175010	Plummers Island, Md.	♂	97.5	56.7	37.7	41.8	66.6	46.5	25.9	21.2	21.2	Adult.
143962	Peaks of Otter, Va.	♂	98.1	58.1	33.6	40.5	65.7	47.2	27.2	20.7	21.2	Do.
58695	Roan Mountain, N. C.	♂	94	57.3	32.6	38.7	....	42.9	24.4	19.5	21.6	Do.
4 447	Douglas County, Kans.	♂	98.7	58.8	36.5	43	....	45.7	27.2	19.7	20.6	Subadult.
125331	Bluemont, Va.	♂	93.7	56	35.3	40.6	61.9	45.8	26.5	19.9	21.2	Adult.
77926	Washington, D. C.	♂	90.4	53.4	33.7	38	59.5	44.3	23.5	21.3	20.5	Do.
4 441	Douglas County, Kans.	♂	100.6	58.7	37.9	43	66.7	49.2	28.4	21.8	21.8	Do.
4 448	do.	♂	95.8	56.3	35.4	43	67.3	48.5	29	23.2	21.9	Do.
6 16029	Lake Forest, Ill.	♂	92	54	34.2	38.6	62.7	46.4	26	22.5	21.6	Do.
<i>Marmota monax rufescens.</i>												
186521	Elk River, Minn.	♂	87.2	50.9	33.2	35.5	64.7	45.1	24.2	18.7	20.4	Adult; type.
191333	do.	♂	89.8	52.2	34	37	59.8	43.4	23.5	20.5	20.9	Adult.
6 3508	Fort Snelling, Minn.	♂	90.7	53.6	34.4	39.8	63.2	42.8	25.3	18.6	21.8	Do.
6 1780	do.	♂	94.4	54.5	36.4	36	61.7	44	25.4	21.1	19	Do.
191244	Locust Grove, N. Y.	♂	90	53.2	32.2	36.5	64.5	44	25.5	21	20.6	Do.
(7)	Adirondack Mountains, N. Y.	♂	91.6	54.2	33.7	38.4	61.4	44.1	24.4	19.8	20.8	Do.
191339	Elk River, Minn.	♂	84.2	49.1	31.5	34.5	57.5	40.6	22.5	18.3	20	Do.
33561	Fort Snelling, Minn.	♂	87.8	52.4	31.8	39.1	62	43.8	23.7	20.4	21	Do.
122207	do.	♂	84	50.3	31.5	33.4	49.2	42	26.3	20	17.5	Do.
191250	Locust Grove, N. Y.	♂	86.3	51	32.5	37.8	60	42	21.8	17.5	20.2	Do.
(8)	Adirondack Mountains, N. Y.	♂	86.8	51.4	31.2	37.1	59.8	41.9	23.5	19.2	20.2	Do.
111091	Peterboro, N. Y.	♂	85	50.3	31.2	35.7	59.4	42	22.8	19.5	20.3	Do.
<i>Marmota monax preblorum.</i>												
78360	Wilmington, Mass.	♂	85.3	50.5	32	34.8	57.4	43.7	22.8	18.5	18.2	Adult; type.
78354	do.	♂	86.1	51.5	31.2	36.3	58.2	42.7	22.5	17.2	18.3	Adult.
78355	do.	♂	84	49.9	31.2	36.2	57.3	41.3	20.7	18.2	19.5	Do.
77111	Ossipee, N. H.	♂	85.4	49.7	31.6	36.6	60.4	43.6	23	19.5	18.9	Do.
6 8235	Rutland, Vt.	♂	85	50.5	31.1	37.5	58	42.2	23.5	18.5	20.5	Do.
78356	Wilmington, Mass.	♂	79.1	47.7	28	33.7	54	37.7	19.8	16	18	Do.
78359	do.	♂	84.8	49.9	31.8	36.8	57.8	40	22.6	18.1	19	Do.
96083	Lunenburg, Mass.	♂	86.6	51.6	30.7	36.5	56.7	42	21.4	19.5	20.4	Do.
96142	do.	♂	81.6	48.7	30	35.3	58	41.5	22.6	18.3	19.6	Do.
<i>Marmota monax ignava.</i>												
9 8871	L'Anse au Loup, Labrador	♂	87.4	51.2	32.5	35.5	63.4	41.7	26.8	19.7	20.8	Adult.
9 8872	do.	♂	82.7	48.7	31	33.2	59	41.2	24.3	18.5	20	Do.
9 8873	do.	♂	85.5	51	32	35.4	60.5	42	24	20.3	20.7	Do.
9 8876	do.	♂	84.4	49.1	31.7	33.6	58.7	41.3	25	19.7	19	Do.
9 8875	do.	♂	84	49.4	30.6	34.2	58.6	41.5	24.3	18.8	19.6	Do.
9 7968	Black Bay, Labrador	♂	80.6	47.7	29.7	31.5	55.8	40	23	17.6	19.5	Do.
<i>Marmota monax canadensis.</i>												
6 7607	Murray Bay, Quebec.	♂	77.3	44	29.6	30.5	56.6	39.4	22.7	17.4	19.1	Adult.
6 7603	do.	♂	75	43.7	28.8	32	53.2	36.4	21.7	16	18.7	Do.
6 16209	Newport, Nova Scotia.	♂	76.4	44.5	28.7	32	53	38.2	20.5	15.8	18.6	Subadult.
191344	Carberry, Manitoba.	♂	79.2	46.3	27.5	31.7	....	36.5	20.5	15.1	19	Adult.
17740	Smith Portage, Mackenzie.	♂	78.3	45.8	28.6	31	53.3	38	20.5	17.2	18.3	Do.
6 7602	Murray Bay, Quebec.	♂	77.6	45.6	28.8	33.5	56.6	38	22	17.6	19	Do.
6 7608	do.	♂	78.7	46	29.6	32	53.3	39	20.4	17.1	18.4	Subadult.
110192	Oxford House, Manitoba.	♂	79.7	47	28.4	33.3	54.7	37.2	21.1	15.9	18.7	Adult.
177378	Little Buffalo River, Mackenzie.	♂	80	47.2	30.5	31.3	52.8	37.3	19.8	16.6	18.1	Do.
6 16208	Newport, Nova Scotia.	♂	79.6	46	30.3	33.3	55.8	38.22	17.7	17.2	19.2	Do.

¹ Collection Mus. Vert. Zool., Univ. of California.

² Collection Provincial Mus., Victoria, B. C.

³ Collection Victoria Mem. Mus.

⁴ Collection Kansas Univ. Mus.

⁵ Collection Field Mus. Nat. Hist.

⁶ Collection Amer. Mus. Nat. Hist.

⁷ Average of 10 adults, Merriam collection.

⁸ Average of 7 adults, Merriam collection.

⁹ Collection Mus. Comp. Zool.

Cranial measurements of the *Marmota monax* group—Continued.

No.	Species and locality.	Sex.	Condylo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mass-tolds.	Least interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
<i>Marmota monax petrensis.</i>												
203532	Revelstoke, British Columbia....	♂	86	50.3	31.8	32.5	57.4	42	23	18.6	20	Adult; type.
101295	Barkerville, British Columbia..	♀	79	46.5	29.5	32.4	53.2	36	19.4	17.6	18.8	Adult.
<i>Marmota monax ochracea.</i>												
202785	Babine Mountains, British Columbia.....	[♂?]	81.2	48	30	33.4	52.7	39.8	19.8	17.2	20	Subadult.
77143	Stuart Lake, British Columbia..	♂	80.6	47.6	29.5	30.6	55.6	38.2	20.6	18.8	19	Adult.
77141	.....do.....	[♂?]	80.2	47.3	30.5	32.4	55.6	38.1	19.8	17.2	17.6	Do.
77137	.....do.....	[♂?]	76.5	45	28.9	32.4	52	36.7	22	16.8	18.6	Do.
77140	.....do.....	[♀?]	77.1	45.4	29.3	31.4	51.3	36.2	19.6	17.4	....	Do.

***Marmota flaviventris* Group.**

[Characters under species.]

MARMOTA FLAVIVENTRIS (AUDUBON & BACHMAN).

[Synonymy under subspecies.]

External characters.—Size variable (small to medium);¹ tail relatively long (about 25 to 30 per cent of total length); ears small; sole pads as in the *monax* group (see Pl. III, fig. 2); mammae: P. $\frac{2}{2}$; A. $\frac{2}{2}$; I. $\frac{1}{1}$ = 10; head usually with white markings between eyes (absent or reduced in *obscura*); sides of neck with conspicuous buffy patches; feet varying from light buff to hazel or dark brown (never black); tail mixed hazel and dark brown (fading to clay color).

Cranial characters.—Skull similar in general outline to that of *monax*; interorbital region relatively narrower; postorbital processes longer and slenderer, projecting slightly back of a line drawn across their bases at right angles to axis of skull; nasals decidedly narrowed posteriorly, where their width is equal to or less than that of nasal branches of premaxillae; temporal ridges usually united in old age to form a well-defined but rather low sagittal crest; floor of basi-occipital with a median subcircular depression, bounded laterally by two low processes which converge and unite into a ridge near the inferior lip of the foramen magnum; posterior border of palate beveled at an obtuse angle; interpterygoid fossa relatively narrow; palatal foramina usually contracted posteriorly or of equal width throughout; molar teeth light; maxillary tooth rows slightly divergent anteriorly; anterior face of incisors yellowish white to zinc orange.

¹ Two adult male specimens of *M. flaviventris nosophora* weighed, respectively, 10 and 12 pounds; two adult males of *M. flaviventris dacota*, 8 and 17 pounds, the latter being very fat.

Color.—General tone of upperparts vinaceous- or orange-cinnamon, hazel, chestnut-brown, or vandyke brown; underfur of upperparts at base mouse gray, fuscous, bister, clove brown, or blackish brown, succeeded by pinkish-, ochraceous-, or cinnamon-buff, pinkish-, vinaceous-, or orange-cinnamon, cartridge- or tilleul-buff, buffy white, hazel, or pale russet; long hairs chestnut-brown, olive-brown, hazel, or black, tipped with light buff, ochraceous- or cinnamon-buff, or white; top of head and face cinnamon-drab, chestnut, bay, chestnut-, vandyke-, or clove-brown, or black; sides of face chestnut-brown or blackish brown, more or less mixed with white or buff; face usually more or less extensively marked with a band or patch of white or buff between the eyes (nearly obsolete in *obscura*); borders of nose, lips, and chin white or ochraceous-buff; sides of neck usually with conspicuous patches of ochraceous-buff or cinnamon-buff (nearly obsolete in *obscura*); underparts ochraceous-buff, ochraceous-tawny, hazel, chestnut-, kaiser-, or blackish-brown, often varied with russet, Sanford's brown, tawny, or pale buff; fore legs ochraceous-buff, tawny, hazel, russet, or kaiser brown, the feet chestnut-brown, russet, auburn, pinkish cinnamon, or cinnamon-buff; hind legs ochraceous-buff, tawny, or hazel (rarely brownish), the feet varying from light buff or pinkish cinnamon to russet, hazel, chestnut-brown, or blackish brown; tail above, hazel, tawny, chestnut-brown, blackish brown, or (in faded pelage) clay color; beneath, blackish brown or chestnut-brown; ears usually some shade of buff, bordered with dark brown.

Geographic distribution.—From the interior valleys of southern British Columbia south in the Great Basin to the Toyabe Mountains, Nev., and Parawan Mountains, Utah; in the Cascade-Sierra system, from Mount Hood, Oreg., to vicinity of Owens Lake, Cal.; and in the Rocky Mountain system, from Flathead Lake, Mont., to the Pecos River Mountains, N. Mex.;¹ east to the Black Hills, S. Dak.; confined to mountains, foothills, and rocky canyons, not occurring on the plains proper. (See fig. 2.)

Remarks.—*Marmota flaviventris* usually may be readily distinguished from *M. monax* by the more ochraceous coloration, by the buffy, hazel, or tawny legs and feet (the latter usually black or blackish brown in *monax*), and by the presence of white or buffy face markings; occasional specimens of *M. flaviventris obscura* and *M. flaviventris luteola* rather closely resemble certain specimens of the *monax* group, but always lack the deep reddish hairs on the fore legs.

¹ Formerly to the Manzano and Datil Mountains (vicinity of Old Fort Tularosa).

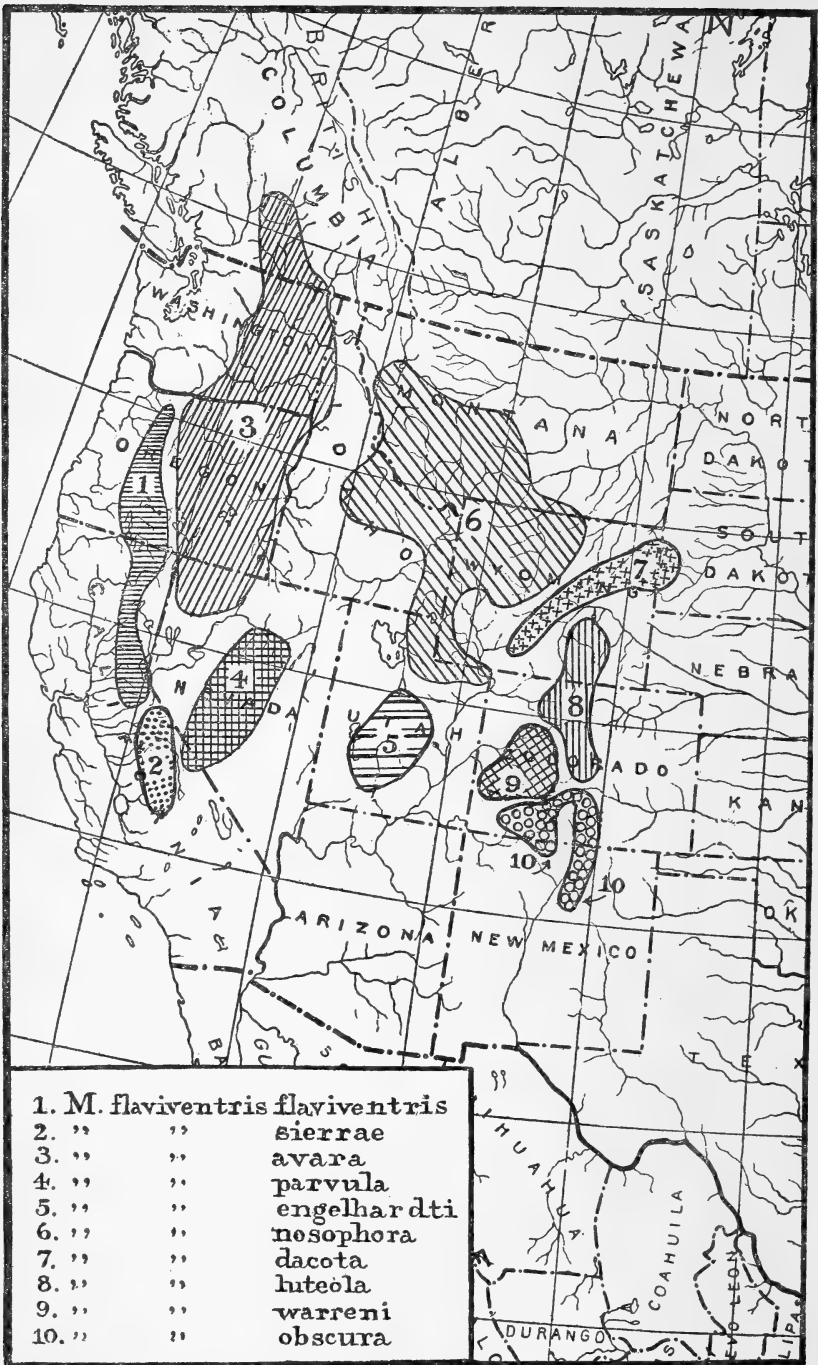


Fig. 2.—Distribution of the *Marmota flaviventris* group. Unshaded areas within the range of the group indicate a lack of definite knowledge as to the subspecies occurring there.

MARMOTA FLAVIVENTRIS FLAVIVENTRIS (AUDUBON & BACHMAN).

YELLOW-BELLIED MARMOT.

(Pl. III, fig. 2; Pl. VII, fig. 1; Pl. XIII, fig. 1.)

Arctomys flaviventris Audubon & Bachman, Proc. Acad. Nat. Sci. Philadelphia, 1841, p. 99; Quad. N. Am., III, 1853, p. 160, Pl. CXXXIV.

[*Marmota*] *flaviventris* Trouessart, Cat. Mamm. Suppl., 1904, p. 344.

Type locality.—"Mountains between Texas and California".—here fixed on Mount Hood, Oreg. (See remarks following, p. 40.)

Distribution.—The Cascade Range in Oregon and the northern Sierra in California, south to Lake Tahoe.

Characters.—Size large; general tone of upperparts russet, grizzled with white, the fore back sometimes overlaid with a rather indistinct buffy mantle; underparts ochraceous-buff to hazel; feet ochraceous or hazel; skull massive.

Color.—Underfur of upperparts deep mouse gray at base, succeeded by a broad area of buffy white, the latter shading on hinder back to pinkish cinnamon (sometimes to hazel); long hairs chestnut-brown or clove brown subterminally, tipped on fore back with light buff, on hinder back with white; top of head and face chestnut-brown to blackish brown, sometimes varied with cinnamon-drab, with an indistinct band of buffy white or ochraceous-buff across face in front of eyes; sides of face mixed chestnut-brown and cinnamon-buff; sides of neck with large patches of light ochraceous-buff; fore legs and feet tawny to hazel; hind feet light ochraceous-buff more or less varied with light hazel; tail hazel (fading to clay color), the bases of the hairs and under surface natal brown, varying to chestnut-brown or blackish brown; underparts ochraceous-buff, varying to hazel, becoming light ochraceous-buff around base of tail, the bases of some of the hairs indistinctly chestnut-brown; sides of nose, lips, and chin white, often varied with ochraceous-tawny around nose and edged with hazel or kaiser brown on throat.

Skull.—Largest of any member of the group; relatively long and narrow; nasals long, and narrow posteriorly; nasal branches of premaxillae broad; postorbital constriction broad; rostrum long and narrow; palatal foramina narrow.

Measurements.—Adult male from Donner, Cal.: Total length, 700; tail vertebrae, 180; hind foot, 90. Adult female from Crater Lake, Oreg.: 640; 170; 80. Adult female from Donner, Cal.: 600; 170; 85.

Skull: Adult male:¹ Condyllo-basal length, 92.5–97.1 (average 94.5); palatal length, 52.3–55 (53.8); postpalatal length, 37.6–38.2 (37.9); length of nasals, 42.5–42.6; zygomatic breadth, 62.3; breadth across mastoids, 41.1–46.2 (43.9); least interorbital breadth, 21.2–23 (22.1); breadth of rostrum, 22.3–23 (22.8); maxillary tooth row, 19.5–

¹ Three specimens from Mount Hood, Oreg., and Fort Crook and Donner, Cal.

20.9 (20.1). Adult female:¹ Condyllo-basal length, 82-87 (84.2); palatal length, 45.8-48.7 (47.6); postpalatal length, 30.6-34.5 (34.1); length of nasals, 34.5-37.2 (35.9); zygomatic breadth, 54.4-58.4 (55.9); breadth across mastoids, 38.5-40.7 (39.8); least interorbital breadth, 17.3-19.3 (18.5); breadth of rostrum, 17.8-21.4 (19.8); maxillary tooth row, 19.5-22.1 (20.5).

Remarks.—This species was described in 1841 and the name has been in use ever since in a broad sense for the marmots of the Sierra-Cascade range and, by most authors, for the Rocky Mountain forms as well. The original describers' statement as to the source of the type specimen—"mountains between Texas and California"—is not only too indefinite to be of use, but the evidence points to its being incorrect. The type specimen, as stated by Audubon and Bachman, was obtained by David Douglass and (the skin only) is still in a fair state of preservation in the British Museum, but unfortunately is unaccompanied by data to show where it was collected. Douglass's journal has been published,² and from it we learn that he spent a considerable time at Fort Vancouver near the mouth of the Columbia River, whence he made journeys up the Columbia and Willamette Valleys and through eastern Washington and southern British Columbia. He spent some time, also, on the coast of California, below Monterey, but apparently never visited either the Sierra or the Cascades proper. His journal does not mention the capture of any marmots.³ He might easily have secured the type specimen on his journey through eastern Washington, in which case it would be the form now known as *avara*, or he might have obtained it from Indians or travelers who had visited Mount Hood—a comparatively short distance from his headquarters—in which case it would be referable to the form which now bears the name *flaviventris*. In order to settle the question a specimen from Mount Hood and one from Okanogan, British Columbia, were submitted to Oldfield Thomas, who compared them with the type in the British Museum. He states as follows:

The underside of forearms [in the type] are about as rufous and its rump as brown and finely speckled as the Oregon specimen, but it has got distinctly the broadly buffy mantle on the fore back so marked in the British Columbia specimen. The type is a good adult skin which has borne remaking very well. The skull, unfortunately, is not in existence.

The buffy mantle of which Mr. Thomas speaks is not a diagnostic character, since it appears in both the British Columbia and Cascade forms. The rufous color of the fore legs, however, is diagnostic,

¹ Seven specimens from Crater Lake, Oreg., and northern parts of Sierra Nevada, Cal.

² Hooker, W. J. Companion to Botanical Mag., II, 1836, pp. 79-182.

³ The statement [p. 92] that a curious species of *Arctomys* was secured and other references to "*Arctomys brachyurus*" [pp. 101-115] doubtless refer to species of either *Citellus* or *Aplodontia*.

and, except for size and cranial characters, is the only sure distinguishing characteristic of the two forms. It seems clear, therefore, that the name *flaviventris* must be applied to the darker of the two forms found in Oregon and Washington, and I have therefore selected Mount Hood, Oreg., as the type locality. The series available from the Cascades is small and contains only one adult male skull—an old weathered specimen picked up on Mount Hood. Several adult females in the collection from Crater Lake and the Klamath Lake region, however, agree essentially with specimens from Fort Crook and the northern Sierra of California. South of Lake Tahoe *flaviventris* grades imperceptibly into the subspecies *sierrae*, occupying the southern end of the Sierra Nevada, in the Mount Whitney region. Intergradation with *avara* occurs in the region east of Klamath Lake and probably all along the east base of the Cascades.

Specimens examined.—Total number, 48, as follows:

California: Donner, 17; Emerald Bay, 1; Fort Crook, 3; Glen Alpine Springs, El Dorado County, 2;¹ Hope Valley, Alpine County, 2; Lassen Creek, Warner Mountains, 1; Mount Lassen, 2; Pine Creek, Lassen County, 1.

Nevada: Mount Siegel, Douglas County, 1;² Winters Mine, Douglas County, 1.²

Oregon: Crater Lake, 2; Fort Klamath, 3; Klamath Lake, 6; Linkville, 2; Mount Hood, 3; Summer Lake, 1.

MARMOTA FLAVIVENTRIS AVARA (BANGS).

PALLID YELLOW-BELLIED MARMOT.

(Pl. VII, fig. 3; Pl. XIII, fig. 3.)

Arctomys flaviventer avarus Bangs, Proc. New England Zool. Club, I, 1899, p. 68.

[*Marmota flaviventer*] *avarus* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Okanogan, British Columbia.

Distribution.—Interior valleys and foothills of southern British Columbia and eastern Washington and Oregon.

Characters.—Similar to *flaviventris*, but smaller and colors paler, especially the underfur and fore legs; upperparts more extensively overlaid with buff.

Color.—General tone of upperparts chestnut-brown, heavily grizzled with buff; underfur at base deep mouse gray (varying to pale fuscous) succeeded by buffy white, the latter shading to light pinkish cinnamon on hinder back; long hairs blackish brown or clove brown subterminally, extensively tipped on fore back with warm buff and on hinder back with light buff; head and face blackish brown or dark chestnut-brown, with an indistinct narrow band of white or buff across face in front of eyes; sides of neck warm buff; fore legs and feet ochraceous-buff; hind legs, hind feet, and buttocks light ochraceous-buff, the feet varying to hazel; tail hazel, the hairs tipped

¹ Collection Mus. Vert. Zool., Univ. of California.

² Collection Field Mus. Nat. Hist.

with warm buff, their bases chestnut-brown; underparts ochraceous-buff or light ochraceous-buff, the bases of the hairs on belly chestnut-brown; sides of nose, lips, and chin white, bordered on throat with hazel.

Skull.—Similar to that of *flaviventris*, but decidedly smaller; nasals shorter, ending but little back of posterior border of premaxillae.

Measurements.—Adult male:¹ Total length, 495–660 (average 554); tail vertebrae, 149–178 (165); hind foot, 76–80 (78). *Skull*: Adult male:² Condyllo-basal length, 85.7–86.5 (86.1); palatal length, 47.9–48.8 (48.3); postpalatal length, 34–34.8 (34.4); length of nasals, 36.6–37.6 (37.1); zygomatic breadth, 55.6–56.7 (56.1); breadth across mastoids, 39.1–42.2 (40.6); least interorbital breadth, 17.8–19.5 (18.6); breadth of rostrum, 19.4–20 (19.7); maxillary tooth row, 19–19.3. Adult female:³ Condyllo-basal length, 76.4–79.4 (77.9); palatal length, 42.6–44.6 (43.6); postpalatal length, 30.3–31 (30.7); length of nasals, 31.5–33.5 (32.8); zygomatic breadth, 52.4–52.7 (52.5); breadth across mastoids, 37.6–38.6 (38); least interorbital breadth, 17.1–18 (17.6); breadth of rostrum, 16.8–18.3 (17.3); maxillary tooth row, 17.8–19.1 (18.5).

Remarks.—This is a small, pale race of *flaviventris* living in the low foothills of eastern Oregon and Washington and southern British Columbia. It intergrades with *flaviventris* along the eastern base of the Cascades, in Oregon; with *nosophora* in northwestern Montana; and probably with *parvula* in northern Nevada. Specimens from Spokane Bridge, Wash., are a little darker than the typical form, and one from Elgin, Oreg., has a slightly larger skull. Specimens from Rockland, Wash., are intermediate between *avara* and *flaviventris*. Melanistic individuals are rare in this race; one from Pullman, Wash., has the fore back solid black, faintly grizzled with white, and the underfur pale gray; the hinder back is gray, the hairs being black subterminally and tipped with white; the belly and feet are black varied with buff; and the tail is black varied with tawny and white.

Specimens examined.—Total number, 53, as follows:

British Columbia: Ashcroft, 8; Cascade, 6;⁴ Midway, 9;^{4,5,6} Nicola Valley, 1;⁶ Okanogan, 9; Penticton, 1;⁴ Vernon, 1.

Oregon: Elgin, 2; Harney, 2; Guano Creek, Lake County, 1.

Washington: Cheney, 1; Diamond, 1; Douglas, 1; Pullman (14 miles southwest), 1; Rockland, 4; Spokane Bridge, 5.

¹ Four specimens from Okanogan, British Columbia; and Douglas, Wash.

² Two specimens from Okanogan and Cascade, British Columbia.

³ Four specimens from southern British Columbia.

⁴ Collection Victoria Mem. Mus.

⁵ Collection Field Mus. Nat. Hist.

⁶ Collection Amer. Mus. Nat. Hist.

MARMOTA FLAVIVENTRIS SIERRAE SUBSP. NOV.

SOUTHERN SIERRA MARMOT.

(Pl. IV, fig. 4.)

Type from head of Kern River, Mount Whitney, Cal. (altitude, 9,300 feet). Adult ♀, No. $\frac{30284}{42359}$, U. S. Nat. Mus., Biological Survey collection. Collected Sept. 3, 1891, by Vernon Bailey; original number, 3242.

Distribution.—Higher parts of the southern Sierra Nevada from upper Kern River north to vicinity of Mono Lake.

Characters.—Similar to *flaviventris*, but colors redder and buffy mantle reduced or obsolete; skull smaller.

Color.—General tone of upperparts vinaceous-cinnamon to mikado brown, narrowly grizzled with white; underfur at base pale bister succeeded by pale pinkish buff, shading at tips into vinaceous-cinnamon and on hinder back to orange-cinnamon or mikado brown; long hairs chestnut-brown or blackish brown subterminally, tipped with white or buffy white; top of head and face dark cinnamon-drab to clove brown, with a rather large patch of white in front of eyes; sides of neck warm buff; fore legs and feet hazel varied with light ochraceous-buff; hind feet similar, or sometimes light buff, varied with brown; tail hazel, the bases of hairs light bister; underparts light ochraceous-buff, much mixed on sides and belly and bordered on throat with mikado brown.

Skull.—Similar to that of *flaviventris*, but decidedly smaller; very similar to that of *avara* but averaging slightly larger, and nasals longer.

Measurements.—Adult male topotype: Total length, 600; tail vertebrae, 200; hind foot, 83. Adult male:¹ 600; 165; 80. Adult female:² 555–645 (average 593); 167–186 (176); 75–80 (77). *Skull*: Adult male:³ Condyllo-basal length, 79.1–85.5 (average 84.7); palatal length, 44–50.5 (47.7); postpalatal length, 30.8–35 (33); length of nasals, 32.6–39 (36.3); zygomatic breadth, 52–58.3 (55.8); breadth across mastoids, 37.5–43.6 (40.8); least interorbital breadth, 17–20.3 (18.1); breadth of rostrum, 17–20 (18.6); maxillary tooth row, 20.2–20.7 (20.4). Adult female:² Condyllo-basal length, 77.1–83.2 (80.1); palatal length, 43.2–47.2 (45.5); postpalatal length, 28.7–32.2 (30.5); length of nasals, 30.7–36.5 (34.2); zygomatic breadth, 51.4–55.4 (53.6); breadth across mastoids, 37–40 (38.4); least interorbital breadth, 15–18.7 (17.2); breadth of rostrum, 17.4–20.2 (18.4); maxillary tooth row, 19–20.2 (19.7).

Remarks.—By reason of the scarcity of specimens from the Cascades (the type region of *flaviventris*) it is impossible satisfactorily to

¹ One specimen from East Fork Kaweah River, Cal.

² Five specimens from southern Sierra Nevada, Cal.

³ Six specimens from southern Sierra Nevada, Cal.

characterize this southern race. The available specimens, however, show a decided reduction in size of skull southward, the small form apparently being confined to the high Sierra south of Mono Lake. Intergradation with *flaviventris* occurs in the region between Mono Lake and Lake Tahoe, and with *parvula* in the White Mountains, on the boundary between California and Nevada.

Specimens examined.—Total number, 47, as follows:

California: Big Meadows, Tulare County, 3; Bishop Creek (altitude, 8,000 feet), 2; Cannell Meadows, Tulare County, 2;¹ Cottonwood Lakes, Inyo County, 3;¹ Independence Lake, 1;¹ Kaweah River (East Fork), 3; Lake Tenaya, 1; Menache Meadows (near Olancha Peak), 1; Mount Lyell, 1; Mount Whitney, 9; Mulkey Meadows (15 miles south of Mount Whitney), 1; Owens River (near Mammoth Pass), 1; Round Valley (12 miles south of Mount Whitney), 2; San Joaquin River (near head), 4; Siberian Outpost, Tulare County, 1;¹ Tuolumne Meadows, 10; Whitney Creek, Tulare County, 1;¹ Whitney Meadow, Tulare County, 1.¹

MARMOTA FLAVIVENTRIS PARVULA HOWELL.

NEVADA MARMOT. .

(Pl. VII, fig. 2; Pl. XIII, fig. 2.)

Marmota flaviventer parvula Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 14.

Type locality.—Jefferson, Toquima Range, Nye County, Nev. (about 10 miles north of Belmont).

Distribution.—Toyabe and Toquima Ranges, Nev.; and White Mountains, Cal. (occurring from about 7,800 to 10,000 feet altitude); probably occupies also other desert ranges in central Nevada.

Characters.—Similar to *avara*, but smaller and colors darker; in color resembling *sierrae*, but upperparts less reddish and overlaid with a buffy mantle; skull smaller than that of *avara*, with narrower rostrum.

Color.—Underfur of upperparts slaty fuscous at base, succeeded by a broad area of cartridge buff on fore back and by light vinaceous-cinnamon on hinder back; long hairs dark brown subterminally, tipped on fore back with warm buff and on hinder back with white; top of head and face dark vandyke brown; a band of buff or buffy white across face in front of eyes; sides of nose and lips and a large patch on chin white varied with buff; sides of neck with a conspicuous patch of warm buff or cinnamon-buff; underparts ochraceous-tawny, shading to russet on abdomen and throat; fore legs tawny or russet, tipped with ochraceous-buff; fore and hind feet varying from light pinkish cinnamon to russet; tail above, dark chestnut-brown varied with tawny and grizzled with buff; beneath, blackish brown.

Skull.—Similar to that of *avara*, but decidedly smaller, with rostrum narrowed anteriorly.

¹ Collection Mus. Vert. Zool., Univ. of California.

Measurements.—Adult female:¹ Total length, 470–500 (average, 480); tail vertebrae, 130–150 (141); hind foot, 70. *Skull:* Adult female:² Condyllo-basal length, 71.3–73 (72.2); palatal length, 39.4–41 (40.2); postpalatal length, 27–28.6 (27.8); length of nasals, 29.4–30.5 (30); zygomatic breadth, 48.6–49 (48.8); breadth across mastoids, 34.2–34.3; least interorbital breadth, 15.5–15.6; breadth of rostrum, 17.2–17.4 (17.3); maxillary tooth row, 17.7–18.6 (18.2).

Remarks.—This is the smallest of the races of *flaviventris*. It most resembles typical *flaviventris* in color, but is even smaller than *avara*. Its small size was noted in the field by Vernon Bailey, who collected the type series. The range of the subspecies is not definitely known but probably extends at least to the Ruby Mountains where, on top of one of the peaks, Mr. Bailey found evidences of the presence of marmots.

A small series in badly worn pelage from White Mountains, Cal., is provisionally referred to this race, the specimens being intermediate in size between *parvula* and *sierrae*, and agreeing fairly well in color with the former, except for a stronger suffusion of red. One adult female skull agrees with skulls of *parvula* while a subadult male agrees equally well with comparable specimens of *sierrae*.

Two very young specimens from Mountain City, northeastern Nevada, are also provisionally referred to this race.

Specimens examined.—Total number, 16, as follows:

Nevada: Arc Dome, Toyabe Range, 6; Jefferson, Toquima Range, 1; Mountain City, 2.

California: White Mountains (altitude 9,300–10,000 feet), 7.

MARMOTA FLAVIVENTRIS ENGELHARDTI ALLEN.

ENGELHARDT MARMOT.

(Pl. VII, fig. 4; Pl. XIII, fig. 4.)

Marmota engelhardti Allen, Mus. Brooklyn Inst. Arts & Sci., Sci. Bul., I, 1905, p. 120.

Type locality.—Briggs [=Britt's] Meadow, Beaver Range, Utah (altitude 10,000 feet).

Distribution.—Beaver and Parawan Mountains, southern Utah; also Midvale, Idaho; exact limits of range unknown.

Characters.—Similar to *flaviventris* but smaller; underparts and hind feet darker (redder); buffy patches on sides of neck less extensive; larger than *parvula*, with darker feet and underfur; skull similar to that of *avara* but bullae larger.

Color.—General tone of upperparts vandyke brown, grizzled with buffy white; underfur fuscous at base succeeded by pinkish buff or pinkish cinnamon, the latter shading on sides to Rood's brown; long hairs blackish brown, tipped with light buff or buffy white; top of

¹ Three specimens from Toyabe and Toquima Ranges, Nev.

² Two specimens from same localities.

head and face blackish brown, with an irregular white patch in front of eyes; sides of head mixed brown and buffy white; sides of neck with a small area of ochraceous-buff; legs and feet hazel; tail above, dark clove brown, tipped with hazel; beneath, blackish brown; underparts hazel or ochraceous-tawny, the bases of hairs blackish brown; sides of nose, lips, and chin, white.

Skull.¹—Similar to that of *avara* but audital bullae averaging larger and more inflated.

Measurements.—Adult female topotype: Total length, 525; tail vertebrae, 110;² hind foot, 75. Adult female from Parawan Mountains, Utah: 554; 154; 68. Immature female topotypes:³ 485–535 (average 507); 139–163 (151); 71–77 (73). *Skull*: Adult female:⁴ Condylobasal length, 76.8–80 (78.4); palatal length, 43.5–46.1 (44.8); postpalatal length, 29.5–30.7 (30.1); length of nasals, 31–34.6 (32.8); zygomatic breadth, 52.3–54 (53); breadth across mastoids, 36.5–37.7 (37.2); least interorbital breadth, 16.3–18 (17.1); breadth of rostrum, 17.8–18 (17.9); maxillary tooth row, 18.8–19 (18.9).

Remarks.—This race is an intermediate form connecting *flaviventris* and *nosophora*, darker beneath than the former but not so reddish as the latter and lacking also its buffy mantle. It is about the size of *avara* with a somewhat shorter tail, but much darker in color. A specimen from Parawan Mountains, Utah, is paler beneath than the type and topotypes, the underparts (except throat) and hind feet being ochraceous-buff varied with brownish. An immature specimen from Midvale, Idaho, provisionally referred to this form, agrees with it in color, except that the underfur on the shoulders is paler (light buff), and in skull characters so far as they can be determined.

Specimens examined.—Total number, 12, as follows:

Idaho: Midvale, 1.

Utah: Beaver Mountains, 6;⁵ Parawan Mountains, 5.

MARMOTA FLAVIVENTRIS NOSOPHORA HOWELL.

GOLDEN-MANTLED MARMOT.

(Pl. I; Pl. VIII, fig. 1; Pl. XIV, fig. 1.)

Marmota flaviventer nosophora Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 15.

Type locality.—Willow Creek, 7 miles east of Corvallis, Mont. (altitude 4,000 feet).

Distribution.—Rocky Mountain region of Montana, Idaho, and Wyoming, from Flathead Lake, Mont., south to the Wasatch Mountains, Utah, and east to the Bighorn Mountains, Wyo.; altitudinal range from about 3,000 to 11,800 feet.

¹ No adult males examined.

² Apparently abnormally short.

³ Three specimens.

⁴ Three specimens from Beaver and Parawan Ranges, Utah.

⁵ Including type in collection Amer. Mus. Nat. Hist.

Characters.—About the size of *engelhardti*, but with longer tail; colors much more ochraceous above and redder below, the fore part of back overlaid with a mantle of golden buff. Compared with *dacota*: Slightly smaller, with upperparts less extensively reddish and more mixed with black, and underfur decidedly paler; skull averaging smaller, with relatively slenderer rostrum and much smaller palatal foramina.

Color.—Underfur of upperparts at base blackish brown on fore part of body, becoming fuscous on hinder parts, succeeded by a broad area of whitish buff (tulleul buff of Ridgway) shading (on hinder back) to pinkish cinnamon or pale russet; long hairs black subterminally, broadly tipped on fore part of back with warm- or ochraceous-buff and on hinder part with white or buffy white; top and sides of head blackish brown, with a conspicuous band of white or buffy white across face in front of eyes; sides of face mixed with cinnamon or white; sides of nose, lips, and chin white or buffy white; sides of neck with ochraceous-buff patches behind ears; fore legs kaiser brown; hind legs and rump warm buff; hind feet hazel to russet; tail chestnut-brown or blackish brown, varied with hazel or cinnamon-buff (fading to dull cinnamon or clay color); underparts hazel shaded with kaiser brown, becoming bright chestnut on throat and sometimes on belly. *Variation*: A dark, brownish color-phase occurring rarely, and seemingly most frequent at high altitudes, may be described as follows: General tone of upperparts dark brown grizzled with white; underfur at base mouse gray (shading on hinder back to fuscous) succeeded by buffy white (shading on hinder back to light pinkish cinnamon); long hairs blackish brown, tipped with white; top and sides of head blackish brown; underparts mixed blackish brown and pinkish buff in about equal proportions; throat shaded with russet; feet and tail blackish brown; legs brownish mixed with ochraceous-tawny. (Specimen from Lake Fork, Wind River Mountains, Wyo.; altitude 10,600 feet.)

Skull.—Females averaging larger than those of *engelhardti*, with broader rostrum and interorbital region and smaller bullae. Compared with *dacota*: Smaller, with narrower rostrum and interorbital region, and much smaller palatal foramina.

Measurements.—Adult male:¹ Total length, 590–600 (average 595); tail vertebrae 159–170 (165); hind foot, 78–79 (78.5). Old male from Pryor Mountains, Mont.: 670; 165; 96. Adult female:² 534–591 (565); 145–175 (165); 75–85 (78). *Skull*: Adult male:³ Condylolbasal length, 86.7–94.2 (90.6); palatal length, 47.7–53 (50.7); postpalatal length, 34.2–37.2 (36.2); length of nasals, 35.1–40.4 (37.8); zygomatic breadth, 55.7–63.7 (59); breadth across mastoids, 41.3–45

¹ Two specimens from Bitterroot Valley, Mont.

² Seven specimens from Bitterroot Valley, Mont.

³ Six specimens from Montana, Idaho, and Wyoming.

(43); least interorbital breadth, 17.8–22.2 (20.1); breadth of rostrum, 19–20.5 (19.8); maxillary tooth row, 19.3–20.8 (20). Adult female:† Condyllo-basal length, 78.2–83.8 (80.4); palatal length, 44.1–47 (45.1); postpalatal length, 29.4–33.5 (31.2); length of nasals, 30.8–34.8 (32.4); zygomatic breadth, 53.2–54.5 (53.9); breadth across mastoids, 37.4–41.6 (39); least interorbital breadth, 18.5–19.7 (19.1); breadth of rostrum, 17–19.3 (18.3); maxillary tooth row, 19.7–20.5 (20.1).

Remarks.—This subspecies, one of the handsomest members of the *flaviventris* group, is abundant and generally distributed in the northern Rocky Mountain region of Montana, Idaho, and Wyoming. Closely related to *dacota* of the Black Hills, it probably intergrades with that race in central Wyoming. Specimens from the northern limit of its range (Horse Plains and Weeksville, Mont.) are considerably paler than the typical form, showing approach to *avara*. The southern limits of the range of *nosophora* are not known, only a few specimens having been seen from the Wasatch Mountains, and none from the Uinta Mountains, Utah. Intergradation with *engelhardti* probably occurs where their ranges meet.

A brown phase of this subspecies, having the tips of the hairs white instead of cinnamon-buff and the underparts mixed brown and buff instead of red, occurs in some localities with the normal phase. Several immature specimens, varying somewhat in color, have been examined from near timberline in the Wind River Mountains, Wyo. An adult female in very worn pelage from timberline in the Bear-tooth Mountains, Mont., is similar to those from the Wind River Mountains, but the brown of the upperparts is paler, evidently faded, and the underparts are mixed chestnut and black, shaded with tawny. Some specimens in this phase somewhat resemble externally the members of the *monax* group but the skulls are typical of *nosophora*.

This marmot serves as a host for the Rocky Mountain fever tick (*Dermacentor venustus*) and thus aids in the dissemination of the deadly spotted fever, particularly along the western side of the Bitterroot Valley, Mont., where the disease occurs in its most virulent form.

Specimens examined.—Total number, 62, as follows:

Idaho: Bear Lake (east side), 1; Bridge, 1; Conant Creek (upper Snake River), 1; Grace, 2; Henry Fork of Snake River, 1; Irwin (20 miles northwest), 1; Island Park, Snake River, 1; Moody Creek (upper Snake River), 1; Preuss Mountains, 1; Sawtooth National Forest, 2; Teton Basin, 1.

Montana: Bass Creek (in mountains northwest of Stevensville), 3; Beartooth Mountains, 3; Bozeman, 1; Como Lake, 1; Florence, 2; Horse Plains, 4; Jardine, 1; Pryor Mountains, 2; Ross Fork (15 miles above Darby), 2; Weeksville, 1; Willow Creek (in mountains east of Corvallis), 3.

† Five specimens from Bitterroot Valley, Montana.

Utah: Blacksmith's Fork (near head), 1; Laketown, 1; Park City, Wasatch Mountains, 3.

Wyoming: Bighorn Mountains (Trapper's Creek), 6; Fremont Peak, 2; Jackson, 2; Kendall (12 miles north), 1; Lake Fork, Wind River Mountains, 3; Little Sandy Creek, 3; Lost Cabin (15 miles northwest), 1; Pahaska, 1; Salt River Mountains (10 miles southeast of Afton), 1; Sheridan, 1.

MARMOTA FLAVIVENTRIS DACOTA (MERRIAM).

BLACK HILLS MARMOT.

(Pl. IV, fig. 1; Pl. VIII, fig. 3; Pl. XIV, fig. 2.)

Arctomys flaviventer Grinnell, Ludlow's Black Hills of Dakota, 1875, p. 82. (Not of Audubon & Bachman).

Arctomys dacota Merriam, N. Am. Fauna No. 2, 1889, p. 8.

[*Marmota*] *dacota* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Custer, S. Dak.

Distribution.—Black Hills, S. Dak., and Bear Lodge Mountains, Wyo., southwest to Bridger Pass, Wyo.

Characters.—Size large (equaling *flaviventris*); color similar to that of *nosophora* but underfur redder and less mixed with black; skull large, with broad rostrum and very large palatal foramina.

Color.—General tone of upperparts orange-cinnamon overlaid with warm buff; underfur at base fuscous or dark mouse gray, succeeded by pinkish cinnamon or vinaceous-cinnamon on fore back and by orange-cinnamon on hinder back, darkening to kaiser brown on sides (sometimes vinaceous-cinnamon to roots on fore back); long hairs on fore back bright cinnamon-buff at tips with an indistinct subterminal band of hazel or chestnut-brown; on hinder back chestnut-brown or blackish brown, tipped with white; buttocks warm buff; top of head and nose blackish brown with a band of yellowish white across face in front of eyes; sides of nose, lips, and chin, white or yellowish white; fore legs kaiser brown, feet russet; hind feet hazel; tail above, hazel mixed with chestnut-brown; beneath, blackish brown; underparts kaiser brown shaded with ochraceous-buff.

Skull.—Similar to that of *nosophora* but larger, with broad rostrum and broad palatal foramina.

Measurements.—Adult male:¹ Total length, 610–680 (average 643); tail vertebrae, 178–200 (185); hind foot, 81–92 (85). Adult female:² 525–627 (602); 130–188 (168); 79–84 (81). *Skull:* Adult male:³ Condyllo-basal length, 89.4–95.7 (92.5); palatal length, 50.8–52.2 (51.6); postpalatal length, 35–38.2 (36.6); length of nasals, 37.8–41.1 (39); zygomatic breadth, 59.5–61.4 (60.7); breadth across

¹ Five specimens from Black Hills, S. Dak., and Bear Lodge Mountains, Wyo.

² Five specimens from Black Hills, S. Dak.

³ Three specimens from Black Hills, S. Dak., and Bear Lodge Mountains, Wyo.

mastoids, 42.3–44.7 (43.3); least interorbital breadth, 21.8–23.2 (22.6); breadth of rostrum, 22–23.6 (23); maxillary tooth row, 21–21.7 (21.4). Adult female:¹ Condylar-basal length, 81.4–84.5 (83.1); palatal length, 45.4–47.7 (46.8); postpalatal length, 31.6–33 (32.4); length of nasals, 31.5–35.5 (33.9); zygomatic breadth, 54.2–56.7 (55.5); breadth across mastoids, 39.4–42.3 (40.5); least interorbital breadth, 19.6–22.5 (20.6); breadth of rostrum, 20–22.3 (20.9); maxillary tooth row, 20.1–20.5 (20.4).

Remarks.—This form is the brightest of all the races of the species, the red and yellow shades being most pronounced and the blacks and browns reduced to a minimum. It is abundant in the Black Hills and apparently ranges through eastern Wyoming to Bridger Pass, intergrading with *luteola* in the Laramie Mountains.

Specimens examined.—Total number, 19, as follows:

South Dakota: "Black Hills," 1; Custer, 8; Savoy, 5; Tigerville (near Hill City), 1.

Wyoming: Bear Lodge Mountains, 1; Bridger Pass, 3.

MARMOTA FLAVIVENTRIS LUTEOLA HOWELL.

PARK MARMOT.

(Pl. VIII, fig. 2; Pl. XIV, fig. 3.)

Arctomys flaviventer Allen, Bul. Essex Inst., VI, 1874, p. 57. (Not of Audubon & Bachman.)

Marmota flaviventer Warren, Colorado Coll. Pub., Sci. Ser., XI, No. 46, 1906, p. 243. (Not of Audubon & Bachman.)

Marmota engelhardti Cary, N. Am. Fauna No. 33, 1911, p. 98. (Not of Allen.)

Marmota flaviventer luteola Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 15.

Type locality.—Woods P. O., in Medicine Bow Mountains, Wyo. (altitude about 7,500 feet).

Distribution.—Mountains of northern Colorado and southeastern Wyoming, from Park County, Colo., (and probably Fremont County) north to the Laramie Mountains, Wyo.

Characters.—About the size of *dacota* and similar in color to it and *nosophora*, but underparts yellowish instead of deep red, and fore back overlaid with white instead of warm buff; skull similar to that of *nosophora*, but averaging narrower.

Color.—*Normal phase:* Underfur of upperparts dark mouse gray at base (shading on hinder back to deep dusky drab), succeeded on fore back by a broad area of warm buff and on hinder back by ochraceous-buff; long hairs blackish brown or dark chestnut-brown, tipped with light buff or buffy white; top of head and nose blackish brown, with a rather large patch of white or ochraceous-buff between eyes; sides of face mixed brown and buff; sides of nose, lips, and chin, white, yellowish white, or ochraceous-buff; sides of neck warm

¹ Five specimens from Black Hills, S. Dak.

buff (the underfur ochraceous-buff); feet hazel or tawny; tail above, mixed hazel and chestnut-brown; beneath, blackish brown; underparts ochraceous-buff (bases of hairs brownish) varied with tawny along sides; rump and buttocks warm buff. *Dark phase* (specimen from Boulder County, Colo., altitude, 8,000 feet): Underfur cinnamon-buff becoming dark cinnamon on hinder back; entire body extensively mixed with dark chestnut-brown hairs, sparingly tipped on back with light buff; feet blackish brown shaded with tawny; light face-markings reduced.

Skull.—Very similar to that of *nosophora*, but averaging relatively narrower, especially rostrum and interorbital region; bullae smaller.

Measurements.—Adult male:¹ Total length, 600–650 (average 623); tail vertebrae, 182–220 (200); hind foot, 86–90 (88). Adult female:² 552–618 (579); 137–192 (171); 78–85 (81). *Skull*: Adult male:³ Condyllo-basal length, 86–92.5 (88.3); palatal length, 48.4–51.1 (49.5); postpalatal length, 33.5–36.5 (35.2); length of nasals, 36–41 (38.4); zygomatic breadth, 55.7–60 (57.9); breadth across mastoids, 39–43.4 (41.5); least interorbital breadth, 17.3–21.8 (19.2); breadth of rostrum, 18.9–20.8 (19.6); maxillary tooth row, 19.9–21.4 (20.5). Adult female:⁴ Condyllo-basal length, 78.3–85 (81.4); palatal length, 43.7–47.6 (45.7); postpalatal length, 30–33.3 (31.5); length of nasals, 32.5–35 (33.7); zygomatic breadth, 51.7–54.9 (53.3); breadth across mastoids, 37.5–40.5 (38.6); least interorbital breadth, 16.4–17.8 (16.9); breadth of rostrum, 17.3–18.3 (17.8); maxillary tooth row, 19.3–21.4 (20.2).

Remarks.—In studying the marmots of this and related races in Colorado several puzzling problems have been encountered, the material at present available being insufficient satisfactorily to work out the characters and exact relationships of the forms. The specimens exhibit considerable individual variation, and, in addition to the dark phase already described, a light phase, characterized by less yellowish underparts and white tips to the hairs above, occurs in the same localities with the normal phase. Specimens in this light phase are known from Meeker, North Park, and Boulder County (altitude 10,300 feet). They rather closely resemble *engelhardti* externally, except that the underfur and feet are paler; the skulls, however, are typical of *luteola*.

The series from Laramie Mountains, Wyo., is intermediate between *luteola* and *dacota*, the pelage averaging redder and the skulls relatively shorter and broader than in typical *luteola*. Most of this series have large ochraceous-buff face markings. The series from Sulphur Springs, Colo., shows intergradation with *warreni*, the

¹ Three specimens from southern Wyoming and northern Colorado.

² Six specimens from northern Colorado.

³ Four specimens from Laramie and Medicine Bow Mountains, Wyo., and Mount Lincoln, Colo.

⁴ Five specimens from northern Colorado.

specimens being considerably redder than typical *luteola*; the skulls, however, are typical.

Specimens examined.—Total number, 42, as follows:

Colorado: Boulder County (altitude 8,000–11,000 feet), 4;¹ Coulter, 1; Elk-head Mountains, 1; Estes Park, 1; Lake John, 1;² Longs Peak, 1; Meeker, 2;² Middle Park, 1; Mount Lincoln, 6;³ North Park, 1;⁴ Pikes Peak, 1;² Sheephorn Pass, 4;² Steamboat Springs (18 miles below), 2;² Sulphur Springs, 5.⁵

Wyoming: Laramie Mountains, 7; Riverside, 2; Sherman, 1; Woods P. O., 1.

MARMOTA FLAVIVENTRIS WARRENI HOWELL.

WARREN'S MARMOT.

(Pl. VI, fig. 4; Pl. XII, fig. 2).

Marmota flaviventer warreni Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 16.

Type locality.—Crested Butte, Colo.

Distribution.—Western Colorado, from Garfield County south to Saguache County; exact limits of range unknown.

Characters.—Size large (equaling *dacota*); colors deep red with little buff; skull similar to that of *obscura*, larger than that of *dacota* or *luteola*.

Color.—General tone of upperparts hazel, the underfur at base between mouse gray and fuscous, succeeded by pinkish cinnamon or cinnamon; long hairs hazel subterminally, tipped with a small area of buffy white; top and sides of head dark chestnut or bay; sides of neck cinnamon-buff; underparts hazel, varied with ochraceous-tawny, becoming chestnut on lower abdomen and Sanford's brown on throat; lips soiled whitish, bordered with cream-buff or pinkish cinnamon; fore legs hazel, shading to auburn on feet; hind feet and toes hazel, varied with cinnamon; tail dark chestnut-brown at base, shading to hazel or tawny; under surface blackish chestnut-brown.

Skull.—(Known only from females): Larger than that of *dacota* with longer, slenderer rostrum and narrower palatal foramina; very similar to that of *obscura*, but averaging longer and relatively narrower.

Measurements.—Adult female (type): Total length, 565; tail vertebrae, 131; hind foot, 82. Skull:⁶ Adult female: Condylar-basal length, 83.3–89.3 (average 85.9); palatal length, 47–49.3 (47.9); post-palatal length, 33.6–36.9 (35.5) length of nasals, 36.8–39.2 (38.1); zygomatic breadth, 57–59 (57.7); breadth across mastoids, 42.9–

¹ Two in collection Field Mus. Nat. Hist.

² Collection E. R. Warren, Colorado Springs, Colo.

³ Collection Mus. Comp. Zool.

⁴ Collection Colo. Mus. Nat. Hist.

⁵ Three in collection E. R. Warren; one in collection Amer. Mus. Nat. Hist.

⁶ Three specimens from Crested Butte and Mud Springs, Colo.

44.7 (43.7); least interorbital breadth, 19–21.2 (20.2); breadth of rostrum, 18.7–20.3 (19.6); maxillary tooth row, 14.9–20.5 (17.4).

Remarks.—This form most nearly resembles *luteola* in color, but is much redder (less yellowish). Its skull also is much larger, agreeing rather with that of *obscura*. It is known from only a few specimens and its range has not been definitely determined. It probably will be found throughout west-central Colorado and adjacent parts of Utah. In both size and color it differs markedly from *engelhardti*, but additional material may show that the two forms intergrade. Intergradation with *luteola* is indicated by a series of specimens from Sulphur Springs (referred to *luteola*), and with *obscura* by a specimen from Florida, Colo. (referred to *obscura*).

Specimens examined.—Total number, 11, as follows:

Colorado: Crested Butte, 4;¹ Cochetopa Pass (9 miles south), 1; Mud Springs, Garfield County, 5;² Sapinero, 1.

MARMOTA FLAVIVENTRIS OBSCURA HOWELL.

DUSKY MARMOT.

(Pl. II, fig. 2; Pl. VIII, fig. 4; Pl. XIV, fig. 4.)

Marmota flaviventer obscura Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 16.

Type locality.—Wheeler Peak, 5 miles south of Twining, N. Mex. (altitude, 11,300 feet).

Distribution.—Upper slopes of high peaks in northern New Mexico and southern Colorado, from Pecos Baldy, N. Mex., north to Sierra Blanca, vicinity of Fort Garland, and to San Juan Range near Osier, Colo. (formerly in the Manzano and Datil Mountains, N. Mex.); occurs in Hudsonian and upper Canadian Zones from about 9,600 feet altitude to the summits of the peaks (13,300–13,700 feet).

Characters.—Size large (exceeding *dacota* and equaling *flaviventris*); sexes about same size; tail long; colors dark brown mixed with white, with relatively little of the buff or tawny shades of other races; face usually without white markings; skull similar to those of *warreni* and *dacota*.

Color.—*Adults:* General tone of upperparts dark brown, grizzled with white, becoming cinnamon on hinder back in some individuals; underfur clove brown succeeded by pinkish buff, shading in some specimens to pinkish cinnamon on hinder back and rump; long hairs dark chestnut-brown, finely grizzled with white; head and face dark chestnut-brown or black, grizzled with white on sides of face, rarely with a whitish band across nose; sides of nose, lips, and chin, white or buffy white; feet dark chestnut-brown often extensively mixed with white or buffy hairs, or sometimes cinnamon-buff shaded with dark brown; tail chestnut-brown, shading to blackish brown beneath;

¹ Three in collection E. R. Warren.

² Four in collection E. R. Warren; one in Amer. Mus. Nat. Hist.

underparts mixed dark chestnut-brown or blackish brown and pale buff (tulleul buff of Ridgway) in varying proportions, buff usually most pronounced in the median line; chin, and sometimes throat, shaded with tawny or bay. *Young* (Osier, Colo.): General tone above, clove brown (becoming slightly more tawny on hinder back) sparingly grizzled with white; underparts mixed blackish brown and light buff; tail snuff brown above, pale clove brown below; hind feet same color as under side of tail, overlaid with light buff.

Skull.—Similar to that of *dacota*, males about the same size or slightly smaller, females larger; nasals (in females) averaging longer; palatal foramina narrower; interpterygoid fossa broader; postorbital constriction narrow; similar to that of *warreni* but averaging shorter and relatively broader with slightly broader premaxillae.

Measurements.—Adult male:¹ Total length, 645–664 (average 655); tail vertebrae, 180–220 (204); hind foot, 90–92 (90.7). Adult female:¹ 630–670 (646); 180–220 (190); 88–90 (89.3). *Skull*: Adult male:² Condyllo-basal length, 88.3–90.8 (89.5); palatal length, 49.4–52.7 (51); postpalatal length, 34–35.2 (34.6); length of nasals, 36.4–38.4 (37.4); zygomatic breadth, 60.2–60.4 (60.3); breadth across mastoids, 41.5–41.7 (41.6); least interorbital breadth, 21–21.1; breadth of rostrum, 21.9–23.3 (22.6); maxillary tooth row, 19–19.8 (19.4). Adult female:³ Condyllo-basal length, 84.5–89.5 (87.7); palatal length, 48.4–50.3 (49.3); postpalatal length, 31.9–35.7 (34.2); length of nasals, 35.4–39 (37.5); zygomatic breadth, 59.4–60.6 (59.8); breadth across mastoids, 41–43.8 (42.7); least interorbital breadth, 20.4–22.3 (21.1); breadth of rostrum, 22.3–22.4; maxillary tooth row, 20–21.

Remarks.—This is the darkest and one of the largest of the races of *flaviventris*. In its dark colors and the absence of light face markings it somewhat resembles the *monax* group. It is closely related to *warreni* and probably intergrades with it, but material from southern Colorado is too scanty to show clearly its relationships. A badly worn skin without skull from "Fort Massachusetts" [= mountains near] has been in the National Museum collection for many years, but not until 1903 and 1904, when Vernon Bailey collected a fine series of adults in the Pecos River and Taos Mountains, N. Mex., was it possible to determine the characters of the species.

In a series of 12 specimens from Osier, Colo., in the San Juan Range, about half of the individuals are considerably paler above than in the typical form, being uniformly pinkish cinnamon grizzled with white, without prominent brownish markings. A badly worn specimen from Florida, Colo., is decidedly redder above, particularly on the head and feet, indicating apparent intergradation with

¹ Four specimens from New Mexico.

² Two specimens from Wheeler Peak, N. Mex.

³ Three specimens from Wheeler Peak and Pecos Baldy, N. Mex.

warreni. Strangely, however, the skull of this specimen is not like that of either *warreni* or *obscura*, but agrees well with that of *luteola*.

Several lower jaws and fragments of crania, found in a cave on the Manzano Mountains by Archibald Rea, and broken pieces of a skull secured by Dr. Walter Hough from a cave on the Tularosa River near Old Fort Tularosa (south slope of the Datil Range) indicate the former occurrence of this species in those ranges. The jaws from the Manzano Mountains agree essentially with recent material, but the fragment from the Tularosa River is not specifically identifiable.

Of the habits of this marmot, Vernon Bailey in his field notes says:

They live entirely in or among rocks and prefer open country, either in parks or above timber line. They often burrow under large boulders in the parks and meadows, but more often live in fathomless piles of broken rock piled along the base of cliffs, or in seams and crevices of the cliffs themselves.

Specimens examined.—Total number, 24, as follows:

Colorado: Osier, San Juan Mountains (altitude, 9,625 feet), 12;¹ Florida, La Plata County (altitude, 7,200 feet), 1;² "Fort Massachusetts" [probably from Sierra Blanca Peak], 1.

New Mexico: Pecos Baldy, 2; Truchas Peak, 2; Wheeler Peak, 4; Aqua Fria Peak, 2.

Cranial Measurements of the *Marmota flaviventris* Group.

No.	Species and locality.	Sex.	Condyllo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least inter-orbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
<i>Marmota flaviventris flaviventris</i> .												
100532	Donner, Cal.	♂	97.1	55	38.2	42.6	62.3	46.2	23	22.3	20.9	Adult.
4750	Fort Crook, Cal.	♂	94	54	37.6	42.5	58.4	44.4	21.2	23	20	Do.
203080	Mount Hood, Oreg.	[♂?]	92.5	52.3	.....	.....	.....	41.1	22	23	19.5	Do.
80360	Crater Lake, Oreg.	♂	87	48.7	33.7	37	58.4	40.7	19.2	19.6	20	Do.
191351	Donner, Cal.	♂	86.2	48.7	34.5	37.2	.....	40.4	17.3	19.4	21	Do.
♂ 11901	Glen Alpine Springs, Cal.	♂	84.1	48.2	32.7	37	57.6	39.2	19	21.2	20.5	Do.
23951	Carson, Nev.	♂	84.6	48.5	31.8	35.4	55.4	39.6	18.7	21.4	22.1	Do.
<i>Marmota flaviventris avara</i> .												
99759	Okanogan, British Columbia.	♂	85.7	47.9	34.8	37.6	56.7	42.2	19.5	20	19.3	Adult.
4 917	Cascade, British Columbia.	♂	86.5	48.8	34	33.6	55.6	39.1	17.8	19.4	19	Do.
94343	Okanogan, British Columbia.	♂	78	43.3	31	33.2	52.7	37.6	18	16.8	17.8	Do.
178842	do.	♂	76.4	42.6	30.3	31.5	52.5	38.6	17.1	17.3	19.1	Do.
4 1107	Midway, British Columbia.	♂	79.4	44.6	30.8	33.5	.....	37.8	17.4	17	19	Do.
<i>Marmota flaviventris sierrae</i> .												
♂ 15157	Cannell Meadows, Tulare County, Cal.	[♂?]	85.5	47.8	34.3	36.6	57.3	40.7	18.5	20	20.2	Old.
♂ 15165	Whitney Creek, Tulare County, Cal.	♂	90.2	50.5	35	37	58.3	43.6	20.3	20	20.5	Adult.
42641	Mount Whitney, Cal.	♂	79.1	44	30.8	32.6	52	37.5	17.7	17.4	20.2	Subadult.
41198	do.	♂	84.5	48	32.4	39	54.6	41.5	17.8	17	20.2	Do.
42859	do.	♂	82.1	46.3	32.2	37.4	55.2	39.3	18.1	18.2	20	Adult.
♂ 15163	Whitney Meadow, Cal.	♂	77.3	44.7	28.7	32	52.7	37	16.5	17.4	19	Old.
41950	Head San Joaquin River, Cal.	♂	81	46	31	34.4	.....	37.9	18.7	18.6	19.5	Do.

¹ Collection Colo. Mus. Nat. Hist.

² Collection Amer. Mus. Nat. Hist.

³ Collection Mus. Vert. Zool., Univ. of California.

⁴ Collection Victoria Mem. Mus.

Cranial measurements of the *Marmota flaviventris* group—Continued.

No.	Species and locality.	Sex.	Condyllo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least inter-orbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
<i>Marmota flaviventris parvula.</i>												
93689	Arc Dome, Toyabe Range, Nev..	♂	73	41	28.6	30.5	48.6	34.3	15.5	17.2	17.7	Adult.
93690	Jefferson, Toquima Range, Nev.	♂	71.3	39.4	27	29.4	49	34.2	15.6	17.4	18.6	Adult; type.
<i>Marmota flaviventris engelhardtii.</i>												
157828	Beaver Mountains, Utah.....	[♀?]	80	46.1	30.7	34.6	54	37.5	17	17.8	19	Adult.
158978	do.....	♂	78.4	44.8	30.2	33	52.3	36.5	16.3	18	19	Do.
158500	Parawan Mountains, Utah.....	♂	76.8	43.5	29.5	31	52.8	37.7	18	18	18.8	Do.
<i>Marmota flaviventris nosophora.</i>												
168493	Ross Fork, Mont.....	♂	86.7	47.7	34.2	35.1	55.7	41.3	17.8	19.5	20.1	Young adult.
156924	Sawtooth National Forest, Idaho	♂	90	50.3	35.5	38.5	59.5	43.1	19	19.6	19.5	Adult.
191363	Conant Creek, Idaho.....	♂	92.2	52.5	35.2	39.1	57.3	42	21	20.5	20.8	Young adult.
66709	Pryor Mountains, Mont.....	♂	94.2	53	37.2	40.4	63.7	45	22.2	20	20.4	Adult.
168473	Bitterroot Valley, Mont.....	♂	83.8	46.2	33.5	34.8	54.5	41.6	19.5	19.3	20.2	Do.
168472	do.....	♂	78.2	42.5	31.8	30.8	54	37.6	19.2	18.7	20.3	Do.
168494	do.....	♂	79	45.5	30	32.8	53.2	40	19.7	17	19.8	Adult; type.
<i>Marmota flaviventris dacota.</i>												
186474	Custer, S. Dak.....	♂	89.4	50.8	35	38	59.5	43	21.8	22	21.5	Sub adult; type.
65920	Bear Lodge Mountains, Wyo.....	♂	95.7	52.2	38.2	41.1	61.3	44.7	23.2	23.3	21.7	Adult.
25529	Bridger Pass, Wyo.....	♂	90.5	51	36.2	38.4	61.7	41.8	18.2	20.5	20.9	Do.
191365	Custer, S. Dak.....	♂	83.5	47.6	31.8	34.1	56.7	40.6	20.7	20	20.1	Do.
191366	do.....	♂	81.8	45.4	32.5	31.5	55.3	39.5	20	20.5	20.3	Do.
168884	Savoy, S. Dak.....	♂	84.5	47.7	33	35	55.7	40.7	19.6	20.4	20.5	Do.
<i>Marmota flaviventris luteola.</i>												
186520	Medicine Bow Mountains, Wyo.	♂	87	48.4	33.5	36	55.7	40.6	17.3	19	21.4	Sub adult type.
25523	Laramie Mountains, Wyo.....	♂	87.8	49.5	35.5	37.3	60	43.4	20.2	19.6	19.9	Adult.
¹ 175	Mount Lincoln, Colo.....	[♂?]	92.5	51.1	36.5	41	59.4	43	21.8	20.8	21	Old.
² 2279	Steamboat Springs, Colo.....	♂	85	47.6	33.3	34	54.9	40.5	17.4	17.7	21.4	Adult.
² 3998	Lake John, Colo.....	♂	81.3	45.3	31.7	33	54	39	16.4	17.7	19.3	Do.
139082	Coulter, Colo.....	♂	78.3	43.7	30	34	52.3	38.5	16.5	17.3	19.5	Do.
<i>Marmota flaviventris warreni.</i>												
202937	Crested Butte, Colo.....	♂	89.3	49.3	36.1	39.2	59	44.7	21.2	20.3	16.7	Adult; type.
² 134	do.....	♂	83.3	47.4	36.9	36.8	57	42.9	19.9	19.9	14.9	Adult.
² 2512	Mud Springs, Colo.....	♂	85.1	47	33.6	38.2	57	43.4	20.3	18.7	20.5	Do.
<i>Marmota flaviventris obscura.</i>												
135504	Wheeler Peak, N. Mex.....	♂	90.8	52.7	34	38.4	60.4	41.7	21	23.3	19	Adult.
133506	do.....	♂	88.3	49.4	35.2	36.4	60.2	41.5	21.1	21.9	19.8	Do.
128750	Pecos Baldy, N. Mex.....	♂	89.5	50.3	35	39	59.4	43.8	20.4	22.4	21	Do.
133505	Wheeler Peak, N. Mex.....	♂	84.5	48.4	31.9	35.4	59.4	41	20.5	22.3	20	Do.
133507	do.....	♂	88.1	49.3	35.7	38.2	60.6	43.3	22.3	22.3	20	Do.

¹ Collection Mus. Comp. Zool.² Collection E. R. Warren, Colorado Springs, Colo.**Marmota caligata Group.**

The *caligata* group includes three species: *M. caligata*, *M. olympus*, and *M. vancouverensis*.

External characters.—Size large;¹ tail long (about 27 to 33 per cent of total length); ears relatively small (actually smaller than those of

¹ Weight of 6 specimens as follows: 9 lbs. (2 ♀, *cascaedensis*); 11 lbs. (♂, *cascaedensis*); 11½ lbs. (♀, *olympus*); 15½ lbs. (♂, *oxytona*); 17 lbs. (old ♀, *cascaedensis*).

M. monax); posterior pads on sole of hind foot subcircular and situated near edges of sole (see Pl. III, fig. 1); mammae:¹ P. $\frac{2}{2}$; A. $\frac{2}{2}$; I. $\frac{1}{1}$ = 10; colors mainly black and white, shaded with cinnamon-buff on hinder parts, or upperparts of solid colors—brownish drab, russet, or vandyke brown.

Cranial characters.—Skull with superior outline nearly straight (as in the other American groups); interorbital region and postorbital processes much as in the *flaviventris* group;² nasals narrowed posteriorly, usually about same width at posterior end as premaxillae or slightly narrower (wider in *olympus*); temporal ridges uniting in old age to form a pronounced sagittal crest; anterior portion of floor of basi-occipital nearly flat, bounded posteriorly by two low processes which unite at about middle of basi-occipital, continuing as a pronounced ridge to the foramen magnum; anterior portion often with two rather pronounced depressions on either side of the median ridge; palate beveled at posterior border (as in *flaviventris* group); interpterygoid fossa relatively narrow (compared with *monax*); palatal foramina variable in shape; molar teeth similar to those of *monax*; maxillary tooth rows divergent anteriorly; anterior face of incisors ivory yellow to orange-buff.

Geographic distribution.—From the Endicott Range, Alaska—the most northerly range in the Rocky Mountains—and the Alaska Peninsula south to the Olympic Mountains and Mount Rainier, Wash., and the Bitterroot and Salmon River Mountains in central Idaho; also on Vancouver Island. Confined entirely to mountain sides at and above timberline except in the north, where the animals live in open meadows and descend to tide water. (See fig. 3.)

Remarks.—The members of this group may readily be distinguished by their greater size and their peculiar coloration—either mixed black and white or solid brownish. All of the races of *Marmota caligata* are colored much alike, differing mainly in relative proportions of black and white and in skull characters. *M. olympus*, isolated on the Olympic Peninsula, has developed a brownish drab coloration with relatively little black or white, and *M. vancouverensis*, dwelling on Vancouver Island, has lost all of the black and white colors and attained a dark seal brown pelage.

MARMOTA CALIGATA (ESCHSCHOLTZ).

[Synonymy under subspecies.]

External characters.—(See under *Marmota caligata* group, excepting color.)

Cranial characters.—(See under *Marmota caligata* group.)

Color.—Fore part of back mixed black and white in varying proportions, sometimes with a buffy or brownish tinge; hinder back similar, but usually strongly suffused with cinnamon-buff or pinkish

¹ As in *M. flaviventris*.

² Excepting *M. olympus*, which is relatively wider interorbitally.

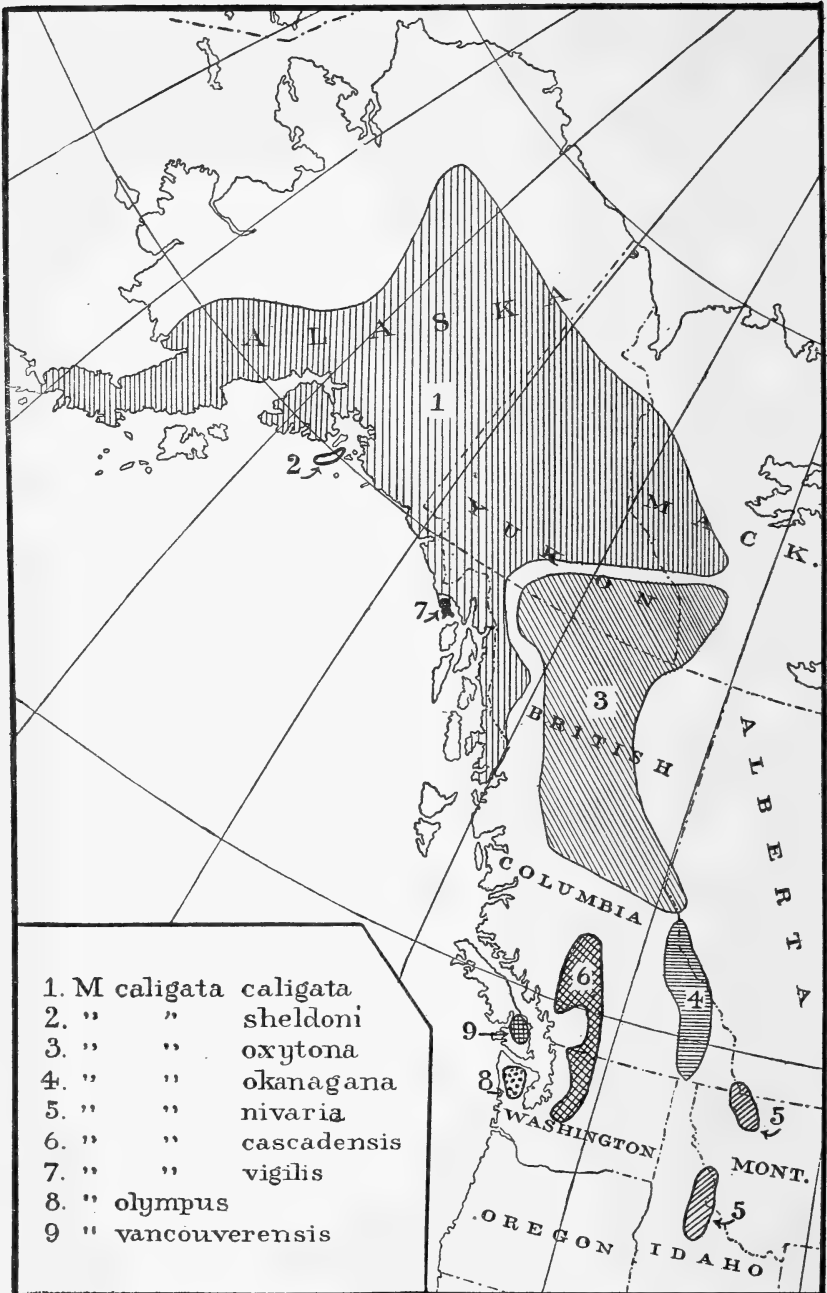


FIG. 3.—Distribution of the *Marmota caligata* group. Boundaries of ranges of subspecies are in many places theoretical.

cinnamon; sometimes tinged with hazel or vandyke brown; underfur dark hair-brown, bone brown, clove brown, bister, mouse gray, fuscous, or fuscous-black; sides of head and neck cinnamon, ochraceous-cinnamon, vandyke brown or blackish brown, more or less mixed with white or buffy white; borders of nose, lips, and chin soiled whitish; top of head and face black or blackish brown; face in front of and between eyes more or less extensively marked with white; legs usually same color as back; feet black or blackish brown, the front feet often with white markings, the hind feet mixed with cinnamon; tail above, cinnamon, pinkish cinnamon, cinnamon-buff, clay color, chestnut-brown, or bay, often mixed with hazel or vandyke brown; beneath, chestnut-brown, clove brown, blackish brown, or hessian brown, mixed with hazel, bay, or ochraceous-tawny; underparts white, grayish white, or clay color, varied with cinnamon, cinnamon-buff, or blackish brown.

Geographic distribution.—From the Endicott Range and the Alaska Peninsula, Alaska, south to Mount Rainier, Wash., and the Bitterroot and Salmon River Mountains, Idaho.

MARMOTA CALIGATA CALIGATA (ESCHSCHOLTZ).

NORTHERN HOARY MARMOT.

(Pl. IV, fig. 6; Pl. IX, fig. 4; Pl. XV, fig. 3.)

Arctomys pruinosus Richardson, Zool. Jour., III, 1828, p. 518. (Not of Gmelin.¹)

Arctomys caligata Eschscholtz, Zool. Atlas, Part II, 1829, p. 1, Plate VI.

Arctomys pruinosus Richardson, Fauna Boreali-Amer., I, 1829, p. 150; Baird, Mamm. N. Am., 1857, p. 345; Allen, Mon. N. Am. Rodentia, 1877, p. 924. (Not of Gmelin.)

Arctomys caligatus Tyrrell, Proc. Canadian Inst., 3rd Ser., VI, 1888, p. 88.

Marmotta caligata Allen, Bul. Amer. Mus. Nat. Hist., XIX, 1903, p. 539.

Marmota caligata MacFarlane, Proc. U. S. Nat. Mus., XXVIII, 1905, p. 751.

Type locality.—Bristol Bay, Alaska.

Distribution.—Alaska and Yukon, from the Portland Canal north on the coast to Bristol Bay, and in the interior to the Endicott Range and the mountains lying westward of Fort Good Hope, Mackenzie.

Characters.—Size medium (for the group); colors moderately white; skull relatively short and broad.

Color.—General tone of upperparts white, moderately tipped with black, becoming cinnamon-buff on hinder back and rump; underfur at base fuscous or dark mouse gray (shading on hinder back to bister), succeeded on fore back by a broad area of white which gradually shades to cinnamon-buff on hinder back (in some

¹ *Arctomys pruinosus*, Gmelin, Syst. Nat., I, 1788, p. 144—based on the hoary marmot of Pennant. A careful comparison of Pennant's description with specimens of the several American species leads to the conclusion that this species is unidentifiable; the name *pruinosus* is therefore rejected.

specimens underfur between shoulders white to roots); top of head and face black, with a white patch in front of eyes often covering the whole face; black of crown usually extending from ear back over shoulders in the form of two divergent (more or less indistinct) stripes; sides of face mixed brown and white (often nearly white); fore legs white or buffy white, hind legs pale cinnamon-buff; fore and hind feet black or blackish brown; tail above, cinnamon-buff, tipped with blackish brown or bay, the bases of the hairs extensively dark chestnut-brown (or sometimes natal brown); beneath, blackish brown or chestnut-brown, sometimes tinged with hazel or ochraceous-tawny; underparts soiled whitish, sometimes mixed with black or blackish brown.

Skull.—Relatively short and broad with short, broad rostrum; zygomata broadly expanded posteriorly; nasals long, extending beyond ends of premaxillae; postorbital constriction rather broad.

Measurements.—Adult male:¹ Total length, 710–715; tail vertebrae, 210–218; hind foot, 91–105. Adult female:² 675; 190; 95. *Skull*: Adult male:³ Condyllo-basal length, 96.5–100.6 (average 98.7); palatal length, 55.7–57.4 (56.4); postpalatal length, 36.5–38.2 (37.4); length of nasals, 38.4–42.3 (40.7); zygomatic breadth, 64.5–68 (66.3); breadth across mastoids, 44–46.2 (44.4); least interorbital breadth, 24.3–27.6 (25.8); breadth of rostrum, 23.7–26.1 (24.6); maxillary tooth row, 22–23.8 (22.6). Adult female:⁴ Condyllo-basal length, 92.8–96.4 (94.2); palatal length, 53–54.8 (53.8); postpalatal length, 35–38 (36.3); length of nasals, 38–39.7 (38.8); zygomatic breadth, 61.6–64.1 (62.7); breadth across mastoids, 40–43.3 (41.9); least interorbital breadth, 23–25 (23.9); breadth of rostrum, 22.1–24.5 (23.2); maxillary tooth row, 20.6–22.5 (21.7).

Remarks.—This race has an extensive distribution in Alaska and Yukon and shows little variation over its whole range. In the southern part it is confined to the region near the coast but in the north it occupies the interior mountain ranges as far east as the main Rocky Mountains in northwestern Mackenzie. In specimens from the Kenai Peninsula the nasals average somewhat shorter than in typical specimens, rarely extending back of the posterior ends of the premaxillae, but the skulls show no other differences. Specimens from the southern coast of Alaska as far south as the Portland Canal (with the exception of the *vigilis* series from Glacier Bay) are typical, but intergradation with *oxytona* occurs a short distance from the coast in northern British Columbia, the series from Cheonee Mountains being distinctly intermediate in character. The form occupying the northern Rockies in eastern Yukon and western

¹ Two specimens from head of Coal Creek, Yukon.

² One specimen from same locality.

³ Five specimens from Becharof Lake, Alaska.

⁴ Seven specimens: 6 from Alaska Peninsula, 1 from Coal Creek, Yukon.

Mackenzie is provisionally referred to this race, no skulls from this entire region being available.

Specimens examined.—Total number, 102, as follows:

Alaska: Aleknagik Lake, 2; Becharof Lake, 12; Cape Elizabeth, 8; Charlie River (near head), 1; Chickamin River (Behm Canal), 2;¹ Cordova Bay, 3;¹ Disenchantment Bay, 1;¹ Fort Yukon, 1;² Hinchinbrook Island, 4; Juneau, 4; Kanatak, Portage Bay, 1; Kenai Mountains, 10;¹ Kenai Peninsula, 4; Mount McKinley, 1; Portage Bay, 5; Port Snettisham, 2;¹ Seldovia, 7;³ Toklat River (near head), 1; Valdez Narrows, 1;¹ White Pass, 4; Yakutat Bay, 2; no specific locality, 2.

British Columbia: Bennett, 2; Cheonee Mountains, 15.³

Mackenzie: Fort Good Hope (mountains west of), 1.

Yukon: Coal Creek (head) 4; Kalzas Creek, Pelly River, 2.

MARMOTA CALIGATA VIGILIS HELLER.

GLACIER MARMOT.

Marmota vigilis Heller, Univ. of California Pub. Zool., V, 1909, p. 248.

Type locality.—West shore of Glacier Bay, Alaska.

Distribution.—Known only from type locality.

Characters.—Similar in size and skull characters to *caligata*; variable in color, but constantly darker than *caligata*, with a strong tendency to run to blacks and browns; top of head and hind feet always brown (except in purely melanistic individuals); underparts darker.

Color.—*Normal fresh pelage* (June 12): Upperparts soiled whitish with a buffy tinge; underfur clove brown at roots, sparingly mixed with dull brown or black; hinder back shading to cinnamon-buff, darkest on rump and hind legs, extensively tipped with blackish brown; underparts dull clay color mixed with grayish white; nose, top of head, and feet blackish brown; sides of face mixed cinnamon-buff and blackish brown; tail above, mixed clay color and chestnut-brown; beneath, blackish chestnut-brown shading to hessian brown in anal region. *Variation:* The above description is based on the lightest and apparently most normally colored individual in the series of topotypes. Between this phase and the pure black phase are found numerous intermediate specimens, some as white beneath as *caligata* and as dark above as *oxytona*, while others are solid blackish brown very similar to *M. vancouverensis*, but slightly blacker; the hind feet and usually the tail are blackish brown; fore feet black or very dark brown.

Skull.—Not appreciably different from that of *caligata*.

Measurements—Adult male:⁴ Total length, 630–745 (average, 676); tail vertebrae, 197–210 (205); hind foot, 92–102 (97). Adult female:⁵ 620–680 (652); 170–212 (191); 90–95 (92). *Skull:* Adult male:⁵ Condyllo-basal length, 97.2–98.4 (97.6); palatal length, 54.7–55.8 (55.3);

¹ Collection Mus. Vert. Zool., Univ. of California.

² Collection Mus. Comp. Zool.

³ Collection Amer. Mus. Nat. Hist.

⁴ Five specimens from type locality.

⁵ Three specimens from type locality.

postpalatal length, 36.7–38 (37.5); length of nasals, 38.9–41.5 (40.6); zygomatic breadth, 62–67.7 (64.8); breadth across mastoids, 43.2–44.6 (43.8); least interorbital breadth, 22.6–26 (24.3); breadth of rostrum, 21.1–23.5 (22.2); maxillary tooth row, 21.8–22.5 (22.2). Adult female: ¹ Condyllo-basal length, 93.7; palatal length, 51.6; postpalatal length, 37.7; length of nasals, 39.6; zygomatic breadth, 61.8; breadth across mastoids, 42.3; least interorbital breadth, 24.5; breadth of rostrum, 21.3; maxillary tooth row, 22.

Remarks.—This form is apparently an incipient species or race in which the characters have not as yet become fixed. It shows the same tendency to become brown that appears so strikingly in *M. Vancouverensis*, and to a lesser degree in *M. olympus*. Its range is apparently limited to the region about Glacier Bay (since specimens from Yakutat Bay, White Pass, and Juneau are referable to *caligata*) but whether it is actually isolated is not known.

Specimens examined.—Ten, from type locality.²

MARMOTA CALIGATA SHELDONI HOWELL.

MONTAGUE ISLAND MARMOT.

Marmota caligata sheldoni Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 18.

Type locality.—Montague Island, Alaska.

Distribution.—Known only from type locality.

Characters.—Similar to *caligata*, but size smaller and nasals shorter.

Color.—Upperparts mixed white and black, whitest on fore back, shading to cinnamon-buff on rump; underfur fuscous, shading on hinder back to natal brown; top of head black; a large white patch on face in front of eyes; sides of face mixed blackish brown and cinnamon; tail deep cinnamon-buff or ochraceous-buff, mixed with black, the bases of hairs chestnut-brown; underparts white, tinged with cinnamon.

Skull.—Similar to that of *caligata*, but decidedly smaller; nasals shorter and broader posteriorly, terminating usually about on a line with ends of premaxillae; premaxillae narrower.

Measurements.—Adult male topotype: Total length, 670; tail vertebrae, 185; hind foot, 94. Adult female topotype: 640; 180; 90. *Skull:* Adult male: ³ Condyllo-basal length, 89.5–96.6 (average, 93.6); palatal length, 51.2–55.4 (53.3); postpalatal length, 34.3–37 (35.5); length of nasals, 35–39 (37.3); zygomatic breadth, 61.5–63.4 (62.4); breadth across mastoids, 41.3–42.4 (41.9); least interorbital breadth, 22.5–23.8 (23.3); breadth of rostrum, 20.5–21.8 (21.2); maxillary tooth row, 22.2–23.1 (22.5). Adult female: ¹ Condyllo-basal length, 88.7; palatal length, 50.2; postpalatal length, 34; length of nasals, 37; zygomatic breadth, 59.4; breadth across mastoids, 39.7; least

¹ One specimen from type locality.

² Four specimens from type locality.

³ Seven in collection Mus. Vert. Zool., Univ. of California.

interorbital breadth, 22.2; breadth of rostrum, 20.5; maxillary tooth row, 21.8.

Remarks.—This race is a small form of *caligata*, confined to Montague Island, and differing from the typical race in size and skull characters. On Hinchinbrook Island, separated from Montague Island by only a narrow channel, the typical form is found.

Specimens examined.—Seven, from type locality.¹

MARMOTA CALIGATA OXYTONA HOLLISTER.

ROBSON HOARY MARMOT.

(Pl. III, fig. 1; Pl. IV, fig. 3; Pl. IX, fig. 2; Pl. X, fig. 4.)

Marmota sibilata Hollister, Smiths. Misc. Coll., Vol. 56, No. 35, 1912, p. 1. (Not *Arctomys sibilata* Wolf.)

Marmota oxytona Hollister, Science, N. S., XXXIX, No. 998, Feb. 13, 1914, p. 251 (new name for *Marmota sibilata* Hollister).

Type locality.—Head of Moose Pass branch of Smoky River, Alberta (altitude, 7,200 feet).

Distribution.—Interior of northern British Columbia, southwestern Mackenzie (?), and southern Yukon, from Teslin Lake and Liard River south to Barkerville, British Columbia, and the Mount Robson region, British Columbia and Alberta.

Characters.—Colors much blacker and tail darker than in *caligata*; skull larger and relatively narrower; males but little larger than females.

Color.—Upperparts as in *caligata*, but more extensively tipped with black, the underfur fuscous, shading to deep mouse gray or fuscous-black; hinder back dark cinnamon-buff, tinged with hazel and heavily mixed with black; top of head black with rather small white patches; cheeks ochraceous-cinnamon, varying to buffy white; tail above, dark cinnamon-buff mixed with bay, the bases of the hairs chestnut-brown or blackish brown; beneath, blackish brown, tinged with bay; underparts soiled whitish mixed with dull cinnamon, the bases of the hairs blackish brown.

Skull.—Much longer and relatively narrower than that of *caligata*, with long rostrum; zygomata less widely expanded posteriorly; zygomatic arch longer and distance from squamosal arm to tip of post-orbital process greater; nasals terminating on a line with ends of premaxillae or slightly posterior; interpterygoid fossa relatively narrower.

Measurements.—Adult male:² Total length, 720–775 (average, 747); tail vertebrae, 210–235 (221); hind foot, 100–110 (105.6). Adult female:³ 720–740 (730); 210; 95–105 (100). *Skull:* Adult male:⁴

¹ Five in collection Mus. Vert. Zool., Univ. of California.

² Five specimens from British Columbia (Mount Robson to Thudade Lake).

³ Two specimens from Sustut Mountains, British Columbia; and head of Smoky River, Alberta.

⁴ Seven specimens from northern British Columbia.

Condyllo-basal length, 101–107.4 (103.6); palatal length, 57–62.5 (58.9); postpalatal length, 38.3–41.7 (40.1); length of nasals, 41.5–45.3 (43.2); zygomatic breadth, 62.8–67.4 (65.8); breadth across mastoids, 44.2–48.3 (46.6); least interorbital breadth, 24–25.8 (25.3); breadth of rostrum, 22–24.8 (23.1); maxillary tooth row, 22–23.5 (22.8). Adult female:¹ Condyllo-basal length, 101.8–104.6 (103.2); palatal length, 56.5–61.2 (58.9); postpalatal length, 36.4–41.1 (38.8); length of nasals, 41–43.6 (42.3); zygomatic breadth, 65.3–66.2 (65.8); breadth across mastoids, 45.9–47.3 (46.6); least interorbital breadth, 25.4–26.7 (26); breadth of rostrum, 23–23.3; maxillary tooth row, 22.7.

Remarks.—This is the darkest and one of the largest of the races of *caligata*. It intergrades with *caligata* in northern British Columbia and southern Yukon, and with *okanagana* in southern British Columbia, but the material at present available is not sufficient to show the exact limits of its range. Specimens from the Liard River (Fort Halkett and Fort Liard) are provisionally referred to this race, no skulls from this region being available and the skins being rather indeterminate in characters. Additional material from the northern Rockies may extend the known range of this form farther northward in the interior.

A series from near Teslin Lake, Yukon, is intermediate between *caligata* and *oxytona*; the skulls are smaller than those of typical *oxytona*, some of them even smaller than those of *caligata*, but relatively narrower. The nasals, though actually longer than in *caligata*, do not extend so far back of the ends of the premaxillae, in this character agreeing with *oxytona*.

Specimens examined.—Total number, 63, as follows:

Alberta: Smoky River (near Moose Pass), 2.

British Columbia: Babine (mountains near), 3; Barkerville, 5; Finlay River (mountains near head), 1; Fort Halkett, 1;² Klappan River (mountains near), 3; Laurier Pass, 1; Level Mountain, 1;³ McConnell Creek (near Sustut Mountains), 1; Moose Pass, 2; Moose River (north fork), 2; Sheslay River, 2;³ Stuart Lake, 2; Sustut Mountains, 4; Thudade Lake, 2.

Mackenzie: Fort Liard, 2.

Yukon: Teslin Lake (mountains near), 29.⁴

MARMOTA CALIGATA OKANAGANA (KING).

OKANAGAN HOARY MARMOT.

(Pl. X, fig. 3.)

*Arctomys okanaganus*⁵ King, Narr. Journ. to Shores of Arctic Ocean, II, 1836, p. 236.

Arctomys pruinosus, Audubon and Bachman, Quad. N. Am., III, 1854, p. 17, Plate CIII. (Not of Gmelin.)

[*Marmota*] *okanagana* Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 17 (type locality fixed).

¹ Two specimens from head of Smoky River, Alberta.

² Collection Univ. of Michigan.

³ Collection Amer. Mus. Nat. Hist.

⁴ Collection Victoria Mem. Mus.; approaching *caligata*.

⁵ "*Arctomys okanaganii*" on plate.

Type locality.—Gold Range, British Columbia.

Distribution.—Gold and Selkirk Ranges, British Columbia, and probably main range of the Rocky Mountains in Alberta from Banff to Henry House; exact limits unknown.

Characters.—Similar in color to *oxytona*, but averaging a little whiter; skull similar to that of *caligata*.

Color.—Upperparts much as in *oxytona*, but averaging whiter (some specimens almost as pale as *caligata*, but tail darker); underfur fuscous, shading to clove brown; fore back white, hinder back cinnamon-buff, more or less overlaid with black; sides of face cinnamon mixed with white; feet blackish brown, the hind feet grizzled with cinnamon; tail above, deep cinnamon (sometimes mixed with hazel) bordered with blackish brown, the bases of the hairs light chestnut-brown; beneath, blackish brown or dark chestnut-brown; underparts soiled whitish mixed with dull cinnamon.

Skull.—Similar to that of *caligata*, but averaging slightly larger, with narrower rostrum and postorbital constriction; nasals shorter, usually terminating little if any posterior to ends of premaxillae. Compared with *oxytona*: Decidedly shorter and relatively broader; braincase less elongated and distance from tip of postorbital process to squamosal arm of zygoma much less.

Measurements.—Adult male:¹ Total length, 670–754 (average, 694); tail vertebrae, 202–218 (212); hind foot, 91–106 (98). Adult female:² 659–735 (695); 202–224 (212); 93–103 (94). *Skull*: Adult male:³ Condylar-basal length, 95–100 (97.7); palatal length, 53.4–57.4 (55.5); postpalatal length, 37–38.1 (37.8); length of nasals, 37–40.5 (38.9); zygomatic breadth, 64.8–67 (66.2); breadth across mastoids, 45.2–46 (45.6); least interorbital breadth, 24.9–27 (25.7); breadth of rostrum, 23–25.2 (24.2); maxillary tooth row, 21.9–22.7 (22.4). Adult female:⁴ Condylar-basal length, 94.4–97.6 (96.4); palatal length, 53.5–55.3 (54.5); postpalatal length, 36–38.7 (37.3); length of nasals, 38–40.3 (39); zygomatic breadth, 62.2–66.3 (64.4); breadth across mastoids, 42.2–45.5 (43.7); least interorbital breadth, 21.9–24.9 (23.7); breadth of rostrum, 21–23.3 (21.9); maxillary tooth row, 21.4–22.4 (22).

Remarks.—This race apparently has a rather limited distribution, but its characters are well marked. It is not in any way intermediate between *oxytona* and *nivaria*, as might be expected from its geographic position, for, while it agrees with the former in color, its skull is much smaller than in either and more nearly resembles that of *caligata*. It is very much darker in color than *nivaria*, the differences being especially noticeable in the young.

¹ Four specimens from Selkirk Range, British Columbia.

² Six specimens from same localities.

³ Three specimens from Glacier and Nelson, British Columbia.

⁴ Five specimens from same localities.

King, in naming the species in 1836, gave an excellent description and figure of the animal, based on two living individuals which had been brought from the Okanogan region to Norway House, Canada. These were later presented by King to the Zoological Gardens in London, where they were seen by Audubon, and after the death of the animals the skins served as the basis of the figure of the hoary marmot in his "Quadrupeds of North America." The type specimen, as I am informed by Oldfield Thomas, is still in the British Museum collection (No. 55.12.24.126) and agrees in every detail with the original description. The skull probably (not certainly) belonging to the skin is so diseased by menagerie life as to be of no use for comparison.

The original description is so complete and agrees so well with the form occurring in the Selkirks that I have no hesitation in fixing the type locality in the Gold Range—the first range to the eastward of Shuswap Lake—where it is likely the type was secured.¹

Specimens examined.—Total number, 18, as follows:

Alberta: Henry House (mountains 15 miles south), 2.

British Columbia: Field, 2;² Glacier, 7; Spillimacheen River, 3;³ Toad Mountain (6 miles south of Nelson), 4.

MARMOTA CALIGATA NIVARIA HOWELL.

MONTANA HOARY MARMOT.

(Pl. X, fig. 2; Pl. XII, fig. 4.)

Marmota caligata nivaria Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 17.

Type locality.—Mountains near Upper St. Marys Lake, Mont. (altitude, 6,100 feet).

Distribution.—Upper slopes (at and above timberline) of high mountains of northwestern Montana and of Bitterroot and Salmon River Mountains, Idaho (limits of range imperfectly known).

Characters.—Whitest member of the group, being very much whiter than either *okanagana* or *oxytona*; similar in size and skull characters to *oxytona*.

Color.—*Adults:* Fore part of back (to middle) snowy white, sparingly grizzled with black, the underfur dark hair-brown; hinder back pinkish cinnamon or cinnamon-buff mixed with black and white, the underfur bone brown; top of head black, much mixed with white and with a large white patch across face in front of eyes; sides of face brownish, mixed with white and cinnamon-buff; fore feet black with

¹ King defines the type region as follows: "In a small tract of country, on the borders of the Rocky Mountains, lying between the Columbia and Fraser Rivers, these animals are found in abundance, supplying with food and clothing the Okanogan Indians, whose territory is bounded to the north by the Seechwap Lake, and to the south by the Spokane River * * *." (King, R. Narr. Journ. to Shores of Arctic Ocean, II, 1836, p. 241.)

² Collection Victoria Mem. Mus.

³ Collection Amer. Mus. Nat. Hist.

white patches; hind feet black, more or less mixed with cinnamon; underparts white, sparingly mixed on abdomen with cinnamon-buff; tail above, mixed pinkish cinnamon and chestnut-brown; beneath clove brown or blackish brown. *Young* (specimen from Elk Summit, Idaho): Nearly pure white above, shading to cinnamon-buff on hinder back; the underfur dark mouse gray; tail cinnamon-buff fringed at tip with blackish brown, the bases of hairs hair-brown; feet and top of head fuscous-black.

Skull.—(Known only from females.) Closely similar to that of *oxytona*, possibly averaging a little shorter; much larger and relatively narrower than that of *okanagana*, with broader rostrum.

Measurements.—Young adult male from type locality: Total length, 755; tail vertebrae, 250; hind foot, 110. Adult female:¹ 700–820 (average, 751); 200–245 (224); 95–113 (105). *Skull*: Adult female:¹ Condylar-basal length, 99.5–106.5 (102); palatal length, 58–61.4 (59.4); postpalatal length, 37.5–39.6 (38.2); length of nasals, 40.6–43.9 (42.2); zygomatic breadth, 64–66.6 (65.7); breadth across mastoids, 44.8–45.7 (45.5); least interorbital breadth, 23.3–27.2 (25.5); breadth of rostrum, 21.6–25 (23); maxillary tooth row, 22.2–24.4 (22.9).

Remarks.—This race widely differs in color from its nearest relatives, *okanagana* and *oxytona*, being even whiter than *caligata*. The characters are strikingly shown by young specimens which are almost pure white except on the hinder back and tail. Additional material is needed to determine the exact range of the form and the cranial characters of the males.

Specimens examined.—Total number, 14, as follows:

Idaho: Bitterroot Mountains (headwaters of Clearwater River), 3; Elk Summit, Salmon River Mountains, 2.

Montana: Upper St. Marys Lake (mountains near), 9.

MARMOTA CALIGATA CASCADENSIS HOWELL.

CASCADE HOARY MARMOT.

(Pl. X, fig. 1; Pl. XV, fig. 4.)

Marmota caligata cascadenensis Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 17.

Type locality.—Mount Rainier, Wash. (altitude, 6,000 feet).

Distribution.—Cascade Range (at and above timberline) from Mount Rainier, Wash., north to southern British Columbia.

Characters.—Size large (equaling *olympus* and *oxytona*; larger than *caligata*); color similar to that of *caligata*, but head and feet usually browner and underparts darker; skull similar to that of *oxytona* but relatively broader, much larger than that of either *caligata* or *okanagana*.

¹ Four specimens from type locality.

Color.—Fore part of back white or creamy white, sparingly tipped with vandyke brown, the bases of the hairs with a broad area of the latter color; hinder back more extensively shaded with brown and sometimes tinged with cinnamon-buff; head and face vandyke brown or blackish brown, often with a white patch in front of eyes; sides of face and neck brownish, tinged with cinnamon or buffy white; feet blackish brown, often mixed with cinnamon; tail cinnamon-buff mixed with vandyke brown, becoming (in some specimens) dark chestnut-brown below; underparts mixed grayish white and blackish brown in varying proportions, faintly tinged with pale cinnamon-buff.

Skull.—Similar to that of *oxytona*, but relatively broader across zygomata and interorbital region; decidedly larger than that of its nearest neighbor, *okanagana*, with broader postorbital constriction; compared with *nivaria* it is shorter, with the zygomata more widely expanded and the premaxillae narrower.

Measurements.—Adult male:¹ Total length, 710–785 (average, 749); tail vertebrae, 205–252 (232); hind foot, 98–112 (102). Adult female:² 680–765 (714); 195–247 (219); 94–107 (99). *Skull:* Adult male:³ Condyllo-basal length, 106.2–107 (106.6); palatal length, 61.6–62.7 (62.2); postpalatal length, 39–40 (39.5); length of nasals, 42–44.5 (43.3); zygomatic breadth, 69.2–69.8 (69.5); breadth across mastoids, 48.5–49.2 (48.9); least interorbital breadth, 27.1–29 (28); breadth of rostrum, 24.5–24.7 (24.6); maxillary tooth row, 22.3–24.1 (23.2). Adult female:⁴ Condyllo-basal length, 95.4–102.5 (98.8); palatal length, 56.3–59 (57.7); postpalatal length, 34.6–39 (37.7); length of nasals, 37.8–44 (41.7); zygomatic breadth, 64.2–68.4 (65.8); breadth across mastoids, 44.9–49.4 (46.7); least interorbital breadth, 22.5–24.6 (23.8); breadth of rostrum, 19.3–22.7 (21.2); maxillary tooth row, 21–23.2 (22.1).

Remarks.—The Cascade hoary marmot differs from both *okanagana* and *oxytona* in whiter and browner (less black) coloration above; from *nivaria* in much more dusky colors, both above and below; and from *caligata* in much larger size and darker coloration. It is widely different from *olympus*, both in color and cranial characters. It is apparently isolated from all the other forms of the group, and no absolute intergrades have been examined, but the characters separating it from the forms of *caligata* are so slight that it seems best to regard it as a subspecies of the latter.

¹ Four specimens from Mount Rainier and Cascade River, Wash.

² Six specimens from same localities.

³ Two specimens from Cascade River, Wash., and Mount Baker Range, British Columbia.

⁴ Seven specimens from Cascade Range, Wash., and Mount Baker Range, British Columbia.

Specimens examined.—Total number, 50, as follows:

British Columbia: Chilliwack (mountains near), 1;¹ Hope, 1;² Howe Sound (near head), 3;¹ Mount Baker Range (near United States boundary), 8;³ Skagit River (mountains near head), 6; Spences Bridge, 1;⁴ Tammi Hy Mountain, 2.¹

Washington: Camp Chiloweyuck, 2; Cascade River (near head), 8; Easton (mountains near), 1; Mount Rainier, 7; "Northwest boundary survey" (probably Mount Baker Range), 10.

MARMOTA OLYMPUS (MERRIAM).

OLYMPIC MARMOT.

(Pl. II, fig. 1; Pl. IX, fig. 1; Pl. XV, fig. 1.)

Arctomys olympus Merriam, Proc. Acad. Nat. Sci., Philadelphia, 1898, p. 352.

[*Marmota*] *olympus* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Head of Soleduck River, Olympic Mountains, Wash. (at timberline).

Distribution.—Upper slopes of the Olympic Mountains, Wash., above timberline (from about 4,000 feet altitude to near summits of peaks).

Characters.—Size large (about equaling *M. caligata cascadiensis*); color in fresh pelage brownish drab mixed with white; feet brown; skull with broad rostrum and interorbital region.

Color.—*Fresh pelage:*⁵ General tone brownish drab, more or less mixed with white hairs; underfur between hair-brown and benzo brown, becoming pale drab-gray at tips; long hairs glossy blackish brown mixed with more or less pure white ones; top and sides of head blackish brown, with a broad, white patch in front of eyes; sides of nose, lips, and chin white; legs brownish drab shading to blackish brown on the feet; tail clove brown, tipped with light pinkish cinnamon; underparts brownish drab mixed with white (or solid soiled whitish). *Worn summer pelage:* General tone of upperparts pinkish buff, varied with russet, the bases of hairs bister; feet chestnut-brown; tail above, pinkish buff or cinnamon-buff, mixed with snuff brown; beneath, snuff brown to chestnut-brown. *Young* (half-grown August specimens): General tone of upperparts grayish brown, becoming cinnamon on rump; underfur hair-brown at base, tipped on fore back with white, and on hinder back and rump with cinnamon or cinnamon-buff; top and sides of head and fore legs bister; feet dark clove brown; underparts light clove brown mixed with white or pale buff.

¹ Collection Victoria Mem. Mus.

² Collection Mus. Comp. Zool.

³ Including five in Mus. Comp. Zool.

⁴ Collection Amer. Mus. Nat. Hist.

⁵ No specimens in full winter pelage have been seen; description from August specimens just beginning to acquire the fall pelage.

Skull.—Similar to that of *cascadensis* but relatively narrower across zygomata and broader between orbits and across rostrum; postorbital constriction narrower; nasal branches of premaxillae narrower than nasals at posterior end.

Measurements.—Adult male:¹ Total length, 720–750 (average, 740); tail vertebrae, 210–237 (219); hind foot, 100–110 (106). Adult female:² 670–690 (680); 180–192 (186); 91–100 (95.5). *Skull*: Adult male:³ Condyllo-basal length, 105–109.8 (106.1); palatal length, 60–63 (61.1); postpalatal length, 39.6–42 (40.6); length of nasals, 40.6–46 (43.7); zygomatic breadth, 64.8–67.1 (65.6); breadth across mastoids, 46.2–47.3 (47); least interorbital breadth, 27.5–31.2 (29.8); breadth of rostrum, 24.5–27.7 (25.8); maxillary tooth row, 21.5–24.2 (23.1). Adult female:⁴ Condyllo-basal length, 99.5; palatal length, 58; postpalatal length, 37.5; length of nasals, 41.5; zygomatic breadth, 64.3; breadth across mastoids, 43.7; least interorbital breadth, 26.5; breadth of rostrum, 24.6; maxillary tooth row, 22.5.

Remarks.—The Olympic marmot is one of the largest members of the *caligata* group, about equaling in external measurements *cascadensis* and *oxytona*. Its skull averages about the size of that of *cascadensis*, but the largest male skull of *olympus* is longer than any other American marmot skull examined. In color the species is decidedly browner than any of the forms of *caligata*, though not nearly so brown as *vancouverensis*. The black colors of *caligata* have almost entirely disappeared, but some of the white hairs remain.

This species is confined to the high mountains of the Olympic Peninsula and is geographically isolated from its nearest relative, *cascadensis*.

Specimens examined.—Total number, 17, as follows:

Washington: Happy Lake, Olympic Mountains, 7; ⁵ Mount Ellinor, 3; Mount Steel, 4; Soleduck River (near head), Olympic Mountains, 3.

MARMOTA VANCOUVERENSIS SWARTH.

VANCOUVER ISLAND MARMOT.

(Pl. IX, fig. 3; Pl. XV, fig. 2:)

Marmota vancouverensis Swarth, Univ. of California Pub. Zool., VII, 1911, p. 201; X, 1912, p. 89.

Type locality.—Mount Douglas, Vancouver Island, British Columbia (altitude, 4,200 feet).

¹ Three specimens from Olympic Mountains, Wash.

² Two specimens from same locality.

³ Five specimens from same locality.

⁴ One specimen from same locality.

⁵ Collection Field Mus. Nat. Hist.

Distribution.—Vancouver Island, British Columbia; apparently not generally distributed, and known at present only from “the mountains at the head of China Creek, some 20 miles south of Alberni, in the Golden Eagle Basin, and King Solomon Basin, and on the surrounding slopes and ridges.”¹

Characters.—Size of *M. caligata cascadenis*; color uniformly dark brown; skull relatively narrow with peculiarly shaped nasals.

Color.—Entire body, legs, and tail dark vandyke brown, the underfur being of the same color, the long hairs more blackish and glossy; sides of nose and chin soiled whitish; underparts sometimes irregularly blotched with white, and back rarely with a few scattering white hairs; feet glossy blackish brown. In worn pelage the upperparts and tail fade to sayal brown or clay color.

Skull.—Similar to that of *cascadenis*, but smaller and relatively narrower; zygomata less widely expanded; premaxillae relatively wider; nasals deeply emarginate posteriorly, the frontals projecting forward and forming a V-shaped notch between nasals; incisors white or yellowish white.

Measurements.—Adult male:² Total length, 660–710 (average, 684); tail vertebrae, 200–300 (222); hind foot, 90–102 (98.4). Adult female:³ 680–720 (700); 210–240 (225); 100–105 (102.5). *Skull:* Adult male:⁴ Condyllo-basal length, 98–103.2 (99.9); palatal length, 57–59.5 (57.8); postpalatal length, 36.5–39.5 (37.8); length of nasals, 40–42.7 (41.4); zygomatic breadth, 64.2–65.5 (64.7); breadth across mastoids, 45.7–47 (46.1); least interorbital breadth, 23.2–24.4 (24); breadth of rostrum, 22–24 (22.9); maxillary tooth row, 23.6–24.7 (24.1). Adult female:³ Condyllo-basal length, 93.7–96.6 (95.2); palatal length, 54–54.3 (54.2); postpalatal length, 35.2–37.5 (36.3); length of nasals, 39–39.6 (39.3); zygomatic breadth, 61.6–62.6 (62.1); breadth across mastoids, 44; least interorbital breadth, 21.7–23 (22.3); breadth of rostrum, 21.5–21.6; maxillary tooth row, 23.1–23.7 (23.4).

Remarks.—This peculiar marmot, although clearly related to the mainland species (*caligata*) has, through isolation, developed striking characters, both external and cranial. The tendency of isolated coastal forms in this group to become brown (shown in a lesser degree by *M. caligata vigilis* and *M. olympus*) has reached the greatest extreme in this species, the black colors of the mainland forms being entirely lacking and the white reduced to scattering hairs.

¹ Swarth, H. S. Loc. cit., X, 1912, p. 89.

² Five specimens from vicinity of type locality.

³ Two specimens from vicinity of type locality.

⁴ Four specimens from vicinity of type locality.

After a season's exploration of the southern part of Vancouver Island, Swarth came to the conclusion that the species is probably confined to a small area in the vicinity of Mount Douglas. He states:

We found them in the mountains at the head of China Creek, some 20 miles south of Alberni, in the Golden Eagle Basin, and King Solomon Basin, and on the surrounding slopes and ridges. They were most abundant on Mount Douglas, the peak to the west of King Solomon's Basin. Wherever the ground was bare of timber, or but sparsely covered, as is the case over extensive areas at this point, the marmots had established themselves, burrowing under the rocks, and apparently never wandering very far from home. * * * Their extreme wariness is correlated with conspicuousness, for the dark brown pelage shows in marked contrast against either gray rocks or green grass. * * * They whistled but seldom, only one or two being heard during the three weeks we spent in their territory.¹

None was found in apparently suitable situations on Mount Arrow-smith, and certain timber cruisers who had explored the wilder parts of the island stated that they had never seen a marmot.

Specimens examined.—Total number, 11,² as follows:³

British Columbia: Golden Eagle Basin, 1; King Solomon Basin, 3; Mount Douglas, 7.

Cranial Measurements of the *Marmota caligata* Group.

No.	Species and locality.	Sex.	Condyllo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mase-toids.	Le a s t interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
<i>Marmota caligata caligata.</i>												
131440	Becharof Lake, Alaska	[♂?]	99	56.8	36.8	38.4	68	46.2	27.6	26.1	22	Adult.
131441	.....do.....	[♂?]	96.5	55.7	36.5	41.4	64.7	44	24.3	24	22.3	Do.
131442	.....do.....	[♂?]	100.6	57.4	38.2	42.3	67.8	44	25.8	24.1	23.8	Do.
98154	White Pass, Alaska	[♂?]	100	57.7	37.8	43	65.2	44.2	23.4	23.6	23.4	Do.
131444	Becharof Lake, Alaska	[♂?]	92.8	53	35.8	38	63.4	43.2	24.3	22.9	21.9	Do.
128069	.....do.....	[♂?]	96.4	53.9	38	39.1	64.1	43	23.9	24.5	22.5	Do.
98153	White Pass, Alaska	[♂?]	88.9	51	33.5	40.5	57.5	40	22.1	20	22	Do.
135161	Head of Coal Creek, Yukon.....	♂	94	53.9	36	38	62.3	43.3	24	22.1	21.7	Do.
<i>Marmota caligata vigilis.</i>												
4 418	Glacier Bay, Alaska.....	♂	97.2	55.8	36.7	38.9	62	43.5	22.6	21.1	22.3	Do.
4 427	.....do.....	♂	97.3	54.7	37.8	41.4	64.8	43.2	24.2	22	21.8	Do.
97952	.....do.....	♂	98.4	55.5	38	41.5	67.7	44.6	26	23.5	22.5	Do.
97953	.....do.....	♂	93.7	51.6	37.7	39.6	61.8	42.3	24.5	21.3	22	Do.
<i>Marmota caligata sheldoni.</i>												
137319	Montague Island, Alaska.....	♂	89.5	51.2	34.3	35	61.5	41.3	22.5	20.5	22.5	Do.
4 962	.....do.....	♂	96.6	55.4	36	39	63	42.3	23.5	21.6	23.1	Do.
4 961	.....do.....	[♂?]	96	54.5	37	38.8	63.4	42.4	23.8	21.8	22.4	Do.
4 969	.....do.....	[♂?]	92.3	52.2	34.8	36.4	61.5	41.5	23.2	21	22.2	Do.
4 960	.....do.....	♂	88.7	50.2	34	37	59.4	39.7	22.2	20.5	21.8	Do.

¹ Swarth, H. S. Univ. of California Publ. Zool., X, 1912, pp. 89-90.

² All in collection Mus. Vert. Zool., Univ. of California.

³ All about 20 miles south of Alberni, British Columbia, within a radius of 10 miles.

⁴ Collection Mus. Vert. Zool., Univ. of California.

Cranial measurements of the *Marmota caligata* group—Continued.

No.	Species and locality.	Sex.	Condylar-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across maulds.	Least interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
<i>Marmota caligata oxytona.</i>												
175565	Moose Forks, British Columbia..	♂	101	57	40	41.5	62.8	44.2	25	23	22	Adult.
202789	Sustut Mountains, Brit. Col.....	♂	102	58.6	39.5	42.7	66.8	46.5	25.8	22.2	23	Do.
202791	Lake Thudade, Brit. Col.....	♂	107.4	62.5	40.2	45.3	67.4	48.3	25.7	23.6	23.3	Do.
120766	Level Mountain, Brit. Col.....	♂	105	59	41	42.3	66.5	47	25.7	24.8	22	Do.
174503	Head of Smoky River, Alberta..	♂	101.8	56.5	41.1	43.6	65.3	45.9	25.4	23	22.7	Do.
174502	.....do.....	♂	104.6	61.2	36.4	41	66.2	47.3	26.7	23.3	22.7	Do.
<i>Marmota caligata okanagan.</i>												
67073	Glacier, British Columbia.....	♂	95	53.4	37	37	66.8	45.5	24.9	23	22.7	Do.
67076	.....do.....	♂	100	54.4	37.3	40.5	67	46	27	25.2	22.5	Do.
66695	Nelson, British Columbia.....	♂	98.1	55.7	38.1	39.3	64.8	45.2	25.3	24.4	21.9	Do.
67072	Glacier, British Columbia.....	♂	96	54.4	37	40.3	64	43.7	23.5	21	22.1	Do.
67074	.....do.....	♂	97.6	55.3	38.7	38.6	66.3	45.5	21.9	21.9	21.4	Do.
67075	.....do.....	♂	94.4	53.3	36	38	65	42.9	24.6	23.3	22.3	Do.
<i>Marmota caligata nivaria.</i>												
72222	St. Marys Lake, Mont.....	♂	106.5	61.4	39.6	41.2	66.6	45.7	27.2	25	22.8	Do.
72223	.....do.....	♂	101	58	37.8	43.9	66.3	45.6	26.1	23.4	22.2	Do.
72225	.....do.....	♂	101	59	37.8	43	65.8	44.8	25.4	21.6	24.4	Do.
72235	.....do.....	♂	99.5	59	37.5	40.6	64	45.7	23.3	22	22.3	Do.
<i>Marmota caligata cascadenis.</i>												
6871	Washington - British Columbia boundary.	♂	107	62.7	40	44.5	69.2	48.5	27.1	24.7	24.1	Do.
42793	Head of Cascade River, Wash....	♂	106.2	61.6	39	42	69.8	49.2	29	24.5	22.3	Do.
6840	Mount Baker Range, Brit. Col....	♂	101	59	37.7	43.2	65.6	47.6	23.3	21.8	21	Do.
42792	Head of Cascade River, Wash....	♂	102.5	58.7	39	44	68.4	49.4	23.1	22.7	23.2	Do.
90133	Mount Rainier, Wash.....	♂	98.5	56.8	38	41.6	66.2	46.7	24.3	20.7	22.1	Do.
90134	.....do.....	♂	95.4	56.3	38.4	43.9	66.7	47.8	22.5	21	22.3	Do.
<i>Marmota olympus.</i>												
67611	Olympic Mountains, Wash.....	♂	105	60.2	40.2	44	64.8	47.3	27.5	24.6	22.9	Do.
92768	.....do.....	♂	105.3	61.8	39.6	43	65.1	47.3	31.2	26.3	21.5	Do.
6235	.....do.....	♂	109.8	63	42	46	67.1	47.3	31.1	27.7	23.7	Do.
67612	.....do.....	♂	99.5	58	37.5	41.5	64.3	43.7	26.5	24.6	22.5	Do.
<i>Marmota vancouverensis.</i>												
12099	Vancouver Island, Brit. Col.....	♂	98	57	37	40.5	...	47	...	24	23.7	Do.
12092	.....do.....	♂	98.2	57.2	36.5	40	64.2	45.7	23.2	22	24.3	Do.
12090	.....do.....	♂	100.4	57.7	38.2	42.4	64.5	46	24.4	22.6	23.6	Do.
12091	.....do.....	♂	103.2	59.5	39.5	42.7	65.5	45.8	24.3	23.2	24.7	Do.
12094	.....do.....	♂	93.7	54	35.2	39	61.6	44	21.7	21.5	23.7	Do.
12100	.....do.....	♂	96.6	54.3	37.5	39.6	62.6	44	23	21.6	23.1	Do.

1 Collection Amer. Mus. Nat. Hist.

2 Collection Mus. Comp. Zool.

3 Collection Field Mus. Nat. Hist.

4 Collection Mus. Vert. Zool., Univ. of California.

EXPLANATION OF PLATES.

PLATE II.

[Much reduced.]

- FIG. 1. *Marmota olympus*, ♂ adult, Olympic Mountains, Wash., (altitude 5,000 feet), Aug. 28, 1897. (No. 92768, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota flaviventris obscura*, ♂ adult, Wheeler Peak, N. Mex. (altitude 12,400 feet), July 27, 1904. (No. 133506, U. S. Nat. Mus., Biological Survey collection.)

PLATE III.

[Natural size.]

- FIG. 1. *Marmota caligata oxytona*. Klappan Mountain, British Columbia. (No. 170-683, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota flaviventris flaviventris*. Summer Lake, Oreg. (No. 89311, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota monax preblorum*. Woburn, Mass. (No. 78358, U. S. Nat. Mus., Biological Survey collection.)

PLATE IV.

[Three-fourths natural size.]

- FIG. 1. *Marmota flaviventris dacota*, ♂ adult, Bridger Pass, Wyo. (No. 25529, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota monax monax*, ♂ adult, Peaks of Otter, Va. (No. 143962, U. S. Nat. Mus.)
3. *Marmota caligata oxytona*, ♂ adult, Lake Thudade, British Columbia. (No. 202791, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota flaviventris sierrae*, ♀ adult, head of San Joaquin River, Cal. (No. 41950, U. S. Nat. Mus., Biological Survey collection.)
5. *Marmota monax rufescens*, ♂ adult, Lake George, N. Y. (No. 67695, U. S. Nat. Mus., Biological Survey collection.)
6. *Marmota caligata caligata*, [♂ ?] adult, Becharof Lake, Alaska. (No. 131437, U. S. Nat. Mus., Biological Survey collection.)

PLATE V.

[Three-fourths natural size.]

- FIG. 1. *Marmota monax monax*, ♂ adult, Peaks of Otter, Va. (No. 143962, U. S. Nat. Mus.)
2. *Marmota monax rufescens*, ♂ adult (type), Elk River, Minn. (No. 186521, U. S. Nat. Mus., Merriam collection.)
3. *Marmota monax preblorum*, ♂ adult, Wilmington, Mass. (No. 78355, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota monax ignava*, ♂ adult, L'Anse au Loup, Labrador. (No. 8871, Mus. Comp. Zool.)

PLATE VI.

[Three-fourths natural size.]

- FIG. 1. *Marmota monax canadensis*, ♂ adult, Murray Bay, Quebec. (No. 7603, Field Mus. Nat. Hist.)
2. *Marmota monax petrensis*, ♂ adult (type), Revelstoke, British Columbia. (No. 203532, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota monax ochracea*, [♂ ?] subadult, Babine Mountains, British Columbia. (No. 202785, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota flaviventris warreni*, ♀ adult (type), Crested Butte, Colo. (No. 202937, U. S. Nat. Mus., Biological Survey collection.)

PLATE VII.

[Three-fourths natural size.]

- FIG. 1. *Marmota flaviventris flaviventris*, ♂ adult, Donner, Cal. (No. 100532, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota flaviventris parvula*, ♀ adult (type), Jefferson, Nev. (No. 93690, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota flaviventris avara*, ♂ adult, Okanogan, British Columbia. (No. 99759, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota flaviventris engelhardti*, ♀ adult, Beaver Mountains, Utah. (No. 158978, U. S. Nat. Mus., Biological Survey collection.)

PLATE VIII.

[Three-fourths natural size.]

- FIG. 1. *Marmota flaviventris nosophora*, ♂ adult, Sawtooth National Forest, Idaho. (No. 156924, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota flaviventris luteola*, [♂ ?] adult, Mount Lincoln, Colo. (No. 175, Mus. Comp. Zool.)
3. *Marmota flaviventris dacota*, ♂ adult, Bear Lodge Mountains, Wyo. (No. 65920, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota flaviventris obscura*, ♂ adult, Wheeler Peak, N. Mex. (No. 135504, U. S. Nat. Mus., Biological Survey collection.)

PLATE IX.

[Three-fourths natural size.]

- FIG. 1. *Marmota olympus*, ♂ adult, Olympic Mountains, Wash. (No. 6325, Field Mus. Nat. Hist.)
2. *Marmota caligata oxytona*, ♂ adult, Lake Thudade, British Columbia. (No. 202791, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota vancouverensis*, ♂ adult, Vancouver Island, British Columbia. (No. 12091, Mus. Vert. Zool., Univ. of California.)
4. *Marmota caligata caligata*, [♂ ?] adult, near Portage Bay, Alaska. (No. 131440, U. S. Nat. Mus., Biological Survey collection.)

PLATE X.

[Three-fourths natural size.]

- FIG. 1. *Marmota caligata cascadensis*, ♂ adult, head of Cascade River, Wash. (No. 42793, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota caligata nivaria*, ♀ adult, St. Marys Lake, Mont. (No. 72222, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota caligata okanagana*, ♂ adult, Glacier, British Columbia. (No. 67073, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota caligata oxyiona*, ♀ adult (type), Head of Smoky River, Alberta. No. 174503, U. S. Nat. Mus.)

PLATE XI.

[Three-fourths natural size.]

- FIG. 1. *Marmota monax monax*, ♂ adult, Peaks of Otter, Va. (No. 143962, U. S. Nat. Mus.)
2. *Marmota monax rufescens*, ♂ adult (type), Elk River, Minn. (No. 186521, U. S. Nat. Mus., Merriam collection.)
3. *Marmota monax preblorum*, ♂ adult, Wilmington, Mass. (No. 78355, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota monax canadensis*, ♂ adult, Murray Bay, Quebec. (No. 7603, Field Mus. Nat. Hist.)

PLATE XII.

[Three-fourths natural size.]

- FIG. 1. *Marmota monax ignava*, ♂ adult, L'Anse au Loup, Labrador. (No. 8871, Mus. Comp. Zool.)
2. *Marmota flaviventris warreni*, ♀ adult (type), Crested Butte, Colo. (No. 202937, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota monax ochracea*, [♂ ?] subadult, Babine Mountains, British Columbia. (No. 202785, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota caligata nivaria*, ♀ adult, St. Marys Lake, Mont. (No. 72222, U. S. Nat. Mus., Biological Survey collection.)

PLATE XIII.

[Three-fourths natural size.]

- FIG. 1. *Marmota flaviventris flaviventris*, ♂ adult, Donner, Cal. (No. 100532, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota flaviventris parvula*, ♀ adult (type), Jefferson, Nev. (No. 93690, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota flaviventris avara*, ♂ adult, Okanogan, British Columbia. (No. 99759, U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota flaviventris engelhardti*, ♀ adult, Beaver Mountains, Utah. (No. 158978, U. S. Nat. Mus., Biological Survey collection.)

PLATE XIV.

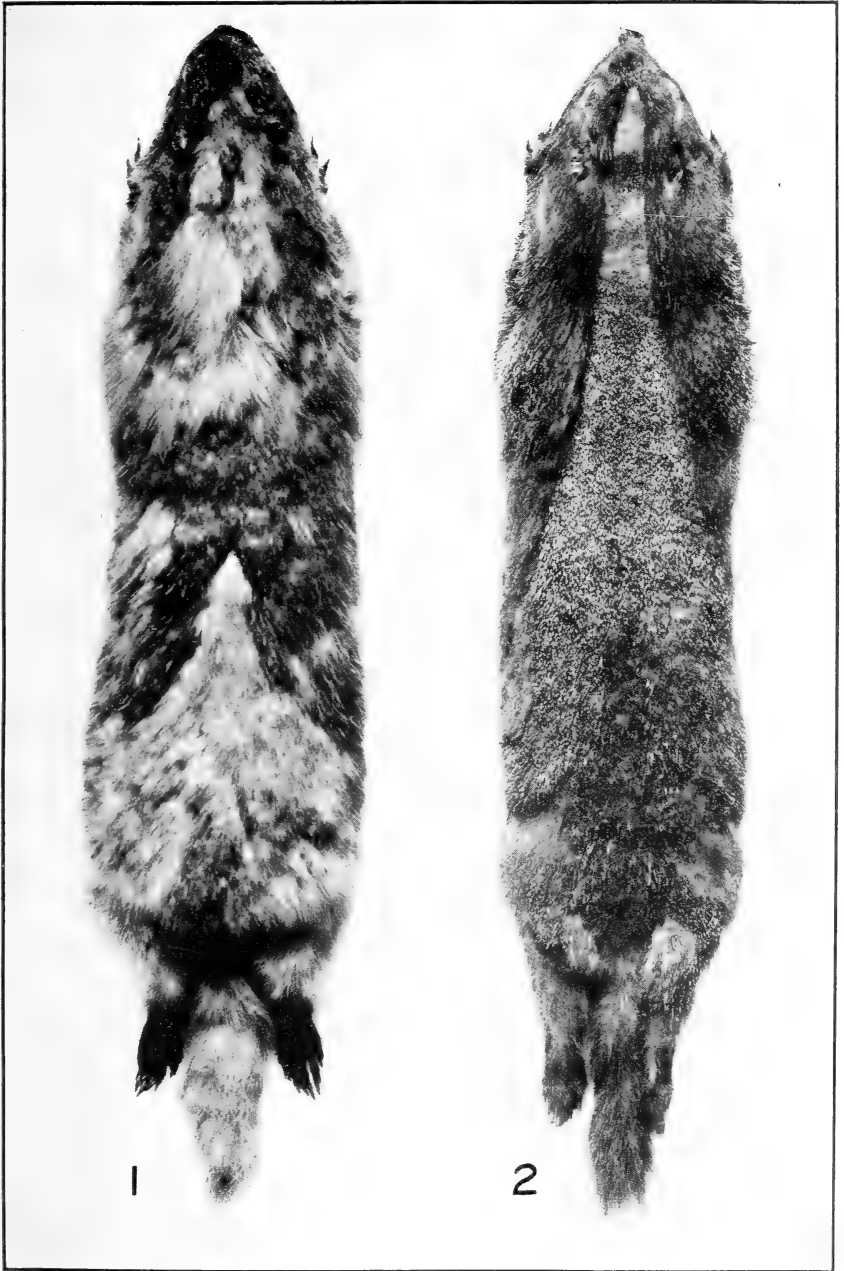
[Three-fourths natural size.]

- FIG. 1. *Marmota flaviventris nosophora*, ♂ adult, Sawtooth National Forest, Idaho. (No. 156924, U. S. Nat. Mus., Biological Survey collection.)
2. *Marmota flaviventris dacota*, ♂ adult, Bear Lodge Mountains, Wyo. (No. 65920, U. S. Nat. Mus., Biological Survey collection.)
3. *Marmota flaviventris luteola*, [♂ ?] adult, Mount Lincoln, Colo. (No. 175, Mus. Comp. Zool.)
4. *Marmota flaviventris obscura*, ♂ adult, Wheeler Peak, N. Mex. (No. 135504, U. S. Nat. Mus., Biological Survey collection.)

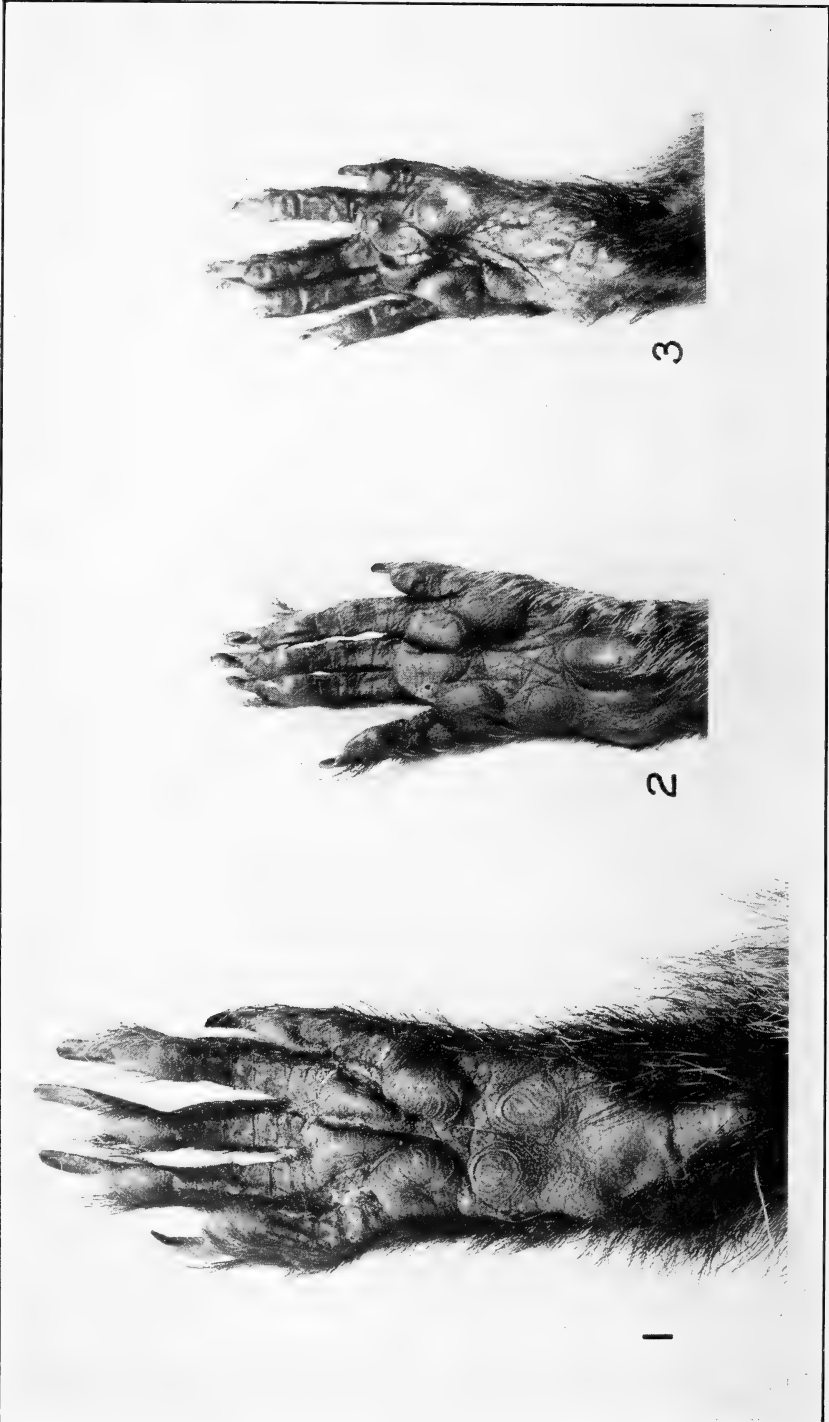
PLATE XV.

[Three-fourths natural size.]

- FIG. 1. *Marmota olympus*, ♂ adult, Olympic Mountains, Wash. (No. 6325, Field Mus. Nat. Hist.)
2. *Marmota vancouverensis*, ♂ adult, Vancouver Island, British Columbia. (No. 12091, Mus. Vert. Zool., Univ. of California.)
3. *Marmota caligata caligata*, [♂ ?] adult, near Portage Bay, Alaska. (No. 131440; U. S. Nat. Mus., Biological Survey collection.)
4. *Marmota caligata cascadenis*, ♂ adult, head of Cascade River, Wash. (No. 42793, U. S. Nat. Mus., Biological Survey collection.)

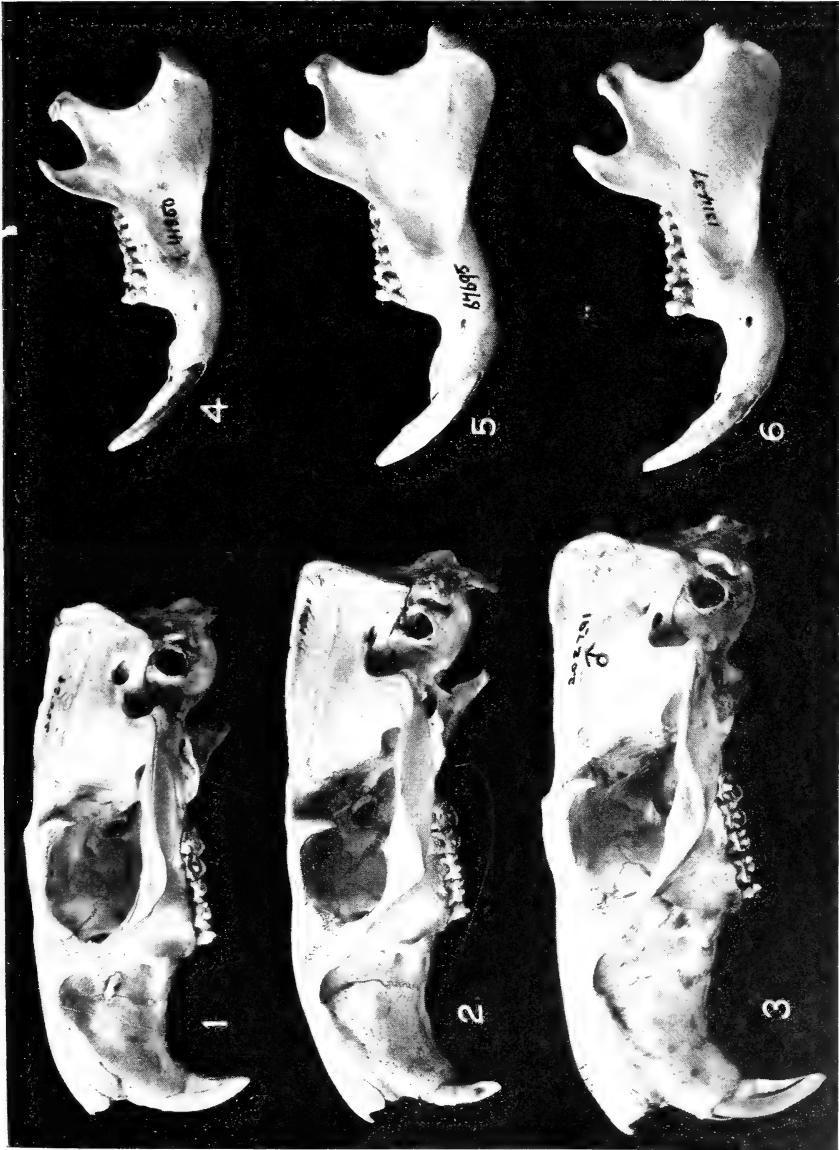


SKINS OF (1) *MARMOTA OLYMPUS* AND (2) *M. FLAVIVENTRIS* *OBSCURA*, SHOWING MOLT.



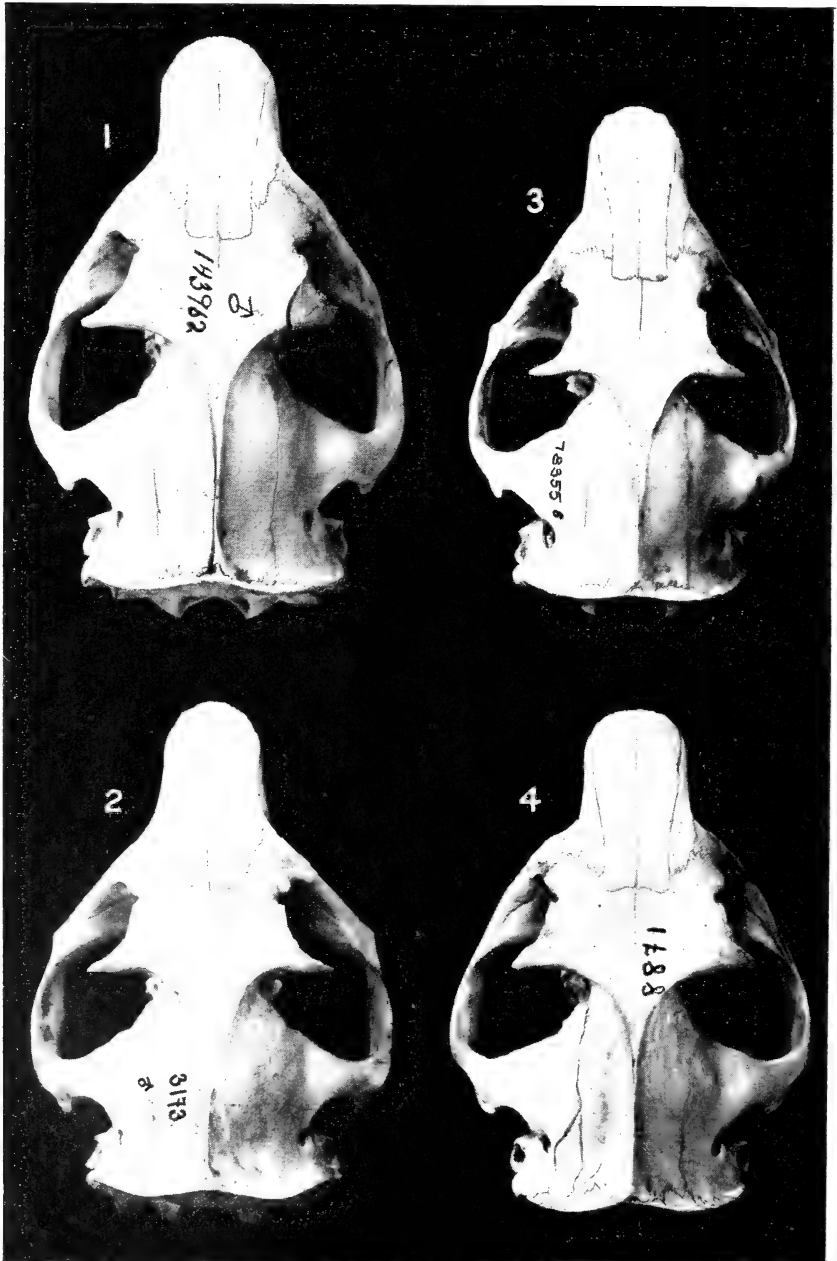
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- 1. *Marmota caligata oxytona*.
- 2. *Marmota flaviventris flaviventris*.
- 3. *Marmota monax pr-blorum*.



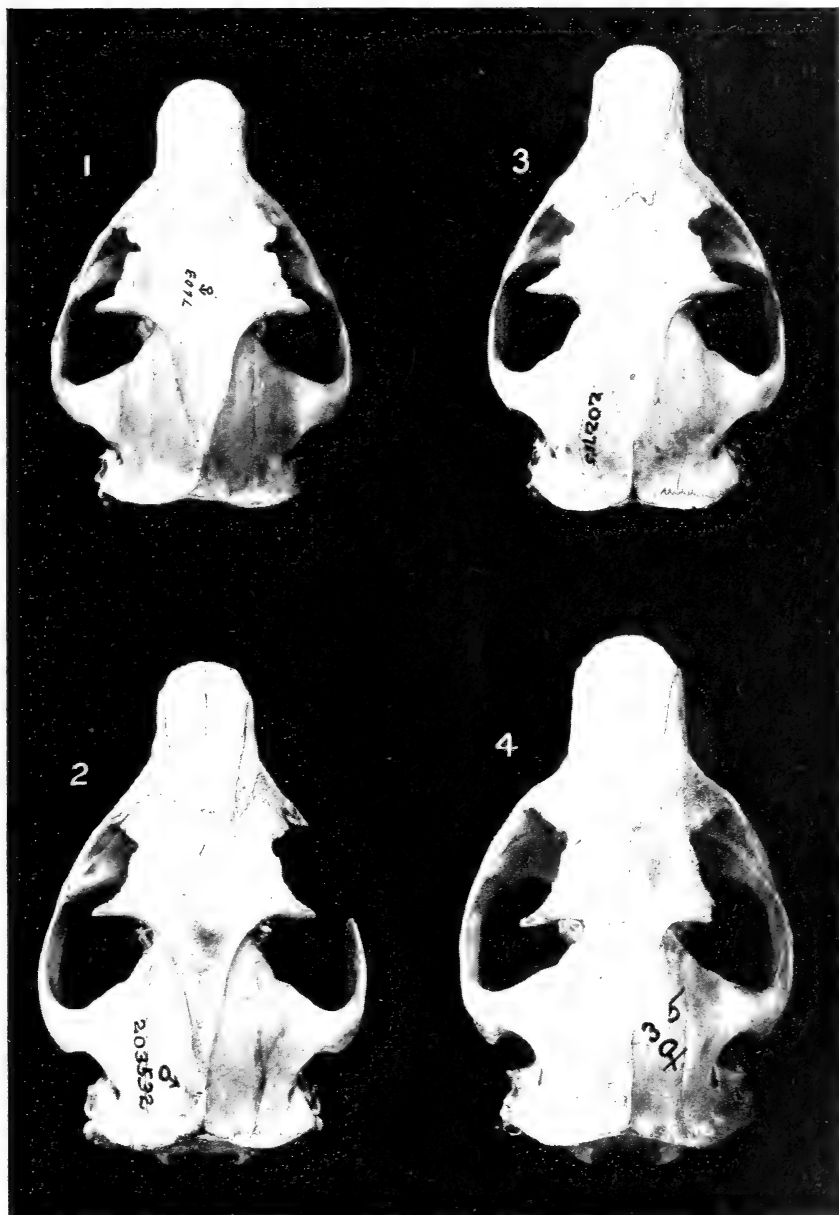
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- 1. *M. flaviventris dacota*.
- 2. *M. monax monax*.
- 3. *M. caligata oxyfons*.
- 4. *M. flaviventris sicrmae*.
- 5. *M. monax rufescens*.
- 6. *M. caligata caligata*.



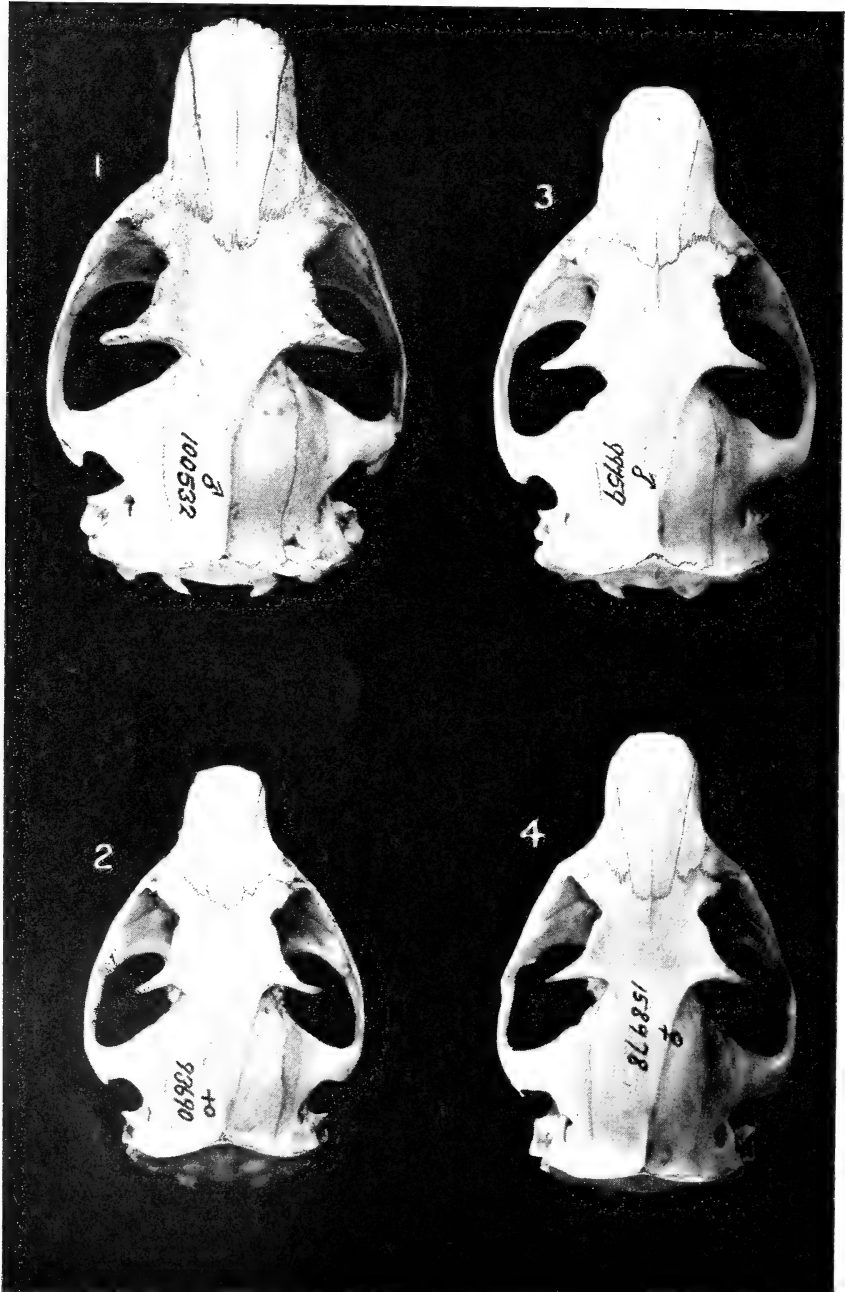
SKULLS OF MARMOTA.

1. *M. monax monax*. 3. *M. monax preblorum*.
2. *M. monax rufescens*. 4. *M. monax ignava*.



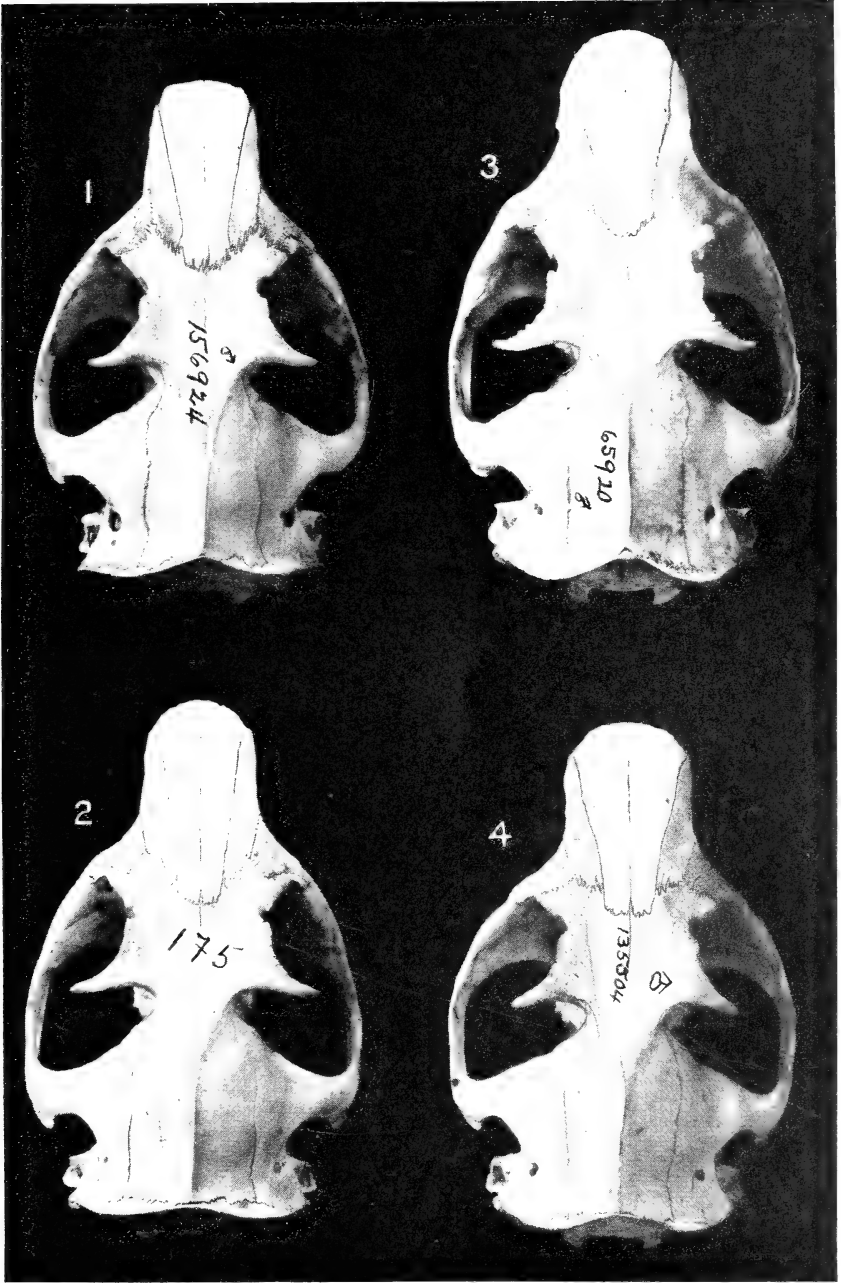
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1. *M. monax canadensis*. 3. *M. monax ochracea*.
2. *M. monax petrensis*. 4. *M. flaviventris warreni*.



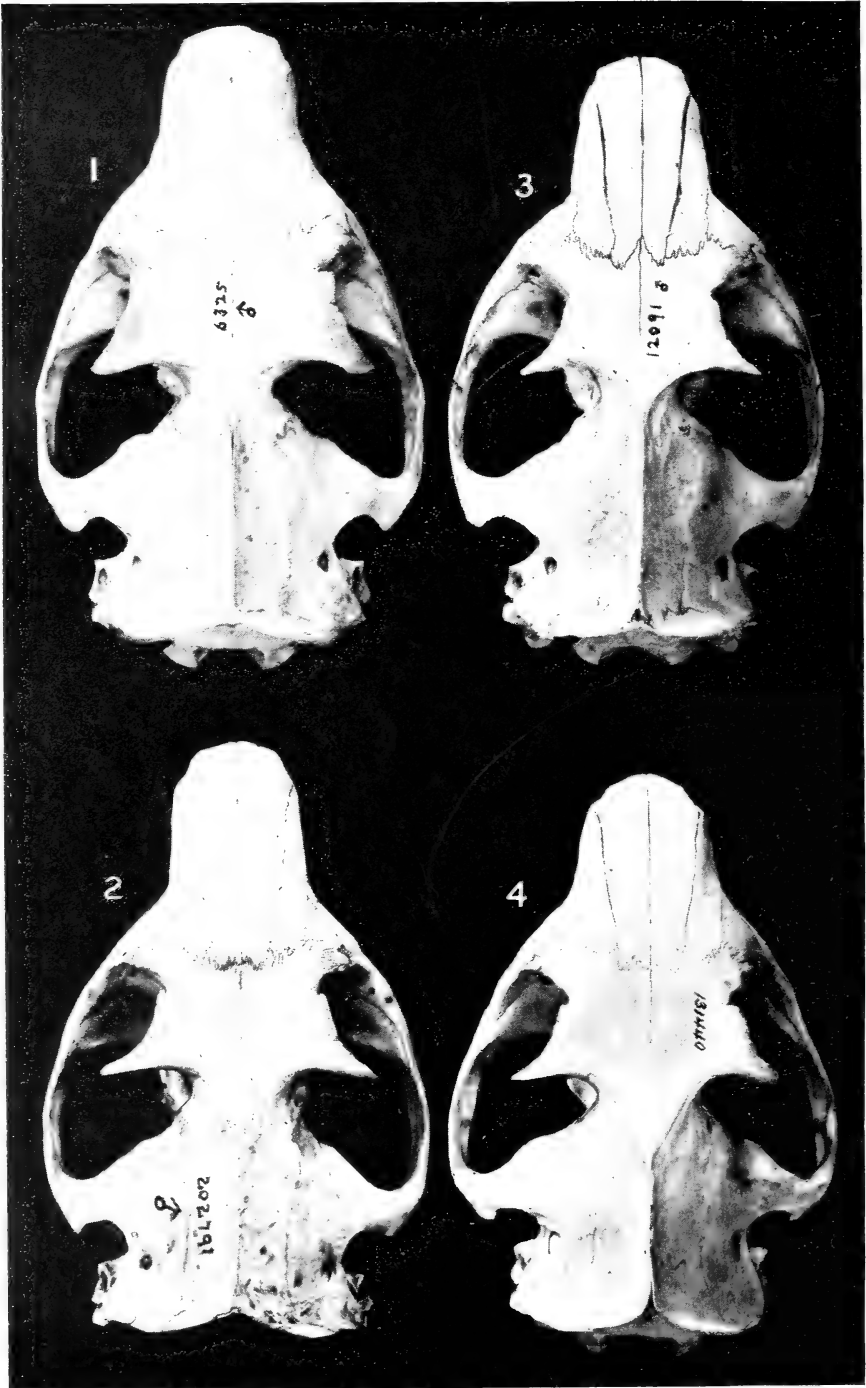
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1. *M. flaviventris flaviventris*. 3. *M. flaviventris avara*.
2. *M. flaviventris parvula*. 4. *M. flaviventris engelhardtii*.



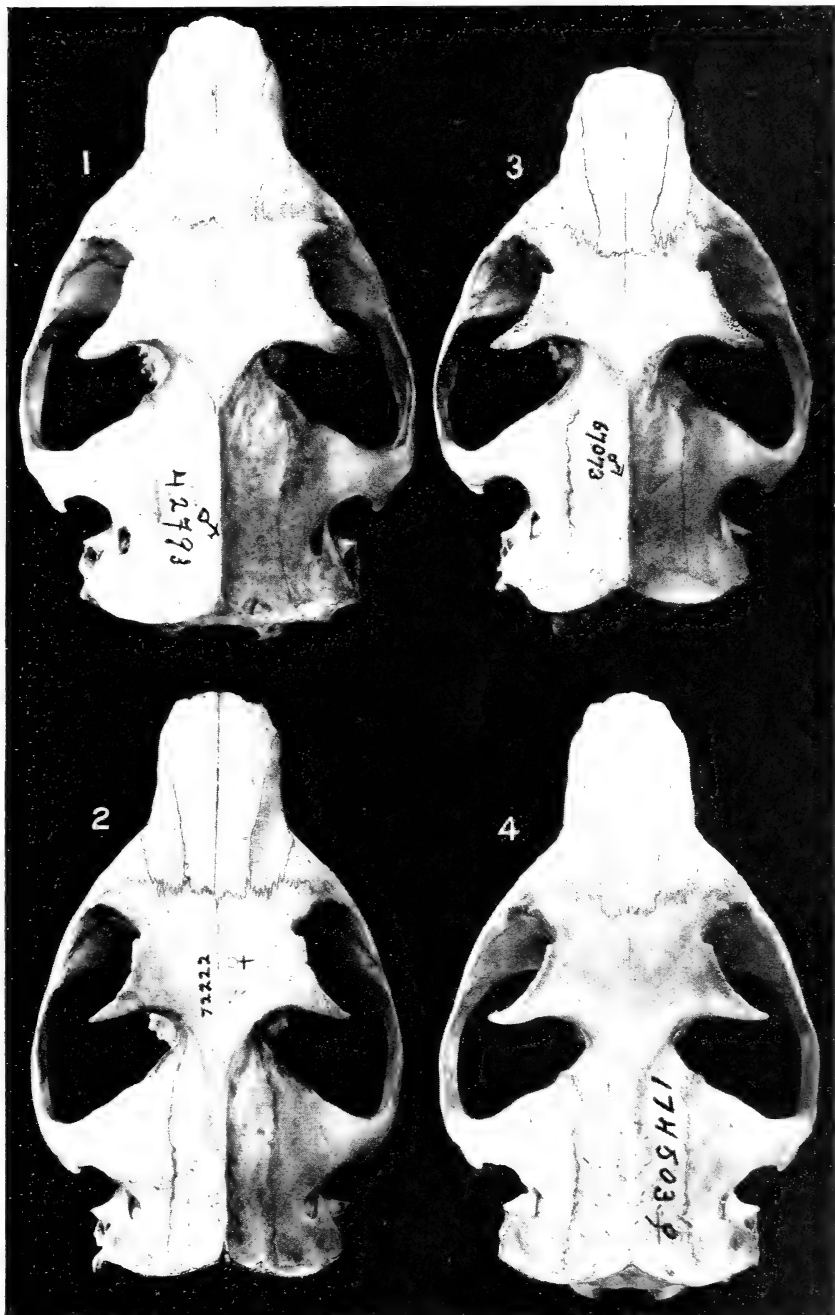
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- | | |
|--------------------------------------|------------------------------------|
| 1. <i>M. flaviventris nosophora.</i> | 3. <i>M. flaviventris dacota.</i> |
| 2. <i>M. flaviventris luteola.</i> | 4. <i>M. flaviventris obscura.</i> |



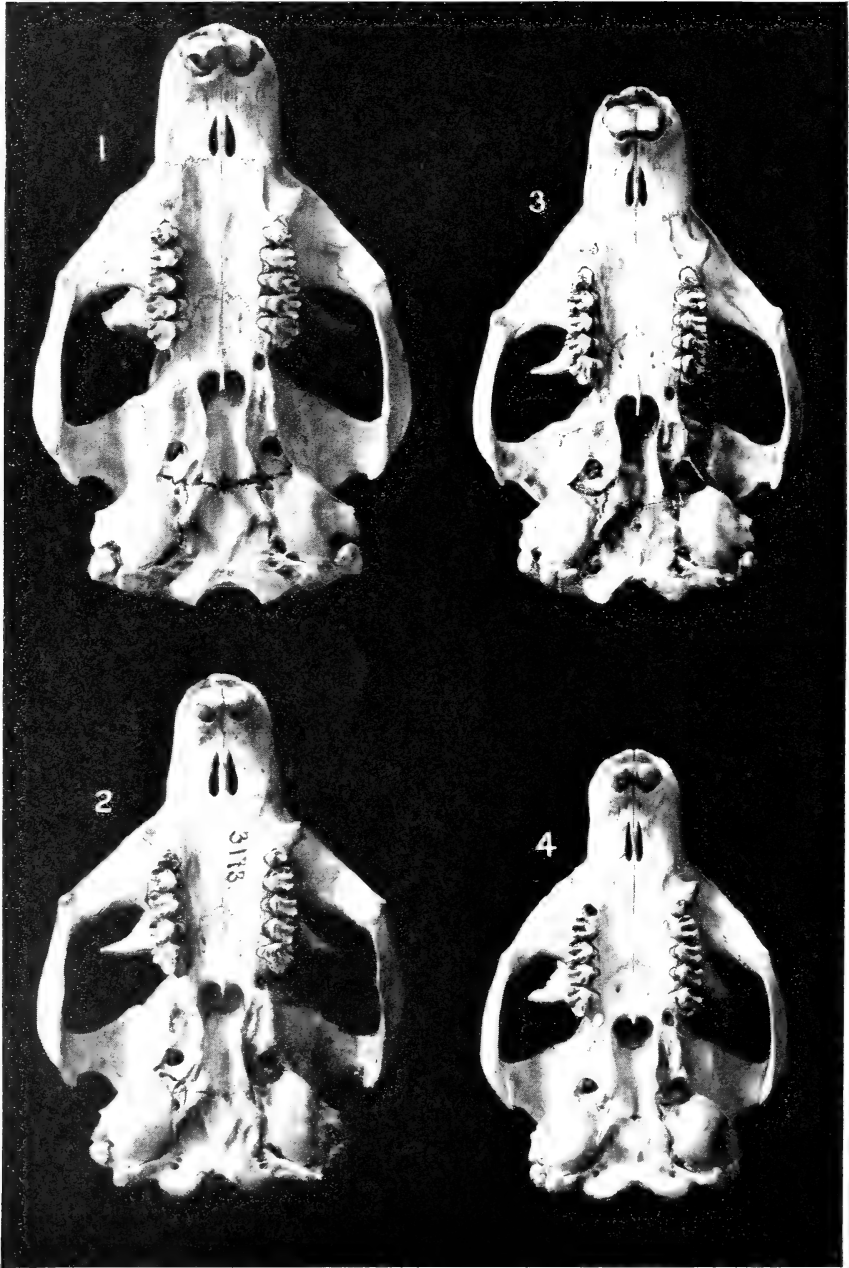
SKULLS OF MARMOTA.

1. *M. olympus*. 3. *M. vancouverensis*.
2. *M. caligata oxytona*. 4. *M. caligata caligata*.



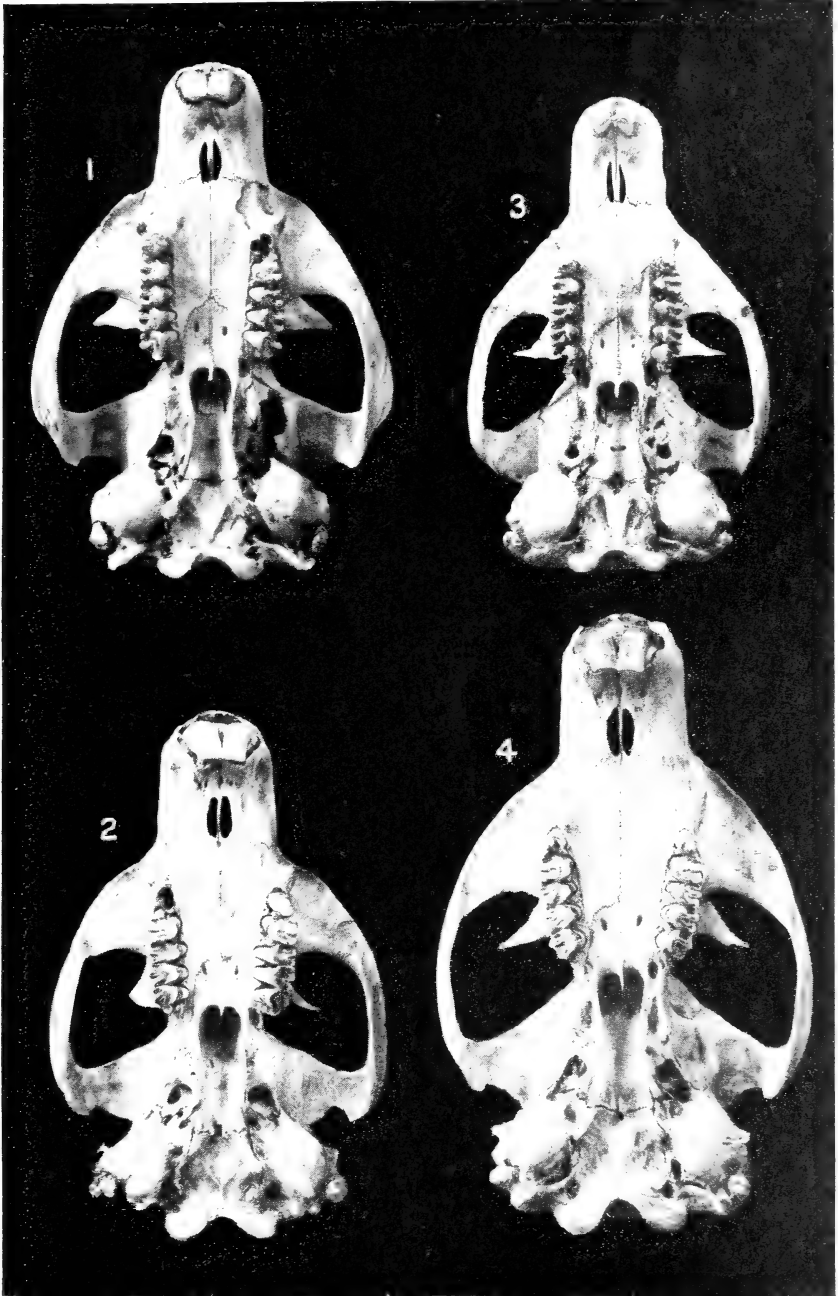
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1. *M. caligata cascadenis*. 3. *M. caligata okanagana*.
2. *M. caligata nivaria*. 4. *M. caligata oxytona*.



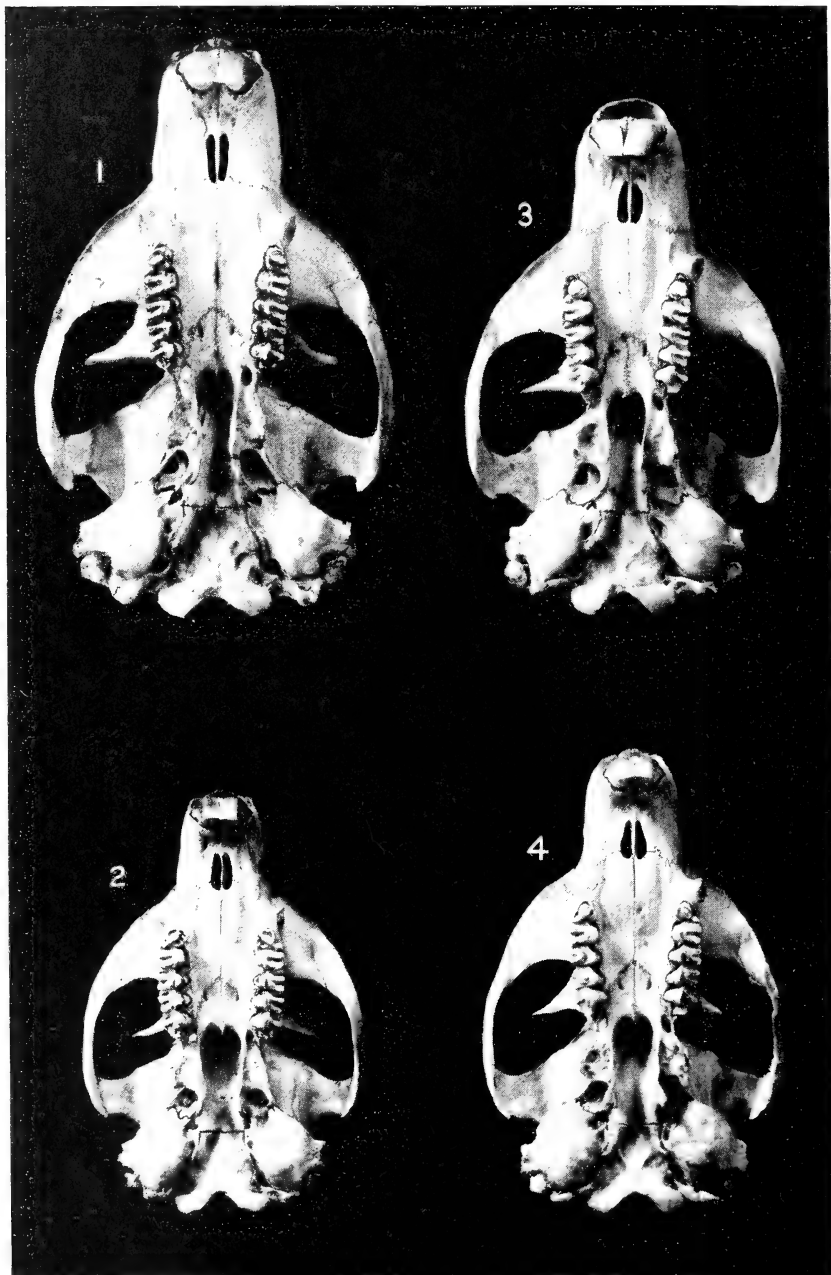
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1. *M. monax monax*. 3. *M. monax preblorum*.
2. *M. monax rufescens*. 4. *M. monax canadensis*.



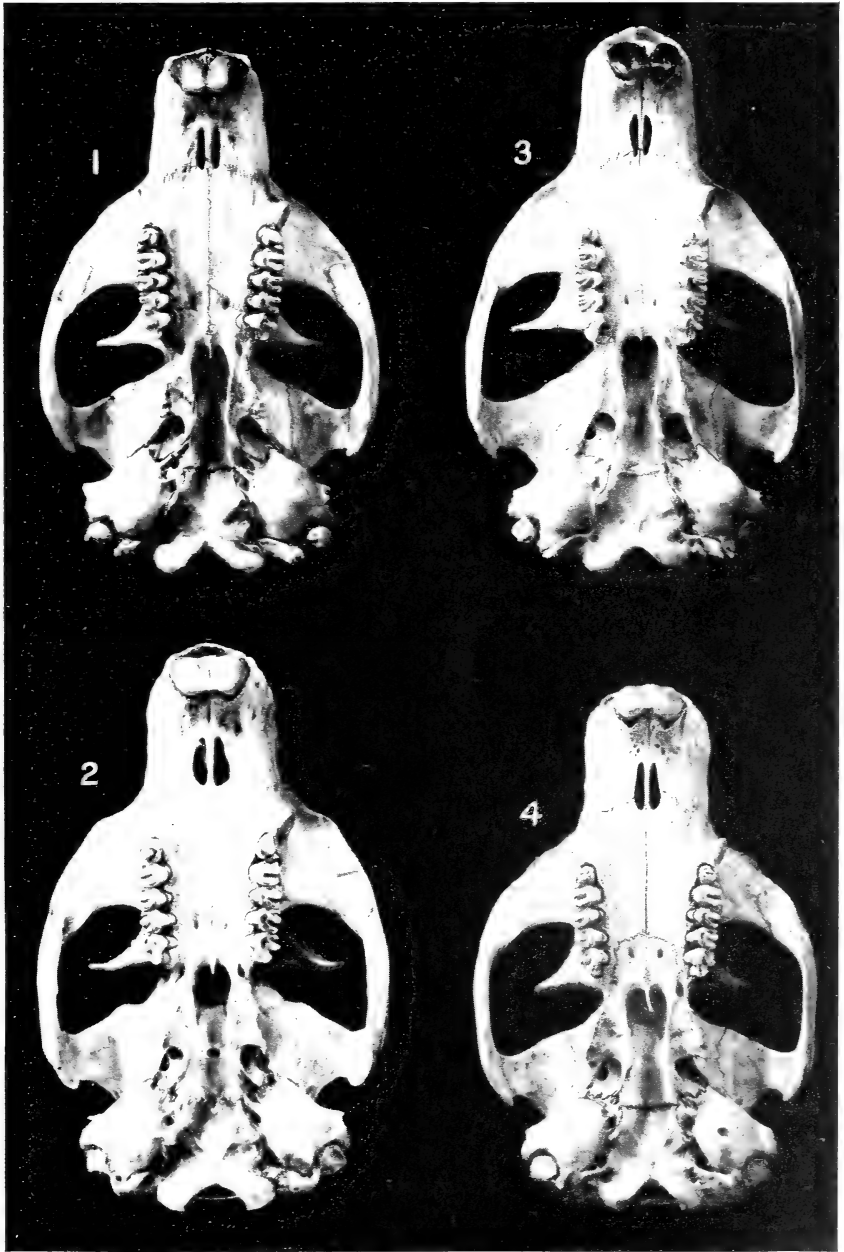
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- | | |
|------------------------------------|--------------------------------|
| 1. <i>M. monax ignava.</i> | 3. <i>M. monax ochracea.</i> |
| 2. <i>M. flaviventris warreni.</i> | 4. <i>M. caligata nivaria.</i> |



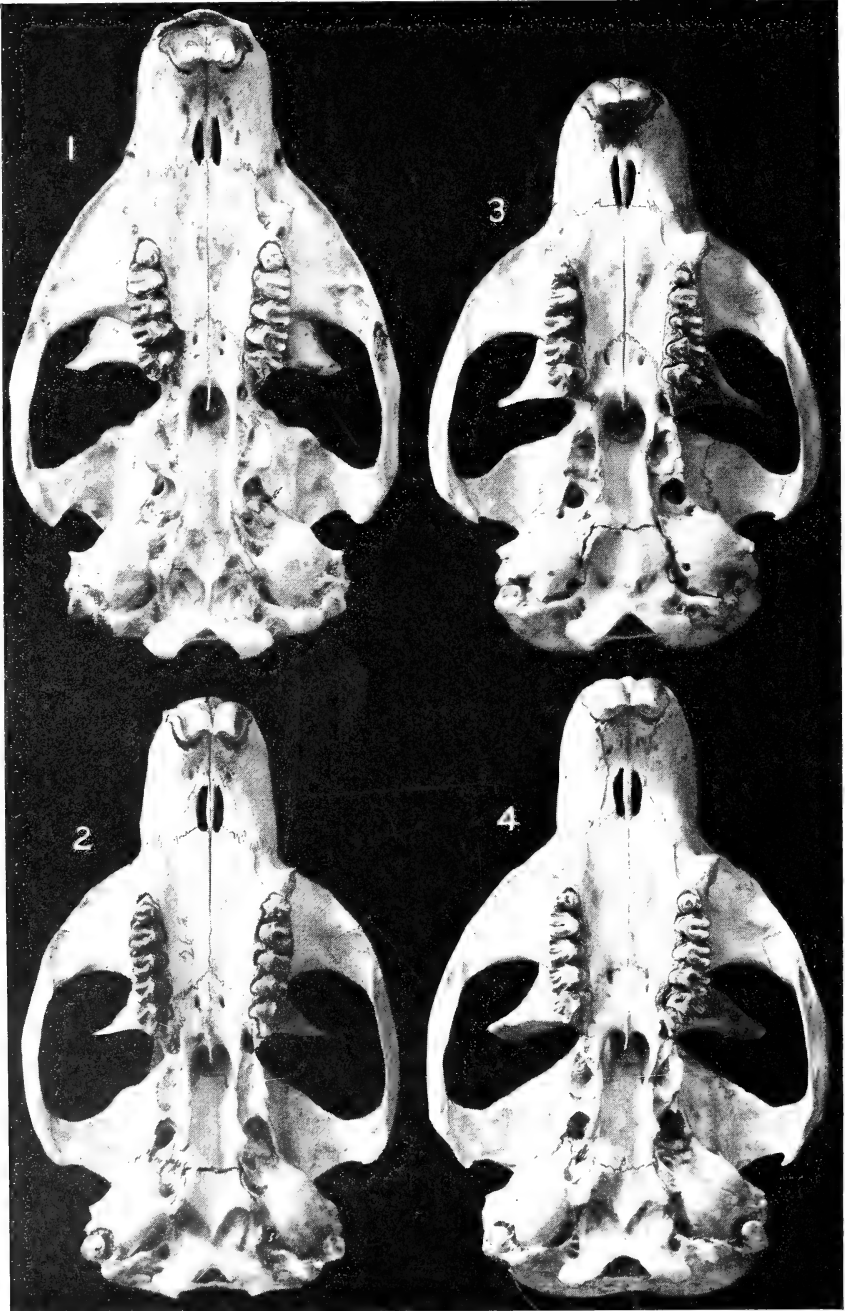
SKULLS OF MARMOTA.

- | | |
|---|--|
| 1. <i>M. flaviventris flaviventris.</i> | 3. <i>M. flaviventris avara.</i> |
| 2. <i>M. flaviventris parvula.</i> | 4. <i>M. flaviventris engelhardti.</i> |



SKULLS OF MARMOTA.

1. *M. flaviventris nosophora.* 3. *M. flaviventris luteola.*
2. *M. flaviventris dacota.* 4. *M. flaviventris obscura.*



SKULLS OF MARMOTA.

- | | |
|-------------------------------|------------------------------------|
| 1. <i>M. olympus</i> . | 3. <i>M. caligata caligata</i> . |
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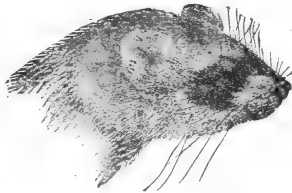
BUREAU OF BIOLOGICAL SURVEY

HENRY W. HENSHAW, *Chief*

NORTH AMERICAN FAUNA

No. 38

[Actual date of publication, September 30, 1915]



A REVIEW OF THE AMERICAN MOLES

BY

HARTLEY H. T. JACKSON

ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY



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1915

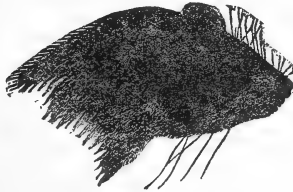


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1915

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., March 26, 1915.

SIR: I have the honor to transmit herewith, for publication as North American Fauna No. 38, a review of the American moles by Hartley H. T. Jackson, assistant biologist, Biological Survey. Widely distributed throughout a large part of North America and very numerous in many places, moles have in some localities proved injurious to agriculture, though they are generally beneficial through their destruction of insects, which form much of their food. Their economic status has not yet been fully determined but is now being carefully investigated by this bureau, and for this work the present paper will serve as a basis.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

2

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A REVIEW OF THE AMERICAN MOLES.

By HARTLEY H. T. JACKSON.

INTRODUCTION.

On account of their subterranean and secretive habits, American moles apparently were not observed by the earlier American explorers. As the settlement of the United States progressed, however, these animals became well known, and in many cases proved injurious to agriculture. Moles occur rather generally in eastern North America along the Atlantic and Gulf coasts from Labrador to Florida and in northeastern Tamaulipas, Mexico, and range westward to Manitoba and northeastern Colorado. Within this area are found three genera, *Scalopus*, *Parascalops*, and *Condylura*. All three genera occur in some localities, but no one covers the entire region occupied by the group. West of the area mentioned no moles are found until the Pacific coast region is reached. There, two other genera, *Scapanus* and *Neirotichus*, occur, their ranges being confined mainly to the humid and semihumid region west of the Cascade Range and the Sierra Nevada, from southern British Columbia to northern Lower California.

In general, the several genera have the following distribution:

Scalopus, comprising the common naked-tailed moles of eastern United States, is the most widely distributed and best-known genus of the family. It ranges from southern Massachusetts, southern Ontario, central Minnesota, and northeastern Colorado south to the Gulf States and northeastern Tamaulipas, Mexico. It is confined almost entirely to the Upper and Lower Austral Zones.

Parascalops, comprising only a single species—Brewer's, or the hairy-tailed mole—is much more restricted in range than *Scalopus*, occurring from southern New Brunswick to northeastern Ohio, southern Pennsylvania, and south along the Appalachian Mountains to North Carolina. Although living in the midst of the range of *Scalopus*, in reality the two occur together at comparatively few

places, since *Parascalops* is confined exclusively to the Transition and Canadian Zones, while *Scalopus* inhabits chiefly the Austral Zones.

Condylura, also comprising only a single species—the star-nosed mole—is widely distributed, but apparently not very abundant. It ranges from southern Labrador and southeastern Manitoba south to northern Illinois, along the Appalachian Mountains to western North Carolina, and on the Atlantic coast to Georgia. Apparently not limited in its distribution by zones, it occurs from the Boreal to the Lower Austral.

Scapanus fills the place on the Pacific coast occupied by *Scalopus* on the Atlantic slope, being abundant and widely distributed from British Columbia south to northern Lower California. It ranges through all the zones from Boreal to Lower Sonoran.

Neurotrichus has a limited distribution on the Pacific coast west of the mountains from southwestern British Columbia south to Monterey County, California, occurring in the Boreal and Transition Zones.

HABITS AND ECONOMIC STATUS OF MOLES.

While all American moles have certain general habits in common, as, for example, spending most of their lives underground and feeding largely upon insects, their habits vary in details. The genera *Scalopus*, *Scapanus*, and *Parascalops* usually inhabit drier soils, burrow deeper, and confine themselves more to subterranean runways than do *Condylura* and *Neurotrichus*. All moles prefer loamy or sandy soil where burrowing is easier, and consequently they are scarce or absent in heavy clay, stony, or gravelly soils. Insufficient food is often the cause of their scarcity in excessively sandy soils.

The common mole (*Scalopus*) is found in almost any area where soil and food are suitable; it is most plentiful in meadows, gardens, and similar habitats, but is by no means confined to them, and frequently is found in open woodland, along the banks of streams, and in other environments. It dwells in a series of subterranean tunnels 10 to 18 inches beneath the surface, and from these it forces to the outside small piles of earth, scarcely large enough to be worthy the name "molehills." A second series of tunnels is made just beneath the surface of the soil and appears as a series of small ridges, usually more or less branching and at times ramifying in all directions. This second series seems to be made chiefly during the animal's hunt for food and may be occupied but once; generally, however, the main surface tunnels are used for a considerable time. During dry weather the mole works deeper and practically deserts the surface ridges. Its change of habit is due in part to the increased hardness of the surface soil, but undoubtedly is more the result of its pursuing worms and

insects into moister regions. Essentially the same condition is produced during winter, when the surface soil is frozen. The common mole seldom leaves its tunnels. Its nest is about 5 or 6 inches in diameter and usually 12 to 18 inches beneath the surface; most frequently it is placed under roots of shrubs or pasture grass and is made of grass and rootlets, but occasionally partly of leaves. In the northern half of its range the young are born during March or April; in the southern part they appear earlier in spring. The number of young in a litter varies from two to five, the usual number being four, and there is probably only one litter produced each year.

The habits of *Scapanus* are much like those of *Scalopus*. The ridges formed by *Scapanus* upon the surface are usually more conspicuous than those of *Scalopus*, and its "molehills," thrown up at frequent intervals, much larger. The hills made by *Scapanus* often contain a half bushel or more of dirt and resemble those made by the pocket gopher. The mounds made by *Scapanus*, however, show no trace of an opening, while those of the pocket gopher do. The mounds of *Scapanus* in most cases are more nearly circular than those of the pocket gopher. So far as known, the breeding habits of subspecies of *Scapanus latimanus* do not differ essentially from those of *Scalopus*; the time of breeding and the number of young in a litter are about the same. With *Scapanus townsendii*, however, the breeding time is later, the young usually being born during May or June. The number in a litter is less than with *S. latimanus*, there being usually only two or three, seldom four, and not infrequently only one.

The habits of *Parascalops* are not well known, but in general they appear to be much the same as those of *Scalopus*.

Star-nosed moles, genus *Condylura*, prefer to make their homes in wet meadows or marshes, though occasionally they may choose the same habitat as *Scalopus*, or even occupy the same tunnels with them. The surface ridges made by *Condylura* are more irregular and broken than those of *Scalopus* and usually smaller and more crooked; the burrows seem to be deep for a short distance, then appear as surface ridges, shortly to disappear again. Besides the subterranean tunnels, the star-nosed mole uses surface runways under and through the grass in marshes and meadows. Unlike other moles, *Condylura* frequently leaves its tunnels in winter and burrows in the snow, or even runs on top of it. Little is known concerning the nesting and breeding habits of this genus. A family of five young about one-third grown, collected May 22, 1888, by Morris M. Green, and now in the Biological Survey collection, was found in a nest under a log on the flats of the Potomac River a short distance north of Georgetown, D. C. Two of the young from this family are slightly more developed than the others, but it is not known whether

this is due to difference in time of birth or to subsequent conditions. Another nest, containing young, is described by Bishop as follows:

On May 22, 1890, while having some apple trees planted, I had the good luck to find a nest containing four young.

The locality where the nest was found was two miles south of Kentville in Kings County, Nova Scotia. The land had been cleared of small forest trees several years before and had grown up with grass and was mowed every year.

The particular spot where the nest was found was a little hillock or cradlehill which had been formed apparently by a tree having been blown down. When the roots had rotted away, a small dry mound of soft black sedimentary earth was formed, and in this the nest was built. This mound was high enough to be out of reach of storm water during wet weather.

The elevation containing the nest was ten inches below the surface, and was made in circular form, seven inches in diameter. The nest was built of old dry grass, and was very compact and neatly made. Although the mound contained a complete network of roadways, no earth was thrown to the surface within ten feet of the nest.¹

The little *Neurotrichus* prefers a damp habitat and is seldom found far from swamps, marshes, or streams. In the extreme southern part of its range it is most frequently found in swampy places overgrown with sedges or shrubs. Farther north its habitat is less confined, and it is found along streams or even in moist dense woods. Its tunnels are more like those of *Condylura* than other moles, and it seems to spend no small part of its time in surface runways or under logs. In fact, the tunnels are often open above for some distance, and in this respect resemble the tunnels of the eastern pine mouse (*Pitymys pinetorum*). The nesting and breeding habits of *Neurotrichus* are unknown.

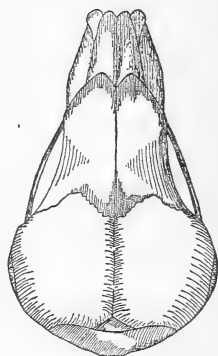
The economic status of American moles has been the subject of much dispute, authorities differing as to whether the animals are beneficial or harmful. The genera *Parascalops*, *Condylura*, and *Neurotrichus* are local in distribution, seldom abundant in any locality, and most frequently inhabit waste or uncultivated lands; they can not, therefore, have extensive economic importance. Such is not the case, however, with *Scalopus* and *Scapanus*, which are more generally distributed throughout their ranges, and usually abundant in lawns, fields, and gardens. The food of moles consists in large measure of insects, and in this they are beneficial. However, moles destroy large numbers of earthworms, make unsightly ridges in lawns, and dig tunnels which permit incursions of rodents injurious to roots, tubers, and planted seeds, and which frequently are directly responsible for the weathering away of humus deposits and super-soils on hillsides; in these activities moles are harmful. The economic status of the mole is being extensively investigated by Theodore H. Scheffer, under the direction of the Biological Survey; the results of his studies will be published later.

¹ Bishop, W. L., Trans. Nova Scotia Inst. Sci., vol. 10. pp. 348-349, October 1, 1902.

CHARACTERISTICS AND DEVELOPMENT OF THE YOUNG.

The young of *Scalopus* (Pl. I, fig. 3) are born hairless. Vibrissæ very soon appear on the lips, but hair does not show until the animal is at least a week or ten days old. The fresh, first pelage remains short and grows little until the animal is nearly one-third grown; it is exceedingly fine and silky, and lies close to the body, giving the animal a smooth, sleek appearance. Two young,¹ probably about a week old, from Jackson, N. C., have the general proportions of the body much as in adults. The feet, both fore and hind, have much the same shape as in adults, and are relatively about the same size, though, on account of the bones of the arm thickening rather than lengthening during growth, the fore feet of the young, being relatively more projected from the body, appear at first glance to be relatively very large. The hind feet are relatively a little wider than those of adults. The claws of the fore feet are soft and weak, though relatively thick and broad; those of the hind feet are very soft and only slightly developed. The external ear appears as a thickening of the dermis into a flat papilla 1.5 mm. in diameter. The center of this is penetrated by a minute auditory opening that seems to be closed by the contact of its sides; as an auditory organ its function is probably exceedingly limited. The rudimentary eye appears as a small pigmented spot covered by dermis; a minute, imperfect opening passes through the dermis to the eye proper, and may be sufficiently penetrable for the animal to perceive light from darkness; it seems improbable, however, that the eye is sufficiently developed for form perception, and it is probable that with advanced age the sense of light perception becomes less acute.

Skulls of young (fig. 1) a week or ten days old distinctly show the sutures between the principal cranial bones; the sutures between the frontals and parietals, however, are now nearly closed. In comparison with skulls of adults, the mastoid region is high and swollen and the zygomata are heavy. The auditory meatus is distinct and more pronounced than in adults, the bullæ small, but relatively high and rounded and not so much flattened. The nasals are short and broad, becoming wider posteriorly; the premaxillæ are triangular, adjoining the anterior two-fifths to one-half of the nasals. During the development of the skull the premaxillæ push forward



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FIG. 1.—Skull of young of *Scalopus aquaticus machrinoides* (X 3). [Reconstructed and drawn by the author from specimens Nos. 5899 and 5900, Field Mus. Nat. Hist.; from Greenway, Ark.]

¹ Alcoholic, No. 7250, U. S. Nat. Mus.

and gradually enclose the nasals anteriorly. Most of the cranial bones are anastomosed and the sutures closed before permanent dentition is acquired. The suture between the interparietal and the parietals is the last to close and is the only one which may remain open and distinct in extreme old age. The sutures between the premaxillæ and the maxillæ and those between the nasals and the maxillæ usually remain indistinctly visible until permanent dentition is acquired.

The writer has examined no very young moles of genera other than *Scalopus*, but it would seem that the general relationships of characteristics of young to those of adults would be essentially the same in the different genera. Bishop, writing about *Condylura*, states: "The young were probably ten days old, the fur just beginning to start, which gave the skin a dark brown colour."¹ The most remarkable difference between young and adults of *Condylura* is in the snout. The character of that organ in the young has been well described by Ayres, as follows:

At birth the star-nosed mole is nearly destitute of visible hair and the tactile bristles of the facial region have not made their appearance at the surface. The snout of the young *Condylura* lacks all the distinctive characteristics of the adult, and the entire body resembles that of *Talpa* much more than it does its parent. On a close examination of the distal end of the snout of such a new-born animal one can distinguish a tract of skin which covers four-fifths of the circumference of the organ (the part not specially marked off is the median ventral fifth). This dermal tract extends for three millimeters toward the base of the snout and is marked off from the remaining surface by a series of furrows running parallel to the long axis of the body. A series of parallel ridges is thus formed, each ridge being bounded on either side by a furrow. At their anterior and posterior ends these ridges pass gradually into the neighboring smooth surface. By a gradual ingrowth of the bottoms of the furrows each groove is deepened and each ridge suffers a correspondingly increased definition of form, while at the same time the posterior end of each groove grows toward its neighbor on either side. When the grooves have all united there is formed by their union a common groove which nearly encircles the snout and separates the tactile from the remaining surface of that organ.

Commencing at the posterior margin of the tactile surface and advancing toward the tip of the snout, the grooves deepen and grow toward each other in their bottom portions until they finally coalesce underneath the ridges. The result of this process is the production of free, finger-shaped processes composed exclusively of ectoderm, attached to the anterior end of the snout in the manner already described for the adult.²

The pelage of individuals of *Scapanus*, *Parascalops*, and *Condylura*, one-third grown, has much the same compact, sleek appearance as that of *Scalopus*, indicating a slow and probably entirely postnatal growth.

¹ Bishop, W. L., Trans. Nova Scotia Inst. Sci., vol. 10, p. 349, Oct. 1, 1902.

² Ayres, H., Biol. Centralb., band 4, pp. 358-359, 1885.

PELAGES AND MOLTS.

The hair of all American moles is fine and silky, producing a soft and velvetlike pelage. In *Scalopus*, *Scapanus*, and *Parascalops* the hairs are nearly equal in length and there is no distinct underfur. In *Condylura* some of the hairs are distinctly longer and coarser than the major portion, the latter forming an underfur, and the whole producing a pelage much less velvetlike than that of any other genus. In *Neiurotrichus* the condition of the pelage is somewhat as in *Condylura*; the fur is shorter, however, and the underfur difficult to detect.

The basal pelage reveals a series of transverse vermiculations, most pronounced in *Scalopus* and *Scapanus*, least in *Neiurotrichus*; in all genera these markings are more noticeable in the fur on the back, less on the ventral parts. Microscopic examination shows that these vermiculations are due to structural as well as chromatic differences. Each hair consists of normally pigmented, gray, cylindrical sections, 1 to 2 mm. long, alternated with finer flat sections, 0.2 to 0.5 mm. long and unpigmented, or with the pigment reduced to a small amount of yellow. Each one of these fine, flat sections acts as a hinge upon which the hair bends; this in part produces the velvetlike texture of the pelage and permits the hair to be rubbed either forward or backward with little friction—a distinct advantage to a subterranean mammal. The vermiculations usually show more clearly in worn pelage than in fresh. The young of *Scalopus*, *Scapanus*, and *Parascalops*, in their first winter pelage, are more grayish than adults; of *Condylura*, paler and more brownish. Winter pelage of adults of all moles is usually darker than that of summer; worn pelage is faded and frequently more brownish than the fresh. The color of specimens retained in a cabinet or storage case for a few years usually fades, becoming more brownish than that of recently killed animals.

TIME OF MOLTING.

There are two molts annually in *Scalopus*, one in spring and the other in fall. Throughout most of the range of the genus the spring molt is usually completed by the last of May or the first of June; the fall molt, in the northern half of the range, by the first week in October; in the southern part of the range the fall molt naturally occurs later in the year, and the spring molt earlier than farther north. The winter pelage of breeding females becomes worn early in the season, but, as has been suggested by True,¹ the actual molting in such individuals may frequently be delayed. Examination of a large series of specimens from Washington, D. C., shows that

¹ True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 37, 1896.

the spring molt in that region occurs usually during the months of April and May, though most of the animals are probably in full summer pelage by the middle of May. A large series of specimens from the same locality, taken during October and the first part of November, are all in full winter pelage; the fall molt seems to take place there during the latter part of August and the first half of September. Specimens of *Scalopus aquaticus machrinus* from northern Illinois show molting during the first half of May; one taken June 15, 1907, at Joliet, Ill., is in fresh summer pelage, except for a small place on the face; in a toptype of *S. a. machrinus* collected September 5, 1898, the ventral parts are in short, fresh, winter pelage, the dorsal parts in old, summer pelage. Specimens of *S. a. pulcher*, taken at Delight, Ark., the middle of September, are in nearly complete winter fur; an adult male taken April 30, 1910, at Lake City, Ark., is in fresh summer pelage except on the nose; specimens taken at Sour Lake, Tex., the latter part of March and first of April, 1905, show the beginning of molt on the underparts. The spring molt of *S. a. australis* seems to occur from about the middle of March to the middle of April. A toptype of *S. a. texanus*, collected February 9, 1893, has fresh summer pelage on the abdomen.

The time of molting seems to be more irregular in *Scapanus* than in *Scalopus*, and the period of seasonal molt during which numbers of individuals may be found molting is more prolonged than with *Scalopus*; it is possible that this difference may be correlated with climatic differences. The spring molt in *Scapanus latimanus latimanus* may commence any time from the middle of January to the last of April; specimens in which the spring molt has just begun were collected at Santa Cruz, Cal., January 14 and February 28, and at Red Bluff, Cal., April 24; one collected at Lower Lake, Cal., April 12, still retains the worn and faded winter pelage; a specimen collected March 13, at Santa Cruz, is in fresh summer pelage, and the majority of specimens show this condition by the middle of April. The autumnal molt of *S. l. latimanus* may begin from the middle of August to the last of November; in a male collected August 14, at Santa Cruz, the molt is well begun; a specimen taken November 30 at Fort Bragg, Cal., has fresh pelage on the head only, and another taken the same day at King City, Cal., has obtained about one-third of its new pelage; in most cases, however, the winter pelage is complete by the last of November. The autumnal molt in *S. l. dilatatus* is usually completed a month earlier than in *S. l. latimanus*, though one specimen collected at Chico, Cal., December 20, has just started to molt. A female collected August 4, at Round Mountain, Cal., is about two-thirds covered with fresh pelage, and is probably in a delayed spring molt. The specimens of *S. l. occultus* examined indicate that the spring molt in that form may begin as early as the first

of January or as late as the latter half of June; a specimen in which the molt is just begun was collected January 2 at Somerset, Cal., and a male in similar condition of molt was taken at Alhambra, near by, on June 21; spring molt in *S. l. occultus* is usually completed by the first of April and the autumnal molt about the first of December. The material available does not show many specimens of *S. townsendii* in process of spring molting; two collected April 7, 1914, at Puyallup, Wash., are in nearly complete summer pelage, while in three others the molt is fully complete. The majority of specimens show full summer pelage the latter part of April. The fall molt of *S. townsendii* occurs most frequently during October; specimens occasionally show molting later in the year, as, for example, one collected December 20, 1912, at Ferndale, Cal., which shows the last remnants of summer fur; on the other hand, the fall molt may begin as early as the latter part of August; several females collected during July and the first half of August, near Portland, Oreg., are in various stages of molting from the beginning to half complete, which may be a delayed spring molt. A specimen of *S. orarius orarius* collected March 11, 1913, at Ferndale, Cal., has begun to molt; one of *S. o. schefferi* collected at Lester, Wash., May 14, 1914, shows only a trace of old pelage on the back and underparts; others secured the middle of May are in full summer pelage. The change to winter pelage in *S. o. orarius* seems to occur mostly during October, though a male taken at Eureka, Cal., August 17, 1910, shows the beginning of the autumnal molt.

Material examined is insufficient for a satisfactory determination of the time of molting of *Parascalops*; in a male from Magnetic City, N. C., collected March 26, 1894, the ventral parts and the rump are in fresh summer pelage, the rest of the fur being worn winter pelage; other specimens in various stages of molt from the same locality were taken between April 24 and July 5. Many specimens collected at various localities during August and September show a much-worn pelage; it seems probable that winter fur appears during October and November; in fact a specimen collected October 12, 1910, in Wetzel County, W. Va., has traces of a new pelage under the old on the breast. An adult male from Magnetic City, N. C., collected August 21, 1893, shows molting and has the entire ventral parts in fresh pelage; it is impossible to determine whether this is an early fall molt or a delayed spring molt.

The spring molt in moles of the genus *Condylura* occurs late, the molting process being at its height during June and the first half of July, though it is usually completed by the middle of the latter month; very rarely molting may begin during the last few days of May, and, equally as rarely, traces of winter pelage may remain well into August. The autumnal molt of *Condylura* takes place

during October, though occasionally it begins the last of September; the full winter pelage is usually obtained before the last of October.

In a large series of *Neirottrichus* from Sumas, British Columbia, the spring molt appears to be at its height during the latter half of May and the first week of June, though one or two specimens indicate a beginning of the molt as early as the latter part of April; most individuals are in full summer pelage by the first of July; none of these specimens show autumnal molt. Farther south, in Washington, Oregon, and northern California, spring molt is earlier, and specimens taken there during the first part and middle of June are in summer pelage. The available material has been insufficient to determine the time of the fall molt, though apparently it occurs during October. A specimen from Goldbeach, Oreg., collected September 21, 1901, has a trace of new pelage under the old on the breast; two from Steilacoom, Wash., October 9 and 12, 1891, and one from Palo Alto, Cal., October 17, 1897, have the molt well advanced; a male taken October 18, 1891, at Tenino, Wash., is in nearly complete winter pelage.

MANNER OF MOLTING.

Molting in *Scalopus* occurs more or less regularly in definite sequence on the different parts of the body, and the same order is followed in both the vernal and autumnal molts. The fresh pelage first appears on the breast and abdomen (Pl. I, fig. 1) and gradually replaces the old until the entire underparts, except the chin and throat, have molted; at this stage there is a sharp lateral line of demarcation between the new and the old fur (Pl. I, fig. 2); the fresh pelage gradually extends up over the back, generally encroaching upon the posterior part first and working forward toward the nose. The chin and throat in most individuals retain the old pelage for several days after all the rest of the molt is complete. There are, of course, exceptions to this general order of molting but most of these occur in animals which are molting either earlier or later than normally, and the writer is inclined to believe that these variations are either due to retarded or stimulated physiological processes, or else result from injuries to the animal. Two specimens show distinctly that the molting process has been retarded on account of injuries; one¹ is in full winter pelage except a very small place on the throat and a small patch directly posterior to a flesh wound on the left side of the posterior part of the back; the other² is in complete winter pelage except a circular patch, about 20 mm. in diameter on the occiput, which is also mostly posterior to a flesh

¹ No. 180769, U. S. Nat. Mus., Biological Survey collection; ♂ adult, collected at Washington, D. C., October 11, 1912.

² No. 6190, Acad. Nat. Sci. Philadelphia; ♀ adult, collected at Audubon, N. J., October 28, 1908.

wound and partly encloses it; winter pelage surrounding the patches is in both specimens long and well developed, in marked contrast with the short fur of delayed growth. A male¹ from Connecticut, in somewhat premature molt, has the entire dorsal parts in fresh pelage except a patch about 30 mm. in diameter on the right shoulder; the anterior three-fifths of the ventral parts are in old pelage, and this extends well up the sides. A postbreeding female,² the molting of which has already been mentioned by True,³ is in retarded, much-worn winter pelage, except the posterior half of the back, anterior to the rump, and a very small portion of the abdomen, which are in rather incomplete spring pelage.

The sequence of molting in *Scapanus* is less definite than in *Scalopus*. The differences of color, texture, and length of hair between the old and new pelages of *Scapanus* are usually slight; often the line of demarcation separating the two pelages is scarcely distinguishable, and seldom sharp as in *Scalopus*. The sequence of molting on the various parts of the body appears in a few cases to be not unlike that of *Scalopus*; the underparts molting first, followed consecutively by the sides and back. More frequently, however, the new pelage appears first on the head and throat, then works down over the nape and back, encroaching last upon the abdomen; or, as is shown most beautifully in a specimen⁴ of *Scapanus latimanus latimanus* from Petrolia, Cal., the new pelage may appear simultaneously in separate patches upon head, back, and rump.

The material has been inadequate to show anything definite regarding the method and sequence of molting in *Parascalops*, but the specimens examined seem to indicate that these processes are not unlike corresponding processes in *Scalopus*.

The new fur of *Condylhura* generally appears first on the posterior part of the flanks, but the body sequence is inconstant; the molt on the flanks usually spreads forward and ventrally, while at the same time on the back fresh pelage replaces the old, which sloughs off in irregular blotches. Probably in most cases the ventral parts are in fresh pelage before the major portion of the back has molted; a small posterior rump patch is almost invariably the last to molt. The contrast between new and old pelages during the spring molt is marked; the autumnal molt, however, is often difficult to detect.

In the genus *Neiurotrichus*, new pelage ordinarily first replaces the old on top of the head; this is soon followed by the molting of the posterior part of the back almost simultaneously with the beginning

¹ No. 4276, Mus. Comp. Zool., Bangs collection; ♂ adult, collected February, 21, 1896, at Liberty Hill, Conn.

² No. 22858, U. S. Nat. Mus., Biological Survey collection; collected July 1, 1888, at Washington, D. C.

³ True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 37, 1896.

⁴ No. 140706, U. S. Nat. Mus., Biological Survey collection; ♂ adult, collected Nov. 6, 1905.

of the molting of the ventral parts on the throat and breast; the molting areas on the back increase in size and finally enclose each other; the area on the breast works posteriorly, then dorsally; the flanks are the last to molt. The molting process in *Neiurotrichus*, once well begun, seems to be very rapid, and this may account for the sparsity of material of this genus showing molt.

GEOGRAPHIC VARIATION.

The maximum of geographic variation occurs in *Scalopus* and *Scapanus*. In *Scalopus* it consists in general of a decrease in size toward the south and an increase in pallor toward the west. The maximum size of individuals is found in the north-central part of the range of the genus; the size decreases gradually both to the east and west, and rather abruptly toward the south. The rostrum tends to shorten in the western and southwestern portions of the range. The palest members of the genus are found in the region of western Nebraska; the color darkens toward the east and south, becoming somewhat ochraceous in the southwestern part of the range.

The size of *Scapanus* (except in *S. townsendii* and *S. orarius orarius*), like that of *Scalopus*, decreases toward the south. In the coast region the pallor increases toward the south, and reaches its maximum in specimens of *Scapanus latimanus occultus* from San Diego County, Cal.; farther south, however, in the San Pedro Martir mountain region of Lower California, the color of *Scapanus* seems to become darker again. In the interior, more mountainous regions, the color of *Scapanus* becomes darker toward the south, the darkest specimens being from Yosemite Valley, Cal., while the palest are from Crater Lake, Oreg., and the Mount Shasta region, Cal.

Geographic variation in *Neiurotrichus* manifests itself in a slight increase in size and a very slight darkening of color in the southern part of the range. A tendency appears also for the more pronounced development of an anterior cusplike process on the cingulum of the second upper premolar in specimens from the southern half of the range of the genus.

Geographic variation in *Parascalops* and *Condylura* is negligible, though a slightly decreasing size southward is noted in *Condylura*.

INDIVIDUAL VARIATION.

The general size, shape, and proportions of skulls of moles, conspecific and of corresponding maturity, from any given locality are usually constant, variation seldom exceeding more than 4 per cent. On the other hand, the shape of individual cranial bones is noticeably variable, especially that of the interparietal. In a series of specimens of *Scalopus* from a given locality the posterior border of the palate

may be simple, spined, or notched; in *Scapanus*, simple, but usually notched; in *Condylura* usually simple, but sometimes spined; and in *Parascalops* and *Neiurotrichus*, almost invariably simple. There is a marked tendency in *Scalopus* and *Scapanus* toward abnormal dentition; this appears not only in the production of accessory cusplike processes on the cingula of the premolars, but also in the increase or reduction of the number of premolars ordinarily present. The tendency in *Scalopus* is toward extra premolars; in *Scapanus* it is toward the suppression of premolars, though in each of at least seven skulls examined there is a supernumerary premolar.

The general color of specimens from a given locality is constant, except for seasonal variations. Individual abnormalities, however, occur frequently in *Scalopus* and *Scapanus*. The common type of chromatic variation in *Scalopus* is the occurrence of white, cream, orange, or ochraceous spots or blotches, appearing usually either on the face or on the ventral parts. Scheffer¹ has remarked upon the prevalence of this form of variation in *Scalopus* at Manhattan, Kans., where he finds that certain regions of the body of a large majority of the moles taken are washed with a tinge of orange, or that on the head or abdomen are distinct patches of this color. Variations similar to these, however, crop out in many localities. They are not confined to any particular species or subspecies, but appear most frequently in *S. a. machrinus* and *S. a. machrinoides*. In many specimens this form of variation is, apparently, partial albinism, the patches being nearly white and the slight creamy or brown tinge probably being due to glandular or other stains. Blotches in other specimens range from cream color to shades of buff, orange, and brown, and show clearly that they are due to mutations of color. A unique variation occurs in a specimen from Warsaw, Ill. (No. 5429, American Museum of Natural History). The entire underparts of this animal, except the vent and right hind foot, are a beautiful capucine buff, as are also the nose and right side of the face; a narrow band of this color extends for a short distance up the posterior part of each flank, and anteriorly another band passes over the shoulders and across the nape, forming a complete collar; the remaining dorsal parts are much as in normal specimens, but perhaps slightly more vinaceous. Another peculiar variation occurs in a specimen from Madison, Ind. (No. 112008, United States National Museum). The entire dorsal parts of this individual are normally colored; the ventral parts are pale ochraceous-salmon to ochraceous-buff, irregularly spotted and blotched especially laterally with grayish fuscous, the whole effect reminding one in certain respects of the ventral parts of some of the spotted tiger-cats or ocelots.

¹ Scheffer, T. H., Kansas State Agr. College Exp. Sta. Bul. 168, p. 4, 1910.

That these chromatic mutations are inherited in Mendelian ratio among the offspring is strongly suggested in the specimens examined from Point Pelee, Ontario. From the small and somewhat isolated colony of *Scalopus* inhabiting this locality 25 specimens collected between October 18, 1908, and June 2, 1913, have been examined. Of these specimens 18 have ochraceous patches on the face, while the remaining 7 are normally colored. On purely unsubstantiated evidence, it would appear that "lack of gray-producing pigment" is here a dominant character, and that the hereditary tendency is probably toward pattern development rather than toward the primitive mammalian monochromatic grayish coloration.

Mutations of color seem to occur less frequently in *Scapanus* than in *Scalopus*; they are most marked in specimens of *Scapanus orarius schefferi* from Walla Walla and Wenatchee, Wash. Abnormalities in color in the genera *Parascalops*, *Condylura*, and *Neiurotrichus*, are confined to albinistic spots which occur only rarely and usually appear to have been caused by injuries.

The writer has seen no melanistic specimens of American moles.

SEXUAL VARIATION.

The only marked sexual variation in American Talpidæ is in size of individuals. This is very noticeable in *Scalopus* and *Scapanus*, in which genera males are considerably larger than females. The same condition probably holds in other genera; in the specimens examined of *Parascalops*, *Condylura*, and *Neiurotrichus* there is no apparent sexual variation, but this may be due to incorrect determinations of sex.

AGE VARIATION.

The most characteristic change in American Talpidæ occurring with increasing maturity is a flattening of the skull and a broadening of the base of the rostrum. These tendencies prevail in all genera. Broadening of the base of the rostrum is due to lateral thickening of the maxillæ. In immature specimens the external roots of the molars are not infrequently exposed in places through the maxillæ. In all genera except *Condylura* the upper premolars tend to become less cuspidate with increasing age, due not alone to wear of the teeth, but apparently to absorption and physiological processes.

The genus *Condylura* furnishes an anomalous and unique age variation; old adults possess a distinct median longitudinal crest on the upper posterior half of the rostrum. Another peculiar variation accompanying age occurs in *Parascalops* in which the hair on the nose and tail frequently turns white in old adults.

SEASONAL VARIATION.

Winter pelage of most moles is slightly darker than that of summer. No other seasonal variations occur except in *Condylura*: The tail of *Condylura* during the summer months is narrow and elongate; during the winter months it becomes much thickened, abruptly constricted at the base, and tapered apically. Both males and females have been found with tails in both conditions. The variation probably is due to assimilation of fat. Enlargement of the tail may begin as early as August, but usually it does not begin until September, or possibly later; the maximum size is reached in most cases by the latter part of November and is retained until March or April, when the tail gradually diminishes to its minimum summer size by the last of May or the middle of June.

EXPLANATIONS.

EXTERNAL MEASUREMENTS.

External measurements of moles are in millimeters and, unless otherwise stated, are those made by the collector from the animal in the flesh. The following have been used:

Total length.—Tip of nose to end of terminal tail vertebra.

Tail vertebrae.—Base of tail at upper surface to end of terminal tail vertebra.

Hind foot.—Heel to end of longest claw.

CRANIAL MEASUREMENTS.

Cranial measurements were made by the author with a vernier caliper. The following have been employed:

Greatest length.—Antero-posterior diameter of skull from anterior median point between bases of first upper incisors to most posterior point of supraoccipital in median line.

Palatilar length.—Antero-posterior diameter of palate from posterior median point between bases of first incisors to posterior median border of palate.

Mastoidal breadth.—Lateral diameter of skull measured through mastoids. Greatest lateral diameter of skull.

Interorbital breadth.—Lateral diameter of cranium measured at coronal suture.

Maxillary tooth row.—Antero-posterior diameter of upper molar-premolar row measured at alveolar border.

Mandibular molar-premolar row.—Antero-posterior diameter of lower molar-premolar row measured at alveolar border.

The bone immediately anterior to the lambdoidal crest and just posterior to the parietals is here called the "interparietal." This bone in moles has been considered by some writers part of the supraoccipital.

COLORS.

The names of colors used throughout the text are those of Ridgway.¹ On account of iridescence and reflection of light from the fur the color of any single animal may appear to vary considerably when viewed from different angles. For this reason the following method of making comparisons and observations of colors was used consistently: Diffused daylight from a window was allowed to strike the animal at an angle of 30° to 45° posterior to a plane perpendicular to the median longitudinal line of the animal. The mole was then viewed from its anterior end at an angle of about 60° from the light rays and in the same plane with them. In spite of this care colors have sometimes been exceedingly difficult to determine and describe.

MATERIAL AND ACKNOWLEDGMENTS.

The present revision recognizes 28 forms of 10 species of American moles and is based upon a study of 2100 specimens, mostly skins accompanied by skulls. Of this number, *Scalopus* comprised 945, *Scapanus* 604, *Parascalops* 129, *Condylura* 218, and *Neurotrichus* 204. While type specimens or essential topotypes of all described forms have been examined, the material has been inadequate for an entirely satisfactory understanding of the group, and this is particularly true of the genus *Scapanus*, and of *Scalopus* from some of the southern and western parts of its range. Unreliable determinations of sex also have been a serious handicap.

Although the study has been based primarily upon specimens in the Biological Survey and other collections in the United States National Museum, including the Merriam collection, it became evident early in the investigation that this material would be insufficient for a proper elucidation of the group. Accordingly specimens were borrowed from various museums and private collections until nearly all that were available in the United States and Canada were examined. For the loan of specimens and for various other courtesies I wish to express my appreciation to the following: Dr. J. A. Allen, of the American Museum of Natural History; Mr. Samuel Henshaw and Mr. Outram Bangs, of the Museum of Comparative Zoology, Harvard College; Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology of the University of California; Mr. Charles B. Cory and Mr. W. H. Osgood, of the Field Museum of Natural History; Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Dr. W. J. Holland and Mr. W. E. Clyde Todd, of the Carnegie Museum; Mr. H. L. Ward, of the Public Museum of the City of Milwaukee; Dr. A. G. Ruthven, of the University of Michigan Museum

¹ Ridgway, R., Color Standard, and Color Nomenclature, 1912.

of Zoology; Mr. P. A. Taverner, of the Victoria Memorial Museum, Ottawa, Ontario; Mr. Stanley G. Jewett, of the Oregon State Game Commission; Dr. Charles H. Gilbert, of Stanford University; Mr. Myron H. Swenk, of the University of Nebraska; Mr. W. H. Over, of the University of South Dakota; Mr. H. E. Anthony, Mr. D. E. Kent, Mr. G. L. Kirk, Mr. W. E. Saunders, and Mr. Thaddeus Surber. The writer is also indebted to Mr. Gerritt S. Miller, jr., and Mr. N. Hollister, of the United States National Museum, and Dr. M. W. Lyon, of the George Washington University, for many courtesies and suggestions. The text drawings, with the exception of figure 1, are the work of Miss Ruth Gibson Collette.

THE FAMILY TALPIDÆ.

The family Talpidæ, exclusive of fossil forms, is composed of thirteen genera peculiar to the temperate regions of the Northern Hemisphere.¹ Five of these (*Scalopus*, *Scapanus*, *Parascalops*, *Condylura*, and *Neurotrichus*) are indigenous to North America. *Scapanus* and *Neurotrichus* are found only on the Pacific slope; *Scalopus*, *Parascalops*, and *Condylura*, only in the Atlantic drainage. The family is a rather heterogenous group which, in certain genera, has characters in common with other families of Insectivora. The characters taken in combination, however, are diagnostic. The nearest relationships of the family are with the Soricidæ, which are approached most closely in the Tibetan genus *Uropsilus*. The American Talpidæ, however, are distinct from any of the American Soricidæ and may be distinguished by the following characters:

AMERICAN TALPIDÆ (MOLES).

Ear-conch absent.

Clavicle short and broad.

Humerus short and broad (length less than twice the width).

Pelvis relatively narrow (length more than thrice the width).

Os falciforme present on the fore foot (rudimentary and indistinct in *Neurotrichus*).

Terminal phalanges of fore feet bifurcate.

Zygomata present.

Audital bullæ present, complete or incomplete.

Exterior pterygoid region rotund and much inflated.

First upper incisor flat, without elongated crown.

AMERICAN SORICIDÆ (SHREWS).

Ear-conch present (small and inconspicuous in *Blarina* and *Cryptotis*).

Clavicle long and slender.

Humerus relatively long and slender (length more than twice the width).

Pelvis relatively broad (length less than thrice the width).

No os falciforme on the fore foot.

Terminal phalanges of fore feet simple, not bifurcate.

Zygomata absent.

Audital bullæ absent.

Exterior pterygoid region angular and not inflated.

First upper incisor not flat, with very elongated crown.

¹ A closely related family, *Chrysochloridæ*, is found in central and southern Africa.

SUBFAMILIES.

Several mammalogists have undertaken to divide the Talpidæ into groups or subfamilies. The most recent classification of this sort is that of Thomas,¹ who divides the family into five subfamilies, namely, Desmaninæ; Talpinæ, Scalopinæ, Condylurinæ, and Urop-silinæ. The American genera *Scalopus*, *Scapanus*, *Parascalops*, and *Neiurotrichus* would fall in the subfamily Scalopinæ, according to this arrangement, while the Condylurinæ would be represented only in America by *Condylura*. Such a system of classification, however, is superficial and unnatural. The anatomical differences, other than dentition, between *Parascalops* or *Neiurotrichus* and each of the other genera of American moles are as great as those between *Condylura* and each of the other genera or even greater. In other words, in order to recognize fundamental and consistent subfamilies it would be necessary to raise nearly every genus to the rank of a subfamily. The convenience of such a classification is not apparent, and accordingly subfamilies have been disregarded here.

HISTORY.

No reference appears in literature to a mole inhabiting America until Seba,² in 1734, described and illustrated two mammals which he called "*Talpa, Virginianus, niger*" and "*Talpa, rubra, Americana.*" Seba, apparently erroneously, gives "America" as the habitat of each of these animals. His figure and description of *Talpa virginianus niger* clearly indicate that *Talpa europæa* Linnæus was the animal in mind. It is impossible definitely to determine the current species to which his name *Talpa rubra americana* refers; probably he had reference to a specimen of the African genus *Chrysochloris*, but it is possible that he based his account upon a verbal description of some species of the American genus *Geomys*. The essentials of his description of *Talpa rubra americana* refer to the red color, the short, white, scantily haired tail, and the "tridactyle" fore feet. Nevertheless, his account shows that the presence of moles in America probably was suspected at that time. The first definite knowledge of their occurrence seems to have been obtained by Kalm,³ who, October 28, 1748, saw burrows and runways of moles near Philadelphia, Pa. He captured one of the animals, and remarked upon its strength and ferocity.

Linnæus,⁴ in 1758, described two American moles under the names *Sorex aquaticus* and *Sorex cristatus*, basing his accounts largely upon Kalm's work. During the century following Linnæus's descriptions

¹ Thomas, Oldfield, Ann. & Mag. Nat. Hist., series 8, vol. 10, p. 397, October, 1912.

² Seba, A., Locupletissimi Rerum Naturalium Thesauri, vol. 1, p. 51, pl. 32, 1734.

³ Kalm, P., Beschreibung der Reise nach dem nördlichen America, vol. 1, pp. 190-191, 1759.

⁴ Linnæus, Systema Naturæ, ed. 10, p. 53, 1758.

of these two forms, many papers on the habits, anatomy, and taxonomy of American moles appeared—the result of an interest aroused largely by the odd habits, specialized anatomy, and unknown relationships of the group. To discuss here these almost innumerable writings would be impracticable, and only the more important taxonomic revisions and synopses and the first usage of current generic names will be mentioned. All other generic, specific, and subspecific names will be discussed in their proper sequence.

The American Talpidæ were confused by early zoologists with the genus *Sorex* and the European genus *Talpa* until the year 1811, when Illiger based the genus *Condylura*¹ upon *Sorex cristatus* Linnæus, and the genus *Scalops*² upon *Sorex aquaticus* Linnæus. The generic name *Scalops* had been used previously by Cuvier³ who, however, gave no description or type species. The name *Scalops* was generally used for the common mole of eastern United States until 1904, when Palmer⁴ revived the accepted name, *Scalopus* Geoffroy,⁵ which apparently had never been employed since proposed in 1803.

One of the first important treatments of a genus of American moles, other than accounts in books on general natural history, is given by Bachman,⁶ who revised the genus *Scalops*, including therein the genera now recognized as *Scalopus*, *Scapanus*, and *Parascalops*. He remarked upon the morphology and distribution of *Scalops aquaticus* and *Scalops townsendii*, and described two new species under the names *Scalops breweri* and *Scalops latimanus*. All of these species are recognized in the present revision.

The genus *Scapanus* was proposed by Pomel,⁷ in 1848, to include Bachman's two species, *Scalops townsendii* and *Scalops breweri*. The type of the genus *Scapanus* automatically became *Scalops townsendii* Bachman when True,⁸ nearly fifty years after Pomel's publication, described the genus *Parascalops* and designated *Scalops breweri* Bachman as its type.

The genus *Scalops* was restored to the genus *Talpa* by Le Conte⁹ in 1854, but his classification was not adopted by zoologists. He divided *Talpa* into three groups: under group 1 he included the European genus known to-day as *Talpa*; under group 2 the modern genera *Scapanus* and *Parascalops*; and under group 3 the genus now known as *Scalopus*. In his revision he described two new forms, one of which, *Talpa reposta*, is a synonym of *Parascalops breweri*

¹ Illiger, C., Prod. Syst. Mamm. et Avium, p. 125, 1811.

² Illiger, loc. cit., p. 126, 1811.

³ Cuvier, G., Leçons d'Anat. Comp., vol. 1, tab. 1, 1800.

⁴ Palmer, T. S., Index Generum Mamm., N. Am. Fauna No. 23, p. 620, Jan. 23 1904.

⁵ Geoffroy Saint Hilaire, É., Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.

⁶ Bachman, J., Boston Journ. Nat. Hist., vol. 4, pp. 26-35, January, 1842.

⁷ Pomel, A., Archiv. Sci. Phys. et Nat., vol. 9, p. 247, November, 1848.

⁸ True, F. W., Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

⁹ Le Conte, Joseph, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, pp. 326-327, 1854.

(Bachman); the other, *Talpa tæniata*, is synonymous with *Scapanus townsendii* (Bachman).

The same year that Le Conte's revision appeared, a mole related to the Japanese genus *Urotrichus* was collected by George Gibbs in the Cascade Mountains of western Washington. This specimen later became the type of *Urotrichus gibbsii* Baird,¹ a species which subsequently became the type of the genus *Neurotrichus* Günther.²

In 1875 Gill³ presented a synopsis of the Insectivora, in which he classified families, subfamilies, and genera, dividing the family Talpidæ into two subfamilies, Talpinæ and Myogalinæ. The Talpinæ were further subdivided into three sections, Talpæ, Condyluræ, and Scalopes; the Myogalinæ into the sections Mygalæ and Urotrichi. The American genus *Condylura* represented the section Condyluræ; *Scalops* and *Scapanus* (including also the form now known as *Parascalops*) represented the section Scalopes; *Urotrichus* (including also the present *Neurotrichus*) and the shrewlike *Uropsilus* formed the section Urotrichi.

Two years after Gill's synopsis was published there appeared a preliminary revision of the American Insectivora by Coues,⁴ in which he listed six species of moles belonging to four genera.

Dobson,⁵ in an extensive revision of the Insectivora published in 1883, gave detailed accounts of the taxonomic characters and anatomy of moles, recognizing five American species which he placed in four genera.

However, it was not until True's monumental revision⁶ of the American moles, in 1896, that the distribution and taxonomic relationships of the group in America began to be understood. True recognized eleven forms, distributed among eight species of five genera, and described one new species, *Scapanus orarius*.⁷

LIST OF GENERIC NAMES THAT HAVE BEEN USED FOR AMERICAN MOLES.

Astromycter Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]). A synonym of *Condylura* Illiger. Based on an abnormally colored specimen of *Condylura cristata* with the tail in the enlarged winter condition.

Astromyctes Gray, List Spec. Mamm. Brit. Mus., p. 76, 1843. Misprint for *Astromycter* Harris (= *Condylura* Illiger).

Astromydes Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863. Misprint or emendation for *Astromycter* Harris (= *Condylura* Illiger).

¹ Baird, S. F., Reports Explor. & Surv. Pacific Railroad, vol. 8, part 1, p. 76, 1857.

² Günther, A., Proc. Zool. Soc. London, 1880, p. 441, October, 1880.

³ Gill, T., Bul. U. S. Geol. & Geog. Surv. Terr., no. 2, series 2, pp. 91-120, 1875.

⁴ Coues, E., Bul. U. S. Geol. & Geog. Surv. Terr., vol. 3, no. 3, pp. 631-653, May 15, 1877.

⁵ Dobson, G. E., Monograph of the Insectivora, systematic and anatomical. Part 2, including the families Potamogalidæ, Chrysochloridæ, and Talpidæ, 1883.

⁶ True, F. W., Proc. U. S. Nat. Mus., vol. 19, pp. 1-112, 1896.

⁷ True, F. W., loc. cit., p. 52.

- Condylura** Illiger, Prod. Syst. Mamm. et Avium, p. 125, 1811. Earliest available name for the genus of which the type is *Sorex cristatus* Linnæus. "We owe the name *Condylura* to the faulty figure of the animal given by De La Faille, in which the tail is represented as constricted at intervals, the whole resembling a string of beads. From this Illiger was led to include in his diagnosis the expression 'cauda mediocris nodosa,' and to bestow an inappropriate name."¹ Illiger includes two species under the genus: *Sorex cristatus* Linnæus and *Talpa longicaudata* Erxleben.
- Condylurus** Blainville, Ann. Français et Étrangères d'Anat. et de Physiol., vol. 2, p. 219, 1838. Emendation for *Condylura*, used subgenerically ad *Talpa cristata*.
- Condylus** Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913. Misprint for *Condylura*.
- Condytura** Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 994, 1839. Used erroneously, but consistently, for *Condylura* Illiger.
- Neurotrichus** Rye, Zool. Record, vol. 17, index, p. 8, 1881. Emendation for *Neurotrichus* Günther.
- Neurotrichus** Günther, Proc. Zool. Soc. London, 1880, p. 441, October, 1880. Earliest name for the genus of which *Urotrichus gibbsii* Baird is the type. Sometimes used without the diæresis (*Neurotrichus* Forbes, Zool. Record, vol. 17, Mammalia, p. 14, 1881).
- Neurotrichus** Günther, Proc. Zool. Soc. London, 1880, plate 42, October, 1880. Misprint for *Neurotrichus*.
- Parascalops** True, Proc. U. S. Nat. Mus., vol. 27, p. 242, April 26, 1894. The first available name for the genus of which *Scalops breweri* Bachman is the type.
- Perascalops** Beddard, Cambridge Nat. Hist., vol. 10, Mammalia, p. 518, 1902. Misprint for *Parascalops*.
- Rhinaster** Wagler, Nat. Syst. Amphib., p. 14, 1830. Name proposed by Wagler to replace *Condylura* Illiger which he considered misleading.² Under this he mentions two species: *Sorex cristatus* Linnæus and *Condylura prasinata* Harris.
- Scalops** Cuvier, Leçons d'Anatomie Comparée, vol. 1, Premier Tableau Général des Classes des Animaux, 1800. Nomen nudum. The generic name *Scalops* later was based upon *Sorex aquaticus* Linnæus by Illiger (Prod. Syst. Mamm. et Avium, p. 126, 1811), but is preoccupied by *Scalopus* Geoffroy.
- Scalopus** Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803. Earliest available name for the genus of which *Sorex aquaticus* Linnæus is the type.³
- Scalpos** Brooks, Rept. W. Va. State Board Agric., Quarter ending December 30, 1910, p. 28, 1911. Misprint for *Scalops*.
- Scapanus** Pomel, Archives Sci. Physiques et Nat., vol. 9, p. 247, November, 1848. Tenable name for the genus of which *Scalops townsendii* Bachman is the type.⁴ Pomel's description⁵ is faulty in that it states that the nostrils are lateral, a condition which is not found in *Scapanus townsendii*.

¹ True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 78, 1896.

² "Wie bekannt, ist der Schwanz dieses Thieres vollkommen eben." (Wagler, loc. cit.)

³ Type fixed by Palmer, T. S. (Index Gen. Mamm., N. Am. Fauna No. 23, p. 621, 1904). The original generic description reads: "Caract. nat. Deux incisives à la mâchoire supérieure, quatre à l'inférieure, les intermédiaires fort petites; un boudoir, une queue assez longue; pieds pentadactyles, doigts des pâtes antérieures réunis jusqu'aux ongles seulement; ces ongles assez longs, plats, et dirigés un peu en arrière; corps couvert de poils." (Geoffroy, 1803, loc. cit.)

⁴ Type fixed by Elliot, D. G. (Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 391, 1901).

⁵ "2° type, LEPTORHINIENS, trompe grêle aiguë, narines ouvertes près de l'extrémité.

" Genres *Hyporyssus?*, *Scalops*, *Scapanus*.

"NOTA.—Ce troisième genre diffère des scalops par la position latérale et non supérieure de l'ouverture des narines, et par la formule dentaire comprenant une intermédiaire supérieure et trois inférieures de plus. Les espèces sont: *Scapanus Townsendii* (sic) et *Breweri* (Scal. *Townsendii* (sic) et *Breweri* Bachm.)." (Pomel, A., 1848, loc. cit., p. 247).

- Scapasius** Beddard, Cambridge Nat. Hist., vol. 10, Mammalia, p. 518, 1902. Misprint for *Scapanus*.
- Scaphanus** Herrick, Mamm. Minnesota, Geol. and Nat. Hist. Surv. Minnesota, Bul. 7, p. 55, 1892. Misprint or emendation for *Scapanus*.
- Sorex** Linnæus, Syst. Nat., ed. 10, vol. 1, p. 53, 1758. The American moles *Condylura cristata* and *Scalopus aquaticus* were placed in the genus *Sorex* by Linnæus. Shaw (Gen. Zool., Mamm., vol. 1, p. 531, 1800) described *Sorex radiatus* (= *Condylura cristata*) from a description and faulty figure by De La Faille.
- Talpa** Linnæus, Syst. Nat., ed. 10, vol. 1, p. 52, 1758. Type species: *Talpa europæa* Linnæus. A Palearctic genus with which some or all American moles were considered congeneric by certain early writers. Last used for American Talpidæ by Le Conte (Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 326, 1854), who referred to it the genera now known as *Scalopus*, *Scapanus*, and *Parascalops*.
- Talpasorex** Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. Substitution for *Condylura* Illiger.
- Talpasorex** Lesson, Manuel de Mammalogie, p. 124, 1827. Synonym of *Scalopus* Geoffroy. Based upon *Scalops pennsylvanica* Harlan (= *Sorex aquaticus* Linnæus), in the original description of which the dental formula was erroneously stated. Nec *Talpasorex* Schinz, by which it is preoccupied.
- Urotrichus** Temminck, Van der Hoeven's Tijdschr. Nat. Geschied. Physiol., vol. 5, p. 286, 1838-1839. A Japanese genus with which *Neurotrichus* was included until 1880.

Keys to the Genera of Moles.

[Based on external characters.]

- a*.¹ Length of tail vertebræ less than one-fourth the total length; width of palm equaling or exceeding length of palm.
- b*.¹ Tail naked or but scantily haired; nostrils superior.
- c*.¹ Tail somewhat slender, essentially naked; fore toes webbed; geographic range east of Rocky Mountains.....*Scalopus* (p. 27).
- c*.² Tail somewhat fleshy, scantily haired; fore toes not webbed; geographic range west of Rocky Mountains.....*Scapanus* (p. 54).
- b*.² Tail densely covered with hair; nostrils lateral.....*Parascalops* (p. 77).
- a*.² Length of tail vertebræ more than one-fourth the total length; width of palm less than length of palm.
- b*.¹ Anterior end of snout surrounded by fringe of processes; nostrils circular to oval, anterior; geographic range east of Rocky Mountains...*Condylura* (p. 82).
- b*.² Anterior end of snout not surrounded by fringe of processes; nostrils crescentic, lateral; geographic range west of Rocky Mountains....*Neurotrichus* (p. 92).

[Based on cranial and dental characters.]

- a*.¹ Audital bullæ complete; interior basal projection of upper molars narrow, simple.
- b*.¹ Mastoids relatively heavy; interparietal small; no functional lower canine; lower incisors two; geographic range east of Rocky Mountains.*Scalopus* (p. 27).
- b*.² Mastoids relatively weak; interparietal large; lower canine present; lower incisors three; geographic range west of Rocky Mountains...*Scapanus* (p. 54).
- a*.² Audital bullæ incomplete; interior basal projection of upper molars relatively broad, lobed.
- b*.¹ Interior basal projection of first and second upper molars trilobed; premolars, $\frac{4}{4}$.
- c*.¹ Braincase relatively broad and flat; anterior nares directed forward; first upper incisors broad, directed downward, with an exterior basal accessory cusp.....*Parascalops* (p. 77).

- c². Braincase relatively narrow and high; anterior nares directed obliquely upward; first upper incisors spatulate, directed somewhat forward, without a basal accessory cusp..... *Condylura* (p. 82).
 b². Interior basal projection of first and second upper molars bilobed; premolars, $\frac{2}{2}$ *Neurotrichus* (p. 92).

List of American Genera, Species, and Subspecies, with Type Localities.

- Scalopus aquaticus aquaticus* (Linnæus)... Philadelphia, Pa. (p. 32).
aquaticus howelli Jackson..... Autaugaville, Ala. (p. 36).
aquaticus australis (Chapman)..... Gainesville, Fla. (p. 38).
aquaticus anastasæ (Bangs)..... Point Romo, Anastasia Island, Fla. (p. 39).
aquaticus parvus (Rhoads)..... Tarpon Springs, Fla. (p. 41).
aquaticus machrinus (Rafinesque)..... Lexington, Ky. (p. 42).
aquaticus machrinoides Jackson..... Manhattan, Kans. (p. 45).
aquaticus pulcher Jackson..... Delight, Ark. (p. 46).
aquaticus caryi Jackson..... Neligh, Nebr. (p. 48).
aquaticus intermedius (Elliot)..... Alva, Okla. (p. 49).
aquaticus texanus (Allen)..... Rockport, Tex. (p. 50).
æreus (Bangs)..... Stilwell, Okla. (p. 52).
inflatus Jackson..... 45 miles from Brownsville, Tex., in Tamaulipas, Mexico (p. 53).
Scapanus townsendii (Bachman)..... Vicinity of Vancouver, Wash. (p. 58).
orarius orarius True..... Shoalwater Bay, Wash. (p. 61).
orarius schefferi nobis..... Walla Walla, Wash. (p. 63).
latimanus latimanus (Bachman)..... Santa Clara, Cal. (p. 64).
latimanus occultus Grinnell & Swarth. Santa Ana Canyon, Cal. (p. 68).
latimanus grinnelli Jackson..... Independence, Cal. (p. 69).
latimanus sericatus Jackson..... Yosemite, Cal. (p. 71).
latimanus minusculus Bangs..... Fyffe, Cal. (p. 72).
latimanus dilatatus True..... Fort Klamath, Oreg. (p. 72).
latimanus alpinus Merriam..... Crater Lake, Oreg. (p. 75).
anthonyi Allen..... San Pedro Martir Mountains, Lower California. (p. 75).
Parascalops breweri (Bachman)..... Marthas Vineyard, Mass. (p. 79).
Condylura cristata (Linnæus)..... Eastern Pennsylvania (p. 86).
Neurotrichus gibbsii gibbsii (Baird)..... White River Pass, Wash. (p. 94).
gibbsii hyacinthinus Bangs..... Nicasio, Cal. (p. 97).

Genus SCALOPUS Geoffroy.

- Scalops* Cuvier, Leçons d'Anat. Comp., tome 1, tabl. 1, 1800. (Nomen nudum.)
Scalopus Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.
Scalops Illiger, Prod. Syst. Mamm. et Avium, p. 126, 1811.
Talpasorex Lesson, Manuel de Mamm., p. 124, 1827. Based upon *Scalops pennsylvanica* Harlan. Nec *Talpasorex* Schinz.
Scalops Brooks, Rept. W. Va. State Board Agric. for Quarter ending December 30 1910, p. 28, 1911.

Type species.—*Sorex aquaticus* Linnæus.

Geographic range.—Eastern and central Massachusetts, southeastern New York, southern Pennsylvania, extreme southern Ontario (Point Pelee), southern Michigan, northern Illinois, western

Wisconsin, central Minnesota, extreme southeastern South Dakota, northern Nebraska, extreme northeastern Colorado, south and east to northeastern Tamaulipas, Mexico (45 miles from Brownsville, Texas), to the Gulf of Mexico, and in Florida to Tampa Bay and Lemon City. (See fig. 2).

External characters.—Body robust, depressed; tail short, round, indistinctly annulated, very scantily haired (in appearance, essen-

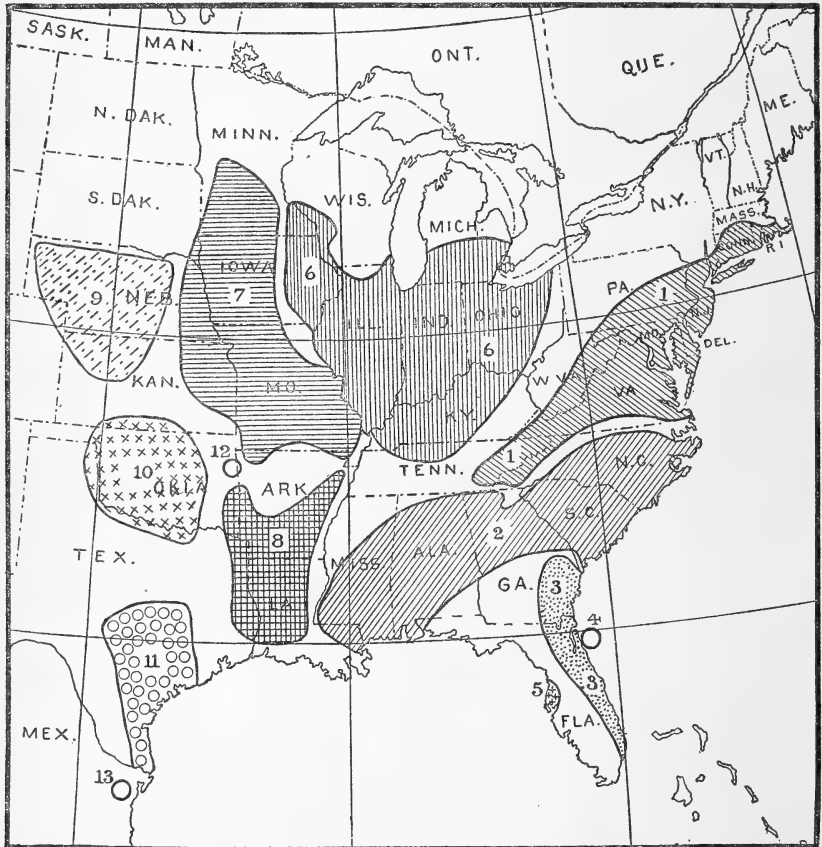


FIG. 2.—Geographic range of the species and subspecies of *Scalopus*.

B2008-103

- | | | |
|------------------------------------|--------------------------------|--------------------------------|
| 1. <i>S. aquaticus aquaticus</i> . | 6. <i>S. a. machrinus</i> . | 10. <i>S. a. intermedius</i> . |
| 2. <i>S. a. howelli</i> . | 7. <i>S. a. machrinoides</i> . | 11. <i>S. a. texanus</i> . |
| 3. <i>S. a. australis</i> . | 8. <i>S. a. pulcher</i> . | 12. <i>S. æreus</i> . |
| 4. <i>S. a. anastasz</i> . | 9. <i>S. a. caryi</i> . | 13. <i>S. inflatus</i> . |
| 5. <i>S. a. parvus</i> . | | |

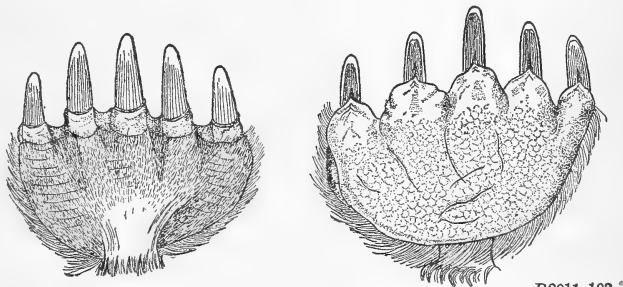
tially naked) (fig. 3). Head conoidal, depressed. Nose elongated into a distinct snout, apical portion naked to line of anterior edge of nasals; nostrils superior, crescentic, with concavities turned in laterally (fig. 4). Eyes minute, concealed in fur. Auricular orifice small. Legs short and stout. Feet large, fleshy, scantily haired above, naked below, without tubercles. Fore feet handlike, the palms

broader than long (fig. 5). Fore toes and hind toes webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and weak (fig. 6). Fur dense, soft, silky, the hairs nearly equal in length, producing a velvetlike pelage. Mammæ 6: latero-pectoral, 1-1; latero-abdominal, 1-1; inguinal, 1-1.



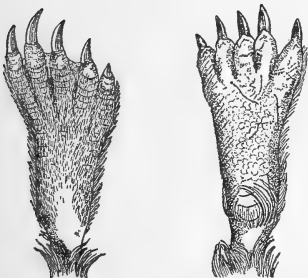
B2009-103
FIG. 3.—Tail of *Scalopus aquaticus aquaticus* (X13). No. 203190, U. S. Nat. Mus., Biological Survey collection; from Woodside, Montgomery County, Md.

Skeletal characters.—Clavicle short and heavy, about two-thirds as broad as long, penetrated antero-posteriorly through the center by a small circular foramen; humerus heavy, about three-fourths as broad as long. Pelvis narrow, bones of the opposite sides adjunct under acetabula; two osseous bridges connect sacral vertebræ with ischium and produce four large foramina or openings, one in each of the angles formed by median lines of acetabula and sacral vertebræ. Superior surface of last sacral vertebra with a very small, low, laterally flattened, longitudinal process. Os falciforme long, reaching to proximal end of terminal phalange of first digit, wider and rather sharply incurved at base, narrower and gradually tapering distally.



B2011-103
FIG. 5.—Fore foot of *S. a. aquaticus* (X13). Individual referred to in fig. 2.

Skull conoidal, flat, with relatively broad braincase, and considerably constricted interorbitally. Mastoids relatively heavy and prominent. Interparietal short and narrow, somewhat irregular in outline, but usually narrower anteriorly. Frontal region flat, not much sloping; frontal sinuses swollen. Rostrum relatively short; anterior ends of premaxillæ much thickened and extending beyond nasals, forming an acute notch anterior to nasals. Anterior nares opening forward. Zygomata moderately long and heavy, not much curved, descending slightly and slanting inward anteriorly, the posterior end well back on squamosal. Foramen magnum oval, of moderate size. Infraorbital



B2012-103
FIG. 6.—Hind foot of *S. a. aquaticus* (X13). Individual referred to in fig. 2.

foramen relatively small, the plate forming its outer wall moderately broad (slightly narrower than diameter of foramen). Audital bullæ complete, depressed (relatively higher than in *Scapanus*); auditory meatus short, scarcely developed. External pterygoid region much inflated posteriorly, slightly inflated anteriorly. Mesopterygoid space broad, the sides gently concave. Palate moderately elongate, terminating at a distance posterior to last molar about equal to diameter of that tooth; posterior border of palate truncate, frequently with a median notch or spine. Anterior palatine foramina small, oval to elliptical; first (anterior) pair of posterior palatine foramina small (smaller than anterior palatine foramina), round to oval; second (posterior) pair minute. Horizontal ramus of mandible heavy, curved upward both at posterior and anterior ends; coronoid process moderately elongate, triangular, somewhat acute, directed slightly posteriorly; angle of mandible relatively short, broad (broader than coronoid), and truncate; inferior mandibular notch moderate, subcircular, relatively narrow and deep.

Dental characters.—First upper incisor long and broad, convex in front, flat posteriorly; second and third upper incisors lateral, simple, conical, minute. Upper canine about two-thirds as large as first incisor, simple. Upper premolars indistinctly cuspidate, the second about twice the size of the first and about equal in size to canine (but broader), the third about half as large again as the second. Upper molars W-shaped in transverse section, with an antero-internal V-shaped cusplike shelf (not lobed); first and second molars subequal, the third much smaller.

First lower incisor small, elongate, conical; second lower incisor about twice the size of the first, elongate, caninelike, with an infero-internal longitudinal groove; no persistent lower canine. Premolars successively increasing in size posteriorly, somewhat simple, with a slight tendency toward the development of a cingulum posteriorly. Lower molars M-shaped in transverse section, the antero-internal cusp bilobed; molars successively decreasing in size posteriorly. Functional dentition: i. $\frac{3}{2}$; c. $\frac{1}{1}$; pm. $\frac{3}{3}$; m. $\frac{3}{3}$; total 36.¹

Keys to Species and Subspecies of *Scalopus*.

I. KEY TO ADULT MALES.

a.¹ Geographic range east of Mississippi River.

b.¹ Total length more than 153 mm.; greatest length of skull more than 33 mm.; breadth of skull across mastoids usually more than 17 mm.

c.¹ Total length less than 190 mm.; length of hind foot less than 21.5 mm.; greatest length of skull less than 37 mm.; breadth of skull across mastoids less than 19 mm. *Scalopus aquaticus aquaticus* (p. 32).

¹ The actual dentition of *Scalopus* is: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{3}{3}$; m. $\frac{3}{3}$; total, 40. The third lower incisor and the lower canine are nonpersistent and disappear before the animal is mature.

- c.³ Total length more than 190 mm.; length of hind foot more than 21.5 mm.; greatest length of skull more than 37 mm.; breadth of skull across mastoids more than 19 mm. *Scalopus aquaticus machrinus* (p. 42).
- b.² Total length less than 153 mm.; greatest length of skull less than 33 mm.; breadth of skull across mastoids usually less than 17 mm.
- c.¹ Length of hind foot usually less than 17 mm.; greatest length of skull 31.2 mm. or less; breadth of skull across mastoids less than 16 mm.,
Scalopus aquaticus parvus (p. 41).
- c.² Length of hind foot usually more than 17 mm.; greatest length of skull more than 31.2 mm.; breadth of skull across mastoids more than 16 mm.
- d.¹ Color golden sepia; face, chin, and wrists bright zinc orange; geographic range Anastasia Island, Fla. *Scalopus aquaticus anastaszæ* (p. 39).
- d.² Color not golden sepia; face, chin, and wrists not bright zinc orange.
- e.¹ Color paler; greatest length of skull usually more than 32 mm.; geographic range North and South Carolina, northern and western Georgia, west to mouth of Mississippi River. . . . *Scalopus aquaticus howelli* (p. 36).
- e.² Color darker; greatest length of skull usually less than 32 mm.; geographic range southeastern Georgia and eastern Florida,
Scalopus aquaticus australis (p. 38).
- a.² Geographic range west of Mississippi River.
- b.¹ Breadth of skull across mastoids 19.3 mm. or more.
- c.¹ Breadth of skull across mastoids more than 20 mm.; palatilar length more than 16 mm. *Scalopus aquaticus machrinus* (p. 42).
- c.² Breadth of skull across mastoids less than 20 mm.; palatilar length less than 16 mm. *Scalopus aquaticus machrinoides* (p. 45).
- b.² Breadth of skull across mastoids less than 19.3 mm.
- c.¹ Greatest length of skull more than 33 mm.; interorbital constriction more than 7.3 mm.
- d.¹ Color coppery snuff brown. *Scalopus æreus* (p. 52).
- d.² Color not coppery snuff brown.
- e.¹ Color dark; geographic range east of 95th meridian,
Scalopus aquaticus pulcher (p. 46).
- e.² Color pale; geographic range west of 95th meridian.
- f.¹ Nose and ankles tinged with ochraceous,
Scalopus aquaticus intermedius (p. 49).
- f.² Nose and ankles not tinged with ochraceous, but usually with ivory yellow. *Scalopus aquaticus caryi* (p. 48).
- c.² Greatest length of skull less than 33 mm.; interorbital constriction less than 7.3 mm.
- d.¹ Prelachrymal region much inflated; rostrum broad and truncate; geographic range Tamaulipas, Mexico. *Scalopus inflatus* (p. 53).
- d.² Prelachrymal region not much inflated; rostrum not broad and truncate; geographic range Texas. *Scalopus aquaticus texanus* (p. 50).

II. KEY TO ADULT FEMALES.

- a.¹ Geographic range east of Mississippi River.
- b.¹ Total length usually more than 148 mm.; greatest length of skull more than 32 mm.; breadth of skull across mastoids usually more than 16.5 mm.
- c.¹ Total length less than 173 mm.; length of hind foot less than 21 mm.; greatest length of skull less than 35.2 mm.; breadth of skull across mastoids less than 18.7 mm. *Scalopus aquaticus aquaticus* (p. 32).
- c.² Total length more than 173 mm.; length of hind foot more than 21 mm.; greatest length of skull more than 35.2 mm.; breadth of skull across mastoids more than 18.7 mm. *Scalopus aquaticus machrinus* (p. 42).

- b.² Total length usually less than 148 mm.; greatest length of skull 32 mm. or less; breadth of skull across mastoids usually less than 16.5 mm.
- c.¹ Total length less than 130 mm.; length of tail less than 18 mm.; greatest length of skull 29.3 mm. or less.....*Scalopus aquaticus parvus* (p. 41).
- c.² Total length more than 130 mm.; length of tail more than 18 mm.; greatest length of skull more than 29.3 mm.
- d.¹ Color golden sepia; face, chin, and wrists bright zinc orange; geographic range Anastasia Island, Fla.....*Scalopus aquaticus anastaszæ* (p. 39).
- d.² Color not golden sepia; face, chin, and wrists not bright zinc orange.
- e.¹ Color paler; greatest length of skull usually more than 31 mm.; geographic range North and South Carolina, northern and western Georgia, west to mouth of Mississippi River.....*Scalopus aquaticus howelli* (p. 36).
- e.² Color darker; greatest length of skull usually less than 31 mm.; geographic range southeastern Georgia and eastern Florida,
Scalopus aquaticus australis (p. 38).
- a.² Geographic range west of Mississippi River.
- b.¹ Total length more than 160 mm.; breadth of skull across mastoids more than 18.4 mm.
- c.¹ Breadth of skull across mastoids more than 19 mm.; palatilar length more than 15.8 mm.....*Scalopus aquaticus machrinus* (p. 42).
- c.² Breadth of skull across mastoids less than 19 mm.; palatilar length less than 15.8 mm.....*Scalopus aquaticus machrinoides* (p. 45).
- b.² Total length less than 160 mm.; breadth of skull across mastoids less than 18.4 mm.
- c.¹ Greatest length of skull more than 32 mm.; interorbital constriction more than 7.2 mm.
- d.¹ Color coppery snuff brown.....*Scalopus æreus* (p. 52).
- d.² Color not coppery snuff brown.
- e.¹ Color dark; geographic range east of 95th meridian,
Scalopus aquaticus pulcher (p. 46).
- e.² Color pale; geographic range west of 95th meridian.
- f.¹ Nose and ankles tinged with ochraceous,
Scalopus aquaticus intermedius (p. 49).
- f.² Nose and ankles not tinged with ochraceous, but usually with ivory yellow.....*Scalopus aquaticus caryi* (p. 48).
- c.² Greatest length of skull less than 32 mm.; interorbital constriction less than 7.2 mm.
- d.¹ Prelachrymal region much inflated; rostrum broad and truncate; geographic range Tamaulipas, Mexico.....*Scalopus inflatus* (p. 53).
- d.² Prelachrymal region not much inflated; rostrum not broad and truncate; geographic range Texas.....*Scalopus aquaticus texanus* (p. 50).

Descriptions of Species and Subspecies of Scalopus.

SCALOPUS AQUATICUS AQUATICUS (Linnæus).

EASTERN MOLE.

(Pl. I, figs. 1, 2; Pl. II, fig. 1; Pl. III, figs. 1, 1a; Pl. VI, fig. 3.)

Sorex aquaticus Linnæus, Syst. Nat., ed. 10, p. 53, 1758.

Talpa europæa flavescens Erxleben, Syst. Reg. Anim., p. 118, 1777. Based on "yellow mole" of Pennant; type locality, New York(?).

Talpa Flava Zimmermann, Specimen Zool. Geog., p. 496, 1777. Based on "yellow mole" of Pennant; type locality, New York(?).

Talpa fusca Zimmermann, Specimen Zool. Geog., p. 497, 1777. Based on "Brown mole" of Pennant; type locality, New York(?).

[*Talpa*] [*europæa*] *flava* Gmelin, Linn. Syst. Nat., ed 13, p. 110, 1788.

Scalopus virginianus Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 78, 1803. Type locality, Virginia(?).

Talpa cupreata Rafinesque, Précis des découv. et travaux somiologiques, p. 14, 1814. Type locality, "Atlantic States" (see Atl. Journ. 1832, p. 61).

Scalops canadensis Desmarest, Mammalogie, 1^{re} partie, p. 155, 1820. New name for *Sorex aquaticus* Linnæus.

Scalops pennsylvanica Harlan, Fauna Amer., p. 33, 1825. Type locality unknown, probably Pennsylvania.

Talpasorex pennsylvanica Lesson, Manuel de Mamm., p. 124, 1827.

Scalops aquaticus Fischer, Synop. Mamm., p. 249, 1829.

Talpa virginiana Blainville (nec *Talpa virginiana* Brisson), Annales Franç. et Étrang. d'Anat. et de Physiol., tome 2, p. 219, 1838.

Talpa sorex pennsylvanicus Blainville, Annales Franç. et Étrang. d'Anat. et de Physiol., tome 2, p. 219, 1838. (In synonymy.)

Talpa (Scalops) Virginiana Blainville (nec *Talpa virginiana* Brisson), Ostéographie, Atlas 1, table des planches, p. 4; Insectivores, pl. 5 (skull), pl. 9 (teeth), 1839-1864.

[*Talpa*] *aquatica* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Scalops aquaticus aquaticus True, Proc. U. S. Nat. Mus., vol. 7, 1884, p. 606, 1885.

Scalopus aquaticus Oberholser, Mammals and Summer Birds of Western North Carolina (publ. by Biltmore Forest School, Biltmore, N. C.), p. 3, June 30, 1905.

Scalopus aquaticus (sic) Hahn, Proc. U. S. Nat. Mus., vol. 32, p. 464, 1907.

Scalops (sic) *aquaticus* Brooks, Rept. W. Va. Board Agric., 1910, p. 28, 1911.

Scalopus aquaticus aquaticus Miller, U. S. Nat. Mus., Bul. 79, p. 7, December 31, 1912.

Type locality.—Philadelphia, Pennsylvania.

Geographic range.—Eastern United States from eastern and southern Massachusetts, southeastern New York, and southeastern Pennsylvania, south through Virginia, and in the Appalachian Mountains south through western North Carolina and eastern Tennessee.

General characters.—Size medium; color dark; skull high, heavy, and angular; rostrum truncate; dentition moderate.

Color.—*Fresh winter pelage*: Back fuscous, fuscous-black, or blackish brown, becoming paler (drab-gray) on nose and ankles; fur at base of hairs dark neutral gray; underparts slightly paler than back, usually showing more neutral gray of base of hairs and frequently tinged ventrally with mummy brown or fuscous. *Summer pelage*: Slightly paler than in winter, usually more brownish; back sepia, fuscous, or fuscous-black; underparts paler than back, more grayish and usually tinged on chest with mummy brown or sepia. *Young*: More grayish than adults and seldom, if ever, tinged ventrally with brown.

Skull.—Medium in size, angular, much constricted interorbitally and usually somewhat depressed postorbitally, slightly swollen supraorbitally; mastoids moderately heavy; interparietal narrow;

coronoid process and angle of mandible broad and heavy, the former usually with a small mammiform process on posterior border; teeth medium.

Measurements.—Average of 2 adult males from type locality: Total length, 182.5 (180–185); tail vertebræ, 29.5 (28–31); hind foot, 21 (21–21). Average of 2 adult females from type locality: 154.5 (154–155); 23 (23–23); 19.5 (19–20). Average of 15 adult males from Washington, D. C.: 163.4 (154–175); 26.5 (22–29); 19.8 (18–21). Average of 8 adult females from Washington, D. C.: 152.6 (146–168); 26 (21–28); 19 (18–20). Average of 6 adult males from Wareham, Mass.: 159.8 (154–167); 26.3 (21.5–30); 19.9 (19.5–21). *Skull:* Average of 3 skulls of adult males from type locality: Greatest length, 35.3 (34.6–35.7); palatilar length, 14.8 (14.7–15); mastoidal breadth, 18 (17.8–18.2); interorbital breadth, 7.4 (7.3–7.5); maxillary tooth row, 10.9 (10.9–11); mandibular molar-premolar row, 10.7 (10.6–10.8). Average of 21 skulls of adult males from Washington, D. C., and vicinity: Greatest length, 34.3 (33.2–35.6); palatilar length, 14.7 (14.3–15.2); mastoidal breadth, 17.7 (17–18.3); interorbital breadth, 7.4 (7.2–7.8); maxillary tooth row, 10.8 (10.4–11.3); mandibular molar-premolar row, 10.4 (10.1–10.8). Average of 15 skulls of adult females from Washington, D. C., and vicinity: Greatest length, 32.9 (32.3–34.2); palatilar length, 13.9 (13.5–14.7); mastoidal breadth, 17.1 (16.3–17.5); interorbital breadth, 7.4 (7–7.6); maxillary tooth row, 10.4 (10.1–10.8); mandibular molar-premolar row, 10.2 (9.8–10.4). Average of 5 skulls of adult males from Wareham, Mass.: Greatest length, 34.3 (33.8–34.8); palatilar length, 14.8 (14.5–15); mastoidal breadth, 18.1 (17.8–18.4); interorbital breadth, 7.7 (7.6–7.7); maxillary tooth row, 11 (10.8–11.2); mandibular molar-premolar row, 10.7 (10.6–10.8). Average of 2 skulls of adult males from Dismal Swamp (Wallaceton), Va.: Greatest length, 35.2 (35.1–35.2); palatilar length, 14.8 (14.6–15); mastoidal breadth, 18.1 (18–18.2); interorbital breadth, 7.5 (7.4–7.6); maxillary tooth row, 11.1 (11–11.2); mandibular molar-premolar row, 10.7 (10.6–10.7). Skull of adult male from Roan Mountain, N. C.: Greatest length, 36.1; palatilar length, 15.5; mastoidal breadth, 18.4; interorbital breadth, 7.8; maxillary tooth row, 11.3; mandibular molar-premolar row, 11.

Remarks.—The first specific description of the common mole of eastern United States is that under *Sorex aquaticus* Linnæus;¹ Linnæus places in its synonymy "*Talpa, Virginianus, niger*" of Seba; but the description and figure² given by Seba seem to characterize the European rather than the American mole; the Linnæan description, however, clearly refers to the common mole of eastern America; as an

¹ Linnæus, Syst. Nat., ed. 10, p. 53, 1758.

² Seba, A., Thesaurus, vol. 1, p. 51, pl. 32, 1734. Seba's description of *Talpa virginianus niger* became the basis for Shaw's diagnosis of *Talpa purpurascens* (Shaw, G., Gen. Zool., Mamm., vol. 1, p. 521, 1800), which is therefore a synonym of *Talpa europæa* Linnæus.

authority for the habitat of the species, Linnæus cites Kalm, who saw mole runways along the Schuylkill River near Philadelphia.

In 1771 Pennant¹ described two abnormally colored or faded specimens of this species under the names of "Yellow Mole" and "Brown Mole"; the yellow mole became *Talpa europæa flavescens* at the hands of Erxleben² in 1777, and the same year Zimmermann³ named the yellow species *Talpa flava* and the brown one *Talpa fusca*. Geoffroy⁴ described *Scalopus virginianus* in 1803, placing in synonymy under it *Talpa virginianus niger* Seba and *Sorex aquaticus* Linnæus.

The description given by Rafinesque⁵ of *Talpa cupreata* is unsatisfactory, but seems to apply to the subspecies *S. a. aquaticus*. The synonymy of this form was still further encumbered when Desmarest⁶ proposed the name *Scalops canadensis* in 1820, apparently basing the name upon "Le Scalope du Canada" of Cuvier and others. The last specific name added to the synonymy of this form is *Scalops pennsylvanica* Harlan;⁷ Harlan believed the structure of the molars in the specimen he described to be different from that of *S. aquaticus*, but his description applies very accurately to *S. aquaticus* except as to the number of teeth, which he states to be forty; elsewhere, however, he writes that "this species corresponds in the number and arrangement of its teeth with the genus *Scalops* of F. Cuvier."⁸

Scalopus aquaticus aquaticus, the common mole of northeastern United States, in full winter pelage is the darkest of the genus. It is subject to slight local variations in size and color, and even in cranial characters, which, were they constant over any considerable geographic range, might be considered differential enough for subspecific recognition. Specimens from Marthas Vineyard and Nantucket Islands and from the mainland of southeastern Massachusetts average very slightly paler and smaller than typical *aquaticus*, and their skulls are slightly shorter and relatively broader than those from the type locality. Specimens from Liberty Hill, Conn., average large; eastern New York specimens are much like those from the vicinity of Philadelphia, Pa., while those from Long Island are very slightly smaller and possibly more grayish. Toward the south *aquaticus* gradually decreases in size, intergrading with *S. a. howelli* in northern and western North Carolina. A large series from the District of Columbia averages smaller than specimens from the type region, but in all essential characters except size they are

¹ Pennant, T., Quadrupeds, 1771. The writer has not had access to this publication, but presumes the descriptions are about the same as those in Pennant's History of Quadrupeds, ed. 3, vol. 2, pp. 230, 232, 1793.

² Erxleben, J. C. P., Syst. Reg. Anim., p. 118, 1777.

³ Zimmermann, E. A. W., Spec. Zool. Geog., pp. 496-497, 1777.

⁴ Geoffroy Saint Hilaire, É., Cat. Mamm. Mus. Nat. Hist. Nat., p. 78, 1803.

⁵ Rafinesque, C. S., Précis des découv. et trav. somiolog., p. 14, 1814.

⁶ Desmarest, A. G., Mammalogie, part 1, p. 155, 1820.

⁷ Harlan, R., Fauna Amer., p. 33, 1825.

⁸ Harlan, loc. cit., p. 34, 1825.

typical of *aquaticus*. Dismal Swamp, Va., produces a mole which is as large as the typical form and has a little more tendency toward a mummy brown shade on the back. Material from the Appalachian Mountain region is entirely too scarce to determine the exact relationship and area of intergradation of *aquaticus* with *S. a. machrinus*; a specimen from Roan Mountain, N. C., shows a very slight approach toward *machrinus* in size. A skin without skull from Walden Ridge, Tenn., is here rather arbitrarily referred to *aquaticus* on account of its size and color.

Specimens examined.—Total number, 322, as follows:

Connecticut: Cos Cob, 3; East Hartford, 2; Liberty Hill, 6.¹

District of Columbia: Washington, 72.

Maryland: Anne Arundel County, 2; Baltimore, 2; Berwyn, 2; Branchville, 5; Cabin John, 1; Capitol View, 1; Chesapeake Beach, 1; Chevy Chase, 1; Highland, 1; Howard County, 1; Landover, 1; Laurel, 11; Mount Rainier, 1; Plummer's Island, 1; Rockville, 2; Seven Locks, 1; Silver Spring, 1; Woodside, 5.

Massachusetts: Holyoke, 1;¹ Middleboro, 1; Nantucket, 6;¹ Wareham, 32;¹ West Tisbury, 4.¹

New Jersey: Afton, 1; Audubon, 6;² Englewood, 1;³ Fairhaven, 1;¹ Haddonfield, 3.²

New York: Brooklyn, 1; Cold Spring Harbor, 1;³ Cypress Hills, 1;³ Dobb's Ferry, 1; Dunwoodie, 1;³ Hastings, Westchester County, 6;^{3,4} Lake Grove, 16; Locust Valley, 1;³ Long Island, 1;⁴ Mount Sinai, 2;³ New Rochelle, 1;³ New York City, 17;^{3,4} Pelham Manor, 1;³ Oyster Bay, 1; Piermont, 1;³ Rye, 1;¹ Sing Sing, 15; Southampton, 1; Tarrytown Heights, 2.³

North Carolina: Asheville, 1;³ Buncombe County, 2;¹ Highlands, 1; Magnetic City, 1; Roan Mountain (altitude 2500 feet), 1; Weaverville, 8.^{3,4}

Pennsylvania: Carlisle, 6; Collingdale, 2;² Delaware County, 1; Marple, 1;² Mechanicsville, 1;² Media, 2;² Mifflintown, 1; Philadelphia (type locality), 6.²

Tennessee: Blount County, 1; Walden Ridge (near Soddy), 1.

Virginia: Alexandria County, 3; Arlington, 3; Bristow, 2; Clark County, 1; Dismal Swamp, 9; Eastville, 1; Falls Church, 9; Fort Myer, 6; Springvale, 1.

West Virginia: Berkeley Springs, 1.

SCALOPUS AQUATICUS HOWELLI Jackson.

HOWELL'S MOLE.

(Pl. I, fig. 3; Pl. II, fig. 2; Pl. III, figs. 2, 2a; Pl. VI, fig. 4.)

Scalopus aquaticus howelli Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

Type locality.—Autaugaville, Autauga County, Alabama.

Type specimen.—No. 177931, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected January 4, 1912, by L. S. Golsan.

Geographic range.—North Carolina (except in Appalachian Mountains), South Carolina, northern Georgia, thence southwest across

¹ Collection Mus. Comp. Zool., Harvard College.

² Collection Acad. Nat. Sci. Philadelphia.

³ Collection Amer. Mus. Nat. Hist.

⁴ Collection Field Mus. Nat. Hist.

central Alabama and southern Mississippi to Pensacola Bay and the Mississippi River.

General characters.—Intermediate in size between *S. a. aquaticus* and *S. a. australis*; usually paler than either *aquaticus* or *australis*; skull flat, less angular than in *aquaticus*; rostrum long and narrow.

Color.—*Full winter pelage:* Back dark drab, hair-brown, or fuscous, becoming in most specimens buffy brown on head; nose and wrists usually slightly suffused with ochraceous-tawny or cinnamon; underparts more grayish than back, usually much tinged with Saccardo's umber or tawny-olive. *Fresh summer pelage:* Back dark cinnamon-drab or drab, sometimes with a very slight coppery sheen, becoming cinnamon-buff or ochraceous-tawny on face; underparts hair-brown to neutral gray, grading into sepia on chest.

Skull.—Size medium (smaller than that of *S. a. aquaticus*, larger than that of *S. a. australis*) flat; rostrum long and narrow; mandible weak; coronoid process and angle of mandible weak and very narrow, incurved toward condyle, making superior and inferior notches small and relatively deep; teeth small.

Measurements.—Type (adult male): Total length, 152; tail vertebrae, 20; hind foot, 18. *Skull:* Average of 5 skulls of adult males from type locality: Greatest length, 32.3 (31.8–32.7); palatilar length, 13 (12.7–13.3); mastoidal breadth, 16.7 (16.3–17.1); interorbital breadth, 7.2 (7–7.4); maxillary tooth row, 10.1 (10–10.3); mandibular molar-premolar row, 10.1 (9.9–10.2).

Remarks.—Howell's mole differs from both *S. a. aquaticus* and *S. a. australis* in cranial characters and is not strictly intermediate between the two. It shows slight local variations which on account of scarcity of material are not fully understood. Skulls from Bay St. Louis and Washington, Miss., and from New Orleans and St. Tammany Parish, La., have braincases higher and narrower than typical specimens, and the rostra taper more gradually; none of the skulls, however, is from a fully adult animal, and it is possible that age might change this condition. Skulls from Biloxi, Cedarbluff, and Kemper County, Miss., are slightly heavier and more angular than those from the type region. In northern North Carolina *S. a. howelli* begins to approach *aquaticus* in size. A series of specimens from Young Harris, Ga., shows in color a tendency toward *aquaticus* and has skulls which in angularity and height of braincase are like those of *aquaticus*, but which in size and breadth of rostrum are like those of *howelli*. A skin without skull from Pensacola, Fla., is indeterminable, but is provisionally referred to *howelli*.

Specimens examined.—Total number, 106, as follows:

Alabama: Ardell, 1; Auburn, 1; Autaugaville (type locality), 15; Castleberry, 2; Cottondale, 1; Eutaw, 1; Greensboro, 3; Huntsville, 1; Sand Mountain (near Carpenter), 3.

Florida: Pensacola, 1.¹

Georgia: Columbus, 2; Crawfordsville, 1; Griffin, 1; Young Harris, 12.

Louisiana: New Orleans, 2; St. Francisville, 1; St. Tammany Parish, 1.²

Mississippi: Bay St. Louis, 3; Biloxi, 2; Cedarbluff, 1; Kemper County, 1; Washington, 1.

North Carolina: Apex, 1;³ Bertie County, 1;¹ Jackson, 2; Kinston, 3; Moran, Chowan County, 1; Raleigh, 23; Wilkesboro, 1.

South Carolina: Abbeville, 1;⁴ Beaufort County, 4; Calhoun Falls, 1;³ Catawba, 2;³ Charleston, 1; Frogmore, 4; Georgetown, 1; Oakley, 2; Society Hill, 1.

SCALOPUS AQUATICUS AUSTRALIS (Chapman).

FLORIDA MOLE.

(Pl. II, fig. 3; Pl. III, figs. 3, 3a; Pl. VI, fig. 5.)

Scalops aquaticus australis Chapman, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 339, December 22, 1893.

Scalopus aquaticus australis Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 470, 1905.

Type locality.—Gainesville, Alachua County, Florida.

Type specimen.—No. $\frac{3916}{2236}$, Amer. Mus. Nat. Hist.; young adult, sex unknown, skin and skull; collected May 4, 1891, by F. M. Chapman.

Geographic range.—Southeastern Georgia and the eastern portion of peninsular Florida south to Lemon City.

General characters.—Size small (smaller than *howelli*); feet relatively large; tail relatively short; skull short and broad (relatively broader and higher than that of *howelli*); teeth small.

Color.—*Full winter pelage*: Back clove brown, mummy brown, or dark fuscous, paler on wrists, slightly tinged with ochraceous-buff on nose; underparts similar to back but showing more dark neutral gray at base of hairs. *Worn winter pelage*: Variable; back clove brown or mummy brown to vinaceous-buff, drab, or drab-gray with or without pinkish buff or ochraceous-buff on nose; beneath much as above, more grayish.

Skull.—Small, not angular, less constricted interorbitally than in *S. a. aquaticus*, and not much depressed postorbitally; mastoids not heavy; coronoid process and angle of mandible narrow and weak, the former generally without mammiform process on posterior border; horizontal ramus of mandible weak; teeth small.

Measurements.—Average of 6 adult males from type locality: Total length, 145 (141–150); tail vertebræ, 24.9 (22–28); hind foot, 18 (17–19). Average of 10 adult females from type locality: 138.8 (131–148); 22.6 (21–26); 17.3 (16–18). *Skull*: Average of 6 skulls of adult males from type locality: Greatest length, 31.7 (31.3–32); palatilar length, 12.9 (12.4–13.3); mastoidal breadth, 16.6 (16–16.8); interorbital

¹ Collection Mus. Comp. Zool., Harvard College.

² Collection Amer. Mus. Nat. Hist.

³ Collection Field Mus. Nat. Hist.

⁴ Collection Univ. Michigan Mus.

breadth, 7.2 (7.1–7.3); maxillary tooth row, 9.9 (9.6–10.3); mandibular molar-premolar row, 9.6 (9.4–9.8). Average of 11 skulls of adult females from type locality: Greatest length, 30.4 (29.5–30.8); palatilar length, 12.4 (12–12.7); mastoidal breadth, 16.1 (15.6–16.4); interorbital breadth, 7 (6.7–7.3); maxillary tooth row, 9.6 (9.4–9.7); mandibular molar-premolar row, 9.4 (9.2–9.6).

Remarks.—The small size of *S. a. australis*, together with its relatively short, broad, and high skull, readily distinguish it from *S. a. howelli*, its nearest relative toward the north. Its characters are retained very constantly throughout most of its geographic range. Skulls of specimens from St. Catherines Island, Ga., are actually and relatively longer than those of typical *australis*, and in this respect approach *howelli*; in other characters the skulls do not differ essentially from those of typical *australis*; in color these specimens are inseparable from *australis*. A similar though less marked tendency toward *howelli* is noticeable in specimens from Ossabaw Island and Barrington, Ga. South of the type locality *australis* decreases slightly in size; specimens from Oak Lodge and Lemon City, Fla., are of minimum size and average very slightly smaller and darker than those from the type region.

Specimens examined.—Total number, 115, as follows:

Florida: Canaveral, 1; East Micco, 2;¹ Enterprise, 6;^{1, 2} Eustis, 1; Gainesville (type locality), 25; Georgiana, 1; Indian River, 1; Jacksonville, 3; Lake Harney, 3; Lake Worth, 1; Lemon City, 1; Lynne, 5; New Berlin, 6; ^{2, 3} Micanopy, 2; Oak Lodge (East Peninsula opposite Micco), 21;³ Orange Hammock, Kissimmee River, 1; Saint Augustine, 1; Saint Charles Creek, 1;² West Jupiter, 1.²

Georgia: Barrington, 2;³ Cumberland Island, 2;³ Hursmans Lake, 10;³ Montgomery, 3;³ Nashville, 1; Ossabaw Island, 4;³ Pinetucky, 3;³ Saint Catherines Island, 5;³ Saint Simons Island, 1; Sterling, 1.³

SCALOPUS AQUATICUS ANASTASÆ (Bangs).

ANASTASIA ISLAND MOLE.

(Pl. II, fig. 4.)

Scalops anastasæ Bangs, Proc. Boston Soc. Nat. Hist., vol. 28, p. 212, 1898.

Scalops anastasiæ (sic) Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 391, 1901.

Scalopus anastasæ Cory, Field Mus. Nat. Hist., publ. 153, zool. series, vol. 11, p. 438, June, 1912.

Type locality.—Point Romo, Anastasia Island, Florida.

Type specimen.—No. 7192, Mus. Comp. Zool., Harvard College, Bangs collection; ♂ adult, skin and skull; collected February 16, 1897, by Outram Bangs.

Geographic range.—Anastasia Island, Fla.

¹ Collection Amer. Mus. Nat. Hist. ² Collection Field Mus. Nat. Hist. ³ Collection Mus. Comp. Zool.

General characters.—Size of *S. a. australis*: Fore feet relatively large, nails long and heavy; skull short, massive; mastoids, heavy; rostrum short.

Color.—*Late winter pelage*: Back golden sepia; face, chin, and wrists bright zinc orange; underparts Sudan brown. *Worn winter pelage*: Paler than in late winter pelage with less golden and zinc orange, and showing more light neutral gray of base of hairs.

Skull.—Small, short, and heavy, narrow through mastoids; mastoids heavy; rostrum short; mandible heavy; coronoid process and angle of mandible short; ascending ramus wide; superior notch shallow.

Measurements.—Average of 2 adult males from type locality: Total length, 137.5 (134–141); tail vertebræ, 21.8 (21–22.5); hind foot, 17.8 (17.5–18). *Skull*: Average of 2 skulls of adult males from type locality: Greatest length, 31.5 (31.4–31.6); palatilar length, 12.8 (12.6–12.9); mastoidal breadth, 16.5 (16.4–16.6); interorbital breadth, 7.1 (7–7.1); maxillary tooth row, 10 (9.9–10); mandibular molar-premolar row, 9.7 (9.6–9.8).

Remarks.—Four of the eight moles examined from Anastasia Island are topotypes in the Bangs collection and were collected by Outram Bangs, February 12–16, 1895; the other four are in the Field Museum and were collected by Thaddeus Surber at Espanita, Anastasia Island, January 25–29, 1901. The two series are very unlike. The specimens collected at Espanita have no orange or golden suffusions and can not be separated by skin characters from *S. a. australis* of the mainland; the skulls, however, are shorter than those of typical *australis* and have shorter rostra and slightly heavier mastoids, and in these characters are more like those of *S. a. anastaxæ*. In a letter, in regard to these specimens, dated August 19, 1913, Surber states:

“Espanita” was the home of a Mr. Middleton (a Georgian) located well toward the southern end of the island about 15 miles south of St. Augustine, on the Matanzas River side of island. Most of my work was done in the vicinity of his house, near which I was camped. * * * In the flesh I could never detect any difference between these island moles and those from the mainland. * * * There were no towns nor villages on the island during my visit in 1901, so that I was forced to use this designation (Espanita) for the locality. Mr. Bangs’s specimens came from the lower end of the island, I believe, but two or three miles from where these were secured.

Bangs, in a letter to the writer October 23, 1913, referring to the locality where Surber collected, states:

I am quite sure * * * that that part of the island is quite different from where I was. He got *Peromyscus floridanus* where he was. In the parts of the island I worked I never saw it at all though I trapped hundreds of small mammals. In fact, there was no country suitable to it. Where I caught my moles they were not common. They were in the salt flats and low sandy stretches, where their long tunnels extended about in the white sand and through the flats. There was very little vegetation here except, of course, “sea oats.”

All the specimens from Anastasia Island are here provisionally called *anastasæ*, although additional material may result in some change of decision. Were the specimens from Espanita older individuals, their skulls might be inseparable from those from Point Romo. The topotype series was taken about two weeks later in the year than that from Espanita. Two weeks is a short time for changes in the pelage, yet such changes are apparently rapid in *Scalopus*, and it would not be entirely impossible for the full winter pelage of the mole at Espanita to develop before molting into a pelage similar to that of the topotype series.

Specimens examined.—Total number, 8, as follows:

Florida: Espanita, Anastasia Island, 4;¹ Point Romo (type locality), Anastasia Island, 4.²

SCALOPUS AQUATICUS PARVUS (Rhoads).

LITTLE MOLE.

(Pl. II, fig. 5; Pl. III, figs. 4, 4a.)

Scalops parvus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1894, p. 157, 1894.

[*Scalops*] [*aquaticus*] *parvus* Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

Type locality.—Tarpon Springs, Hillsboro County, Florida.

Type specimen.—No. 8468, Acad. Nat. Sci. Philadelphia (No. 1468, Rhoads collection); ♀ adult, skin and skull; collected December 24, 1893, by W. S. Dickinson.

Geographic range.—Region north of Tampa Bay, in Hillsboro and Pasco Counties, Fla.

General characters.—Smallest of the genus; tail relatively short, shorter than that of *S. a. australis*; color much like *australis*; skull small, weak; rostrum very narrow (narrower than that of *australis*).

Color.—*Full winter pelage*: Much like corresponding pelage of *S. a. australis*; back sepia or dark sepia, becoming pinkish cinnamon or ochraceous-buff on nose; underparts slightly paler than back and showing dark neutral gray of base of hairs, sometimes tinged with cinnamon-brown.

Skull.—Like that of *S. a. australis* but smaller, weaker, and with rostrum actually and relatively narrower; teeth small.

Measurements.—Average of 3 adult males from Port Tampa City, Fla.: Total length, 134.3 (131–136); tail vertebræ, 19.7 (19–20.5); hind foot, 16.8 (16.5–17). *Skull*: Average of 3 skulls of adult males from Port Tampa City, Fla.: Greatest length, 30.6 (30.2–31.2); palatilar length, 12.7 (12.5–12.9); mastoidal breadth, 15.7 (15.5–15.8); interorbital breadth, 7.1 (7.1–7.3); maxillary tooth tow, 9.8

¹ Collection Field Mus. Nat. Hist.

² Collection Mus. Comp. Zool, Harvard College.

(9.6–10); mandibular molar-premolar row, 9.7 (9.5–10). Skull of type (probably a female, though sexed "male" by collector): Greatest length, 29.3; palatilar length, 11.9; mastoidal breadth, 15.1; inter-orbital breadth, 6.6; maxillary tooth row, 9.2; mandibular molar-premolar row, 9.2.

Remarks.—The original description of this form was based upon a single specimen which was unique in collections for several years. True,¹ on account of insufficient material, placed *parvus* in questionable synonymy under *S. a. australis*, where it has since remained. The number of specimens now available from the type region is far from satisfactory, but they show characters sufficient to warrant their separation from *australis*. The type of *S. a. parvus* is in worn pelage; True² was inclined to believe on account of the appearance of the skin and the peculiarly worn state of the teeth that the mole had been kept in confinement; there appears no reason for such a conclusion, however, the wear in the teeth and pelage of the type being nothing which might not occur in the normal habitat of the mole. Three males from Port Tampa City, Fla., while distinctly different from *australis*, do not appear to be the extreme type of *parvus*; unfortunately, however, the only specimens from the immediate vicinity of the type locality, except the type, are young.

Specimens examined.—Total number, 9, as follows:

Florida: Belleair, 2; Port Richey, 1;³ Seven Oaks, 1; ⁴ Port Tampa City, 3;⁵ Tarpon Springs (type locality), 2.³

SCALOPUS AQUATICUS MACHRINUS (Rafinesque).

PRAIRIE MOLE.

(Pl. II, fig. 6; Pl. VI, fig. 6.)

Talpa machrina Rafinesque, Atlantic Journ., vol. 1, p. 61, 1832.

Talpa sericea Rafinesque, Atlantic Journ., vol. 1, p. 61, 1832. Type locality near Nicholasville and Harrodsburg, Ky.

Scalops argentatus Audubon & Bachman, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, p. 292, 1842. Type locality southern Michigan.

Talpa Pennantii Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854. Type locality unknown.

Scalops aquaticus argentatus Coues, Bul. U. S. Geol. & Geog. Surv. Terr., vol. 3, p. 633, 1877.

Scalops (aquaticus var.) argentatus Herrick, Mamm. of Minnesota, Geol. & Nat. Hist. Surv. Minnesota. Bul. 7, p. 54, 1892.

Scalops aquaticus machrinus True, Proc. U. S. Nat. Mus., vol. 19, p. 20, December 21, 1896.

Scalopus aquaticus machrinus Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 470, 1905.

¹ True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 21, 1896. ⁴ Collection of Hartley H. T. Jackson.

² True, loc. cit., p. 34, 1896.

⁵ Collection Mus. Comp. Zool, Harvard College.

³ Collection Acad. Nat. Sci. Philadelphia.

Type locality.—Lexington, Fayette County, Kentucky.

Type specimen.—None known to exist.

Geographic range.—Eastern Iowa, and east of the Mississippi River west of the Appalachian Mountains from western Wisconsin, northern Illinois, southern Michigan, southwestern Ontario (Point Pelee), and northern Ohio, south to central Tennessee.

General characters.—Largest of the genus; tail relatively long; color paler than that of *S. a. aquaticus* and usually more reddish brown; skull flat, broad, heavy, and angular; rostrum massive; teeth very large.

Color.—*Full winter pelage*: Above, sepia, mummy brown, or hair-brown, occasionally showing pinkish buff or cinnamon-buff on nose; underparts more grayish than back and usually tinged with Prout's brown or cinnamon-brown. *Summer pelage*: Slightly paler than winter pelage and usually more grayish.

Skull.—Large, broad, angular, and massive; mastoids very massive; rostrum large; coronoid process and angle of mandible heavy, the former frequently with a distinct secondary process on posterior margin; dentition very heavy.

Measurements.—Adult male from type locality: Total length, 208; tail vertebrae, 38; hind foot, 24. Adult male from Midway, Ky.: 190; 29; 22.5. Adult female from Midway, Ky., 175; 27; 22. Average of 3 adult males from Warsaw, Ill., 199 (194–206), 35.7 (31–38). *Skull*: Adult male from Midway, Ky.: Greatest length, 39.1; palatilar length, 16.7; mastoidal breadth, 20.7; interorbital breadth, 8.2; maxillary tooth row, 12.2; mandibular molar-premolar row, 11.6. Skull of adult female from Midway, Ky.: Greatest length, 37.7; palatilar length, 16.2; mastoidal breadth, 19.2; interorbital breadth, 7.7; maxillary tooth row, 12.1; mandibular molar-premolar row, 11.7. Average of 5 skulls of adult males from Warsaw, Ill.: Greatest length, 39.2 (38.8–39.5); palatilar length, 16.8 (16.6–17); mastoidal breadth, 20.5 (20.3–20.7); interorbital breadth, 7.9 (7.7–8.1); maxillary tooth row, 12.4 (11.9–12.6); mandibular molar-premolar row, 12 (11.5–12.2).

Remarks.—The name *Talpa machrina* Rafinesque¹ and the earliest description of this form were apparently lost to science from shortly after they were published until True² resurrected them in 1896; Rafinesque very accurately describes the form and distinctly indicates "near Lexington" as the locality where the species occurred. In the same publication Rafinesque describes another mole, "found in woods near Nicholasville and Harrodsburg," under the name *Talpa sericea*;³ his second species is clearly the young of his *Talpa machrina*. Audubon and Bachman⁴ described a mole from southern Michigan,

¹ Rafinesque, C. S., *Atlantic Journ.*, vol. 1, p. 61, 1832.

² True, F. W., *Proc. U. S. Nat. Mus.*, vol. 19, p. 20, 1896.

³ Rafinesque, loc. cit., p. 62, 1832.

⁴ Audubon and Bachman, *Jour. Acad. Nat. Sci. Philadelphia*, vol. 8, p. 292, 1842.

in 1842, under the name *Scalops argentatus*; although Michigan specimens of *Scalopus* average slightly smaller than typical *S. a. machrinus*, and possibly also slightly paler, the difference is insufficient for sub-specific recognition. Le Conte¹ in 1854 described a mole under the name of *Talpa pennantii* which he seemed to believe was the yellow mole of Pennant; Pennant's yellow mole, however, received Latin binomial designation as early as 1777² and is purely a synonym of *S. a. aquaticus*. Le Conte states in his description of *T. pennantii* that it "differs from *S. aquaticus* in being much larger (equal in size to *Talpa europæa*) and in having much larger anterior feet."³ It is evident, therefore, that the specimen he had in hand was probably *S. a. machrinus*.

This large mole retains its characters with remarkable regularity throughout its range. Specimens from the Mississippi Basin in western Wisconsin, as far north as Prescott, Pierce County, are as large as specimens from the type region, if not slightly larger; specimens from eastern Iowa are indistinguishable from specimens from Kentucky. The color tends to become more grayish in northern and western Illinois and in western Wisconsin, possibly indicating an approach toward *S. a. machrinoides*. Moles from Big Sandy and Nashville, Tenn., have somewhat weaker dentition than typical *machrinus* but do not differ essentially in other respects.

Specimens examined.—Total number, 159, as follows:

Illinois: Alton, 2; Belleville, 1; Calhoun, 3;⁴ Chicago, 9;⁵ Fremont, 1; Hamilton, 1; Joliet, 1;⁶ Olive Branch, 1;⁵ Olney, 5; Ozark, 1;⁶ Parkersburg, 2; Ravenswood, 1;⁶ Richland County, 7; Riehl Station, 1; Rosiclare, 1;⁵ "Southern Illinois,"⁷ 3; Union County, 2; Warsaw, 18.

Indiana: Denver, 2;⁴ Effner, Newton County, 1; Fort Wayne, 1; Lake Maxinkuckee, 3; Madison, 1; New Lebanon, 1; Waterloo, 2; West Baden, 2;⁶ Wheatland, 2.

Iowa: Hillsboro, 1; Knoxville, 1.⁵

Kentucky: Eubanks, 1; Lexington (type locality), 1; Midway, 3.

Michigan: Ann Arbor, 2;⁴ Chelsea, 1;⁴ Denton, 2;⁴ Flushing, 3;⁷ Greenfield, 1;⁸ Holland, 1;⁵ Lansing, 1;⁴ Manchester, 1; Milan, 1;⁴ Portage Lake, 11;⁴ Saline, 1.

Ohio: Cleveland, 1; Fairfield County, 1; Madisonville, 3; Salem, 1.

Ontario: Point Pelee, 25.^{8, 9}

Tennessee: Big Sandy, 1; Clarksville, 1; Nashville, 3;⁵ Tennessee River, 1.

Wisconsin: Camp Douglas, 2; Durand, 1; Fountain City, 4;⁶ Maiden Rock, 3;⁶ Prescott, 1;⁶ Wyalusing, 4.⁶

¹ Le Conte, Joseph, Proc. Acad. Nat. Sci., Philadelphia, vol. 6, 1853, p. 327, 1854.

² *Talpa europæa flavescens* Erxleben (Syst. Reg. Anim., p. 118) and *Talpa flava* Zimmermann (Spec. Zool. Geog. p. 497).

³ Le Conte, loc. cit.

⁴ Collection Univ. Michigan Mus.

⁶ Collection Field Mus. Nat. Hist.

⁶ Collection Milwaukee Public Mus.

⁷ Collection of Hartley H. T. Jackson.

⁸ Collection Victoria Mem. Mus.

⁹ Collection of W. E. Saunders, London, Ontario.

SCALOPUS AQUATICUS MACHRINOIDES Jackson.

MISSOURI VALLEY MOLE.

(Pl. II, fig. 7.)

Scalopus aquaticus machrinoides Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

Type locality.—Manhattan, Riley County, Kansas.

Type specimen.—No. 169717, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected June 1, 1910, by W. E. Berg.

Geographic range.—West of the Mississippi River, except eastern Iowa, from central Minnesota, southeastern South Dakota, and the eastern border of Nebraska, south through northeastern Kansas to extreme northern Arkansas.

General characters.—Size large, exceeded only by *S. a. machrinus*; color more grayish than *machrinus*; skull heavy, angular, smaller than that of *machrinus*, with a shorter rostrum, and relatively smaller inferior mandibular notch.

Color.—*Winter pelage*: Upperparts ranging from bistre to clove brown, becoming paler on face and wrists; underparts slightly paler than back, and usually showing more slate color of base of hairs, washed ventrally with raw umber or mummy brown. *Summer pelage*: Upperparts light drab, drab, or wood brown, paler on face, nose, and ankles; beneath slightly paler than back, more grayish.

Skull.—Most nearly like that of *S. a. machrinus* but smaller, with a relatively shorter rostrum; ascending ramus of mandible not so heavy as in *machrinus*, and inferior mandibular notch smaller; rostrum short and broad; molariform dentition very heavy.

Measurements.—Average of 3 adult males from Elk River, Minn.: Total length, 172 (168–178); tail vertebræ, 30 (27–32); hind foot, 22.2 (22–22.5). Average of 3 adult females from Fort Leavenworth, Kans., Bismarck, Mo., and Council Bluffs, Iowa: 181 (180–182); 32 (31–33); 22.3 (22–23). *Skull*: Average of 3 skulls of adult males from type locality: Greatest length, 37.1 (36.2–37.7); palatilar length, 15.3 (15.2–15.5); mastoidal breadth, 19.4 (19.3–19.5); interorbital breadth, 8 (7.9–8.1); maxillary tooth row, 12 (11.8–12.1); mandibular molar-premolar row, 11.8 (11.5–12).

Remarks.—The Mississippi River separates the range of *S. a. machrinus* from that of *S. a. machrinoides* except for a short distance where the former extends into Iowa. Specimens from St. Louis, Mo., are somewhat intermediate between the two forms, being larger than typical *machrinoides* and having relatively longer rostra. Toward the north (Elk River, Minn.), *machrinoides* decreases slightly in size; along the western border of its range it intergrades with *S. a. caryi*,

specimens from Lincoln, Nebr., being smaller and paler than typical *machrinoïdes*, while those from Vermillion, S. Dak., though large, are distinctly paler than the typical form and have higher, more rounded skulls. Two specimens from Carthage, Mo., and one from Winslow, Ark., are smaller than specimens from the type region, and have smaller teeth and narrower rostra; the heavy mastoids and the massive skulls are much as in *machrinoïdes*. A series from Greenway, Ark., shows a very slight approach toward *S. a. pulcher* in color and width of rostrum, but is easily referable to *machrinoïdes*.

Specimens examined.—Total number, 77, as follows:

Arkansas: Greenway, 7;¹ Winslow, 1.

Iowa: Council Bluffs, 1.

Kansas: Burlington, 1; Fort Leavenworth, 4; Manhattan (type locality), 6; Neosho Falls, 2; Onaga, 2; Stillwater Creek, 1.

Minnesota: Elk River, 4; Fort Snelling, 2.

Missouri: Bismarck, 1; Carthage, 2;² Charleston, 1; Columbia, 11; Independence, 1; Marble Hill, 1; St. Louis, 7; Stotesbury, 9.³

Nebraska: Everett, 1; Fort Crook, 2;⁴ Lancaster County, 1;⁵ Lincoln, 5;⁵ Perch, 1.⁴

South Dakota: Big Sioux River (at mouth), 1; Vermillion, 2.⁶

SCALOPUS AQUATICUS PULCHER Jackson.

ARKANSAS MOLE.

(Pl. II, fig. 8.)

Scalopus aquaticus pulcher Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

Type locality.—Delight, Pike County, Arkansas.

Type specimen.—No. 170698, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected January 20, 1911, by W. G. Savage.

Geographic range.—Humid lowland region of southern and eastern Arkansas, southeastern Oklahoma, northwestern and central Louisiana, and eastern Texas.

General characters.—About the size of *S. a. aquaticus*; hind foot larger; skull larger than that of *aquaticus*, flatter, less swollen supra-orbitally, wider interorbitally; interparietal wider than in *aquaticus*; skull narrower through mastoids than that of *S. a. machrinoïdes*, with narrower rostrum and smaller teeth. Slightly larger than *Scalopus æreus*; skull relatively wider interorbitally, through mastoids and through rostrum, flatter and more angular.

Color.—*Full winter pelage*: Back dark fuscous with many hairs tipped with pearl gray, producing in places a slightly frosted appearance; top of head mummy brown; nose cinnamon-brown; underparts

¹ Collection Field Mus. Nat. Hist.

² Collection of Hartley H. T. Jackson.

³ Collection Mus. Comp. Zool., Harvard College.

⁴ Collection Amer. Mus. Nat. Hist.

⁵ Collection Univ. Nebraska.

⁶ Collection Univ. South Dakota.

sepia, showing much blackish plumbeous of base of hairs. *Worn winter pelage*: Above fuscous or olive-brown, usually tinged on head with mummy brown or Saccardo's umber; underparts dark neutral gray, becoming paler anteriorly, tinged with bister. *Fresh summer pelage*: Upperparts olive-brown shading into coppery seal brown on head and face; nose and wrists slightly tinged with ochraceous-orange; beneath, bright cinnamon, becoming grayish posteriorly.

Skull.—Somewhat similar to that of *S. a. aquaticus*, but slightly larger, less angular, with flatter braincase, and averaging wider inter-orbitally and through mastoids; postorbital region less depressed than in *aquaticus*, zygomata heavier posteriorly, and horizontal ramus of mandible more arched ventrally; no distinct secondary process on posterior margin of coronoid process, though central portion of posterior border of ascending ramus is sometimes slightly expanded posteriorly.

Measurements.—Average of 6 adult males from type locality: Total length, 155.9 (153–170); tail vertebrae, 25 (23–29); hind foot, 22 (21–23). Average of 3 adult females from type locality: 149.3 (146–156); 23.3 (20–25); 21 (20–22). *Skull*: Average of 7 skulls of adult males from type locality: Greatest length, 35.6 (34.7–37.4); palatilar length, 14.7 (14.2–15.4); mastoidal breadth, 18.2 (17.6–19.2); interorbital breadth, 7.8 (7.5–8.2); maxillary tooth row, 11.3 (11–11.7); mandibular molar-premolar row, 11 (10.8–11.5). Average of 3 skulls of adult females from type locality: Greatest length, 34.3 (34.1–34.6); palatilar length, 14.3 (14.2–14.4); mastoidal breadth, 18 (17.5–18.3); interorbital breadth, 7.7 (7.4–8); maxillary tooth row, 10.9 (10.7–11); mandibular molar-premolar row, 10.7 (10.6–10.8).

Remarks.—Like other members of the genus, this beautiful mole is subject to slight local variations throughout its range. Specimens from Grand Coteau and Clarks, La., are somewhat smaller than the typical form; one from Clarks is unusually grayish for the form, but the much-worn fur and the partial molt may account for the color. The very few not immature in a series from Mer Rouge, La., are much alike in color, but are not so richly colored as most specimens of *S. a. pulcher*; skulls of males, however, show the greatest individual variation observed in any series from a single locality; two skulls are indistinguishable from topotype skulls of *pulcher*; two others are long, narrow, high, and rotund, and have narrow rostra; another is short, broad, and flat, and has a broad rostrum; age may possibly account for some of the variation, and incorrect sex determinations may also be partly responsible. An old male from Lake City, Ark., is in some respects intermediate between *pulcher* and *S. a. machrinoides*; the teeth are large; the mastoids almost as heavy as those

of *machrinoides*; and the rostrum is slightly heavier than that of typical *pulcher*, but in size and other characters it is very similar to skulls from the type locality. The specimen is in very fresh spring pelage, a little of the winter fur remaining on nose and rump, and in color it seems to be more nearly like *machrinoides* than *pulcher*. A specimen from Fort Smith, Ark., and one from Wister, Okla., neither adult, are referable to *pulcher*.

Specimens examined.—Total number, 67, as follows:

Arkansas: Camden, 1; Delight (type locality), 15; Lake City, 1; Fort Smith, 1; Wilmot, 1.

Louisiana: Clarks, 1; Columbia, 1; ¹ Grand Coteau, 1; Mer Rouge, 23; Natchitoches, 1; Shreveport, 3.

Oklahoma: Wister, 1.²

Texas: Joaquin, 1; Sour Lake, 16.

SCALOPUS AQUATICUS CARYI Jackson.

NORTHERN PLAINS MOLE.

(Pl. II, fig. 9.)

Scalopus aquaticus caryi Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 20, February 2, 1914.

Type locality.—Neligh, Antelope County, Nebraska.

Type specimen.—No. 116799, U. S. Nat. Mus., Biological Survey collection; ♂ young adult, skin and skull; collected September 18, 1901, by Merritt Cary.

Geographic range.—Arid and semiarid plains region of central and western Nebraska, northeastern Colorado, and northwestern Kansas.

General characters.—Size medium; tail long; color palest of the genus; most nearly like *S. a. intermedius* but much paler and lacking ochraceous suffusions on nose and wrists; skull slightly shorter than that of *intermedius* and relatively broader interorbitally.

Color.—*Autumn pelage*: Back light drab slightly tending toward avellaneous, becoming paler on head and shading in some cases into ivory yellow on nose; underparts much the same color as back, more mixed with neutral gray and occasionally washed with Saccardo's umber or cinnamon-brown.

Skull.—Size moderate, short, broad, and rotund; rostrum short; mandible heavy; dentition relatively heavy. Very similar to the skull of *S. a. intermedius* but slightly shorter and relatively broader interorbitally. Compared with the skull of *S. a. pulcher* that of *S. a. caryi* is shorter and higher, wider interorbitally, and has weaker mastoids, shorter, wider rostrum, and larger teeth; it is larger, much higher, and more massive than the skull of *S. æreus*, and is much smaller, higher, and less angular than that of *S. a. machrinoides*,

¹ Collection Field Mus. Nat. Hist.

² Collection Carnegie Mus.

though in extreme old age it tends to become angular and the brain-case flattens.

Measurements.—Average of 3 males from type locality: Total length, 159 (157–160); tail vertebræ, 32 (31.5–32.5); hind foot, 21.1 (20.3–22). *Skull:* Average of 3 skulls of males from type locality: Greatest length, 34.2 (33.1–34.8); palatilar length, 14.2 (14.1–14.4); mastoidal breadth, 17.8 (17–18.4); interorbital breadth, 8.1 (7.7–8.4); maxillary tooth row, 11.2 (11.1–11.3); mandibular molar-premolar row, 10.9 (10.8–11).

Remarks.—This subspecies can be distinguished from all other moles by its pale color and lack of ochraceous suffusions. Its nearest relationships are with *intermedius* with which it probably intergrades in southern Kansas.

Specimens examined.—Total number 16, as follows:

Colorado: Wray, 1.

Kansas: Long Island, 3.¹

Nebraska: Kennedy, 1; Neligh (type locality), 4; Long Pine, 2;² Niobrara River, 1;³ "Sandhills," 1; Warbonnet Canyon, Sioux County, 3.³

SCALOPUS AQUATICUS INTERMEDIUS (Elliot).

SOUTHERN PLAINS MOLE.

Scalops machrinus intermedius Elliot, Field Columb. Mus., publ. 37, zool. series, vol. 1, p. 280, 1899.

[*Scalops*] [*aquaticus*] *intermedius* Elliot, Field Columb. Mus. publ. 45, zool. series, vol. 2, p. 390, 1901.

Scalopus aquaticus intermedius Bailey, N. Am. Fauna No. 25, p. 207, October 24, 1905.

Type locality.—Alva, Woods County, Oklahoma.

Type specimen.—No. 6832, Field Mus. Nat. Hist.; ♂ adult, skin and skull; collected February 23, 1899, by Thaddeus Surber.⁴

Geographic range.—Central and western Oklahoma and adjacent parts of northern Texas.

General characters.—Size medium; tail relatively long; color pale with ochraceous on nose and wrists, darker and more ochraceous than *caryi*; skull relatively short, high and heavy, but not angular; rostrum short; teeth large.

Color.—*Winter pelage:* Back light drab to drab tinged with buff-pink; nose and wrists ochraceous-buff to zinc orange; underparts

¹ Collection Amer. Mus. Nat. Hist.

² Collection Stanford Univ.

³ Collection Univ. Nebraska.

⁴ Mr. C. B. Cory, in a letter dated March 20, 1914, advises the writer that the specimen labeled as the type of *Scalops machrinus intermedius* Elliot is No. 6829, Field Mus. Nat. Hist., collected at Alva, Okla., December 8, 1899, by Thaddeus Surber. In the original description Elliot designates no type specimen by number, but describes an adult male collected at Alva, Okla., February 23, 1899, by Thaddeus Surber. Since No. 6832, Field Mus. Nat. Hist. is the only specimen of the original series to which this description can apply, it is necessary to consider it the type of *intermedius*.

slightly paler than back, more silvery and showing less buff-pink; base of hairs deep neutral gray. *Young*: More plumbeous than adults, darker, less pink-buff tinge on back and little or no ochraceous-buff on nose and wrists.

Skull.—Resembles that of *S. a. caryi* in nearly every particular, but averages slightly larger, is usually slightly more depressed post-orbitally, and has relatively heavier molariform dentition.

Measurements.—Average of 4 adult males from type locality: Total length, 164.5 (160–169); tail vertebræ, 28.8 (27–31); hind foot, 21.8 (21–22). *Skull*: Average of 4 skulls of adult males from type locality: Greatest length, 35 (34.5–35.6); palatilar length, 14.7 (14.5–14.9); mastoidal breadth, 18.3 (17.8–18.5); interorbital breadth, 8.1 (7.8–8.3); maxillary tooth row, 11.4 (10.9–11.7); mandibular molar-premolar row, 11.1 (10.5–11.4).

Remarks.—The subspecies *intermedius* can be distinguished from its nearest congener, *S. a. caryi*, by its slightly darker color, and, in full adult pelage, by the ochraceous-buff or zinc orange on nose and wrists; the skull of *intermedius* is generally longer than that of *caryi*. Specimens from Mount Scott, Okla., are a little darker than typical *intermedius*, and the skulls are slightly longer. Intergradation between this subspecies and *S. a. texanus* apparently occurs in north-central Texas. It seems probable that *intermedius* intergrades also with *S. a. pulcher* in eastern Oklahoma, though specimens from Red Fork, Okla., show no approach to *pulcher*. An alcoholic specimen from Belknap, Tex., too young for positive identification, is provisionally referred to *intermedius*.

Specimens examined.—Total number, 22, as follows:

Oklahoma: Alva (type locality), 6; Dougherty, 1;¹ Fort Reno, 1; Mount Scott, 5; Red Fork, 3.

Texas: Belknap, 1; Lipscomb, 3; Mobeetie, 2.

SCALOPUS AQUATICUS TEXANUS (Allen).

TEXAS MOLE.

(Pl. II, fig. 10; Pl. III, figs. 5, 5a; Pl. VI, fig. 7.)

Scalops argentatus texanus Allen, Bul. Amer. Mus. Nat. Hist., vol. 3, p. 221, April 29, 1891.

Scalops texanus Allen, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, 1893.

Scalops aquaticus texanus True, Proc. U. S. Nat. Mus., vol. 19, p. 21, 1896.

[*Scalops*] [*aquaticus*] *texensis* (sic) Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

Scalopus aquaticus texanus Bailey, N. Am. Fauna No. 25, p. 206, October 24, 1905.

Scalopus aquaticus texensis (sic) Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 471, 1905.

¹ Collection Field Mus. Nat. Hist.

Type locality.—Rockport, Aransas County, Texas.

Type specimen.—No. $\frac{3488}{2740}$, Amer. Mus. Nat. Hist.; sex unknown; skin and skull; collected September, 1887, by William Lloyd.

Geographic range.—Coast region of Texas from Matagorda Bay to Cameron County, north in the interior to central and east-central Texas.

General characters.—Size small; much smaller, darker, and more brownish than *intermedius*; back generally much tinged with bronze, and nose and wrists suffused with orange; skull small, flat, much depressed postorbitally, and swollen supraorbitally; rostrum short; teeth large.

Color.—*Full winter pelage*: Back Saccardo's umber to mummy brown with bronze tinge; nose and wrists zinc orange to xanthine orange; underparts much like back, less bronze, occasionally tinged with amber-brown; base of hairs dark mouse gray dorsally, becoming slightly paler ventrally. *Fresh summer pelage*: Slightly paler than winter pelage, less brown, with less orange on nose and wrists; underparts distinctly more grayish than in winter pelage.

Skull.—Small, flat, constricted interorbitally, much depressed postorbitally, and swollen supraorbitally; rostrum short; mandible relatively heavy; teeth relatively large. The skull of *S. a. texanus* is very much smaller than that of *S. a. intermedius* or *S. a. pulcher*; about the size of that of *S. a. australis* but differs from it in shape and in having much heavier mandibles and dentition.

Measurements.—Average of 8 adult males from type locality: Total length, 138.5 (128–152); tail vertebræ, 23.8 (21–26); hind foot, 17.2 (15.5–18). Average of 4 adult females from type locality: 133.8 (130–137); 22.3 (20–24); 16.3 (15–17). *Skull*: Average of 9 skulls of adult males from type locality: Greatest length, 31 (30–32); palatilar length, 13 (12.7–13.7); mastoidal breadth, 16.6 (16.1–17); interorbital breadth, 6.8 (6.6–7.1); maxillary tooth row, 10.3 (10–10.6); mandibular molar-premolar row, 10.1 (9.7–10.3). Average of 4 skulls of adult females from type locality: Greatest length, 29.8 (29.3–30.2); palatilar length, 12.6 (12.3–12.8); mastoidal breadth, 16.2 (15.9–16.5); interorbital breadth, 6.9 (6.7–7.1); maxillary tooth row, 9.8 (9.7–9.9); mandibular molar-premolar row, 9.7 (9.5–9.9).

Remarks.—Local variation in the genus seems to reach its maximum in *S. a. texanus*, there being no two localities from which specimens of this form have been examined but exhibit differences either in skin or cranial characters, or in both; there is, however, very little individual variation in a series from any one locality. Unfortunately, no considerable number of specimens are available except from Rockport, Tex., and until extensive series of specimens and careful habitat

studies are obtained from each of many localities it will be impossible to determine the extent and meaning of these variations. The large series from the type locality is remarkably uniform in characters except for seasonal color variations. Skulls from Corpus Christi are slightly larger, higher through the braincase, and broader through the rostrum than typical *texanus*, as are also two believed to have been collected at Brownsville, Tex.; specimens from Padre Island are very slightly longer than those from Rockport; one from Santa Rosa is high and weak and has a rather short rostrum. The color of the Santa Rosa specimen is much paler than that of typical *texanus* due probably to the peculiar condition of the pelage. Specimens from Mason have large skulls and pale color and in these respects seem to approach *S. a. intermedius*; the skulls, however, are flat and have narrow rostra. A skin without skull from Waco is inclined toward *intermedius* in color, but is much too small for that form and has been provisionally called *texanus*; another skin, in very soiled pelage, from Longpoint, Tex., does not differ from typical *texanus* in size or color.

Specimens examined.—Total number, 42, as follows:

Texas: Brownsville, 2; Corpus Christi, 2; Longpoint, 1; Mason, 3; Padre Island, 3; Rockport (type locality), 25; San Antonio, 4; Santa Rosa, 1; Waco, 1.¹

SCALOPUS ÆREUS (Bangs).

COPPERY MOLE.

(Pl. II, fig. 12; Pl. III, figs. 7, 7a; Pl. VI, fig. 9.)

Scalops texanus æreus Bangs, Proc. Biol. Soc. Washington, vol. 10, p. 138, December 28, 1896.

[*Scalops*] *æreus* Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

Scalops aquaticus æreus Miller & Rehn, Proc. Boston Soc. Nat. Hist., vol. 30, p. 250, December, 1901.

Scalopus æreus Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 471, 1905.

Scalopus aquaticus æreus Miller, U. S. Nat. Mus., Bul. 79, p. 8, December 31, 1912.

Type locality.—Stilwell, Payne County, Oklahoma.

Type specimen.—No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ adult, skin and skull; collected August 13, 1896, by Thaddeus Surber.

Geographic range.—Known only from type locality.

General characters.—Size medium; differs from all other forms of *Scalopus* in its color, a rich coppery snuff brown; skull weak and narrow.

Color.—Type (female), in *late summer pelage*: Upperparts rich coppery snuff brown; underparts less coppery than above, more grayish.

¹ Collection Acad. Nat. Sci. Philadelphia.

Skull.—Much smaller, weaker, and narrower than that of *S. a. machrinoides*, *S. a. pulcher*, or *S. a. intermedius*; larger than that of *S. a. texanus*, relatively longer, less depressed postorbitally and less swollen supraorbitally, with longer, narrower rostrum; teeth small.

Measurements.—Type (adult female): Total length, 154; tail vertebræ, 24; hind foot, 19. *Skull* (of type): Greatest length, 33.2; palatilar length, 14; mastoidal breadth, 17; interorbital breadth, 7.5; maxillary tooth row, 10.6; mandibular molar-premolar row, 10.5.

Remarks.—The status and relationships of this form are unknown. The type and only specimen in collections was taken August 13, 1896; the rich coppery color may be due in part to a deadening of the summer fur preceding molt and if such proves to be the case the coppery color will not be of diagnostic value. The skull is weak, narrow, moderately high and rounded, and has a long, narrow rostrum; the teeth are much worn, the sutures closed, and from all appearances the animal was adult; it was sexed female by the collector.

Specimen examined.—One, the type.

SCALOPUS INFLATUS Jackson.

TAMAULIPAS MOLE.

(Pl. II, fig. 11; Pl. III, figs. 6, 6a; Pl. VI, fig. 8.)

Scalopus inflatus Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 21, February 2, 1914.

Type locality.—State of Tamaulipas, Mexico (45 miles from Brownsville, Texas).

Type specimen.—No. 52709, U. S. Nat. Mus., Biological Survey collection; young adult, sex unknown; skin and imperfect skull; collected in 1892 by F. B. Armstrong.

Geographic range.—Known only from type locality.

General characters.—Size small, larger than *S. a. texanus*; skull broad, high, and arched, much inflated in prelachrymal region; rostrum broad, truncate; zygomata heavy.

Color.—Back between wood brown and drab, becoming ochraceous-buff on cheeks; general tone of underparts much as on back but more mixed with mouse gray.

Skull.—Size medium, high and arched; prelachrymal region much swollen; audital bullæ high and well defined; zygomata heavy; posterior edge of lachrymal foramen meets zygoma at nearly right angle; rostrum broad; mandible heavy, horizontal ramus much arched ventrally; outer groove in third upper premolar pronounced; first lower premolar small and inconspicuous.

Measurements.—Type (from dry skin, foot relaxed): Tail vertebræ, 18; hind foot, 16.5. *Skull* (of type): Palatilar length, 13.4; mastoidal breadth, 17; interorbital breadth, 7.1; maxillary tooth row, 11.1; mandibular molar-premolar row, 11.

Remarks.—The only-known specimen of this form is imperfect; it lacks complete data, the pelage is ragged and apparently faded, and the posterior portion of the braincase is broken away. Aside from its many other distinctive characters, *Scalopus inflatus* can easily be separated from all other members of the genus by the peculiarly

inflated prelachrymal region of the skull. It was at first thought that this inflation was due to parasites; but the bilateral symmetry of the inflations, the fact that no apparent work of parasites has been noticed in this region of the skull in the many hundred specimens of *Scalopus* examined, and, further, the fact that a very slight and inconspicuous tendency toward prelachrymal inflation is present in all members of the genus, leads to the belief that the inflation in this species is an extreme accentuation of normal development.

Specimen examined.—One, the type.

Genus SCAPANUS Pomel.

Scapanus Pomel, Archives Sci. Physiques et Nat., tome 9, p. 247, November, 1848.

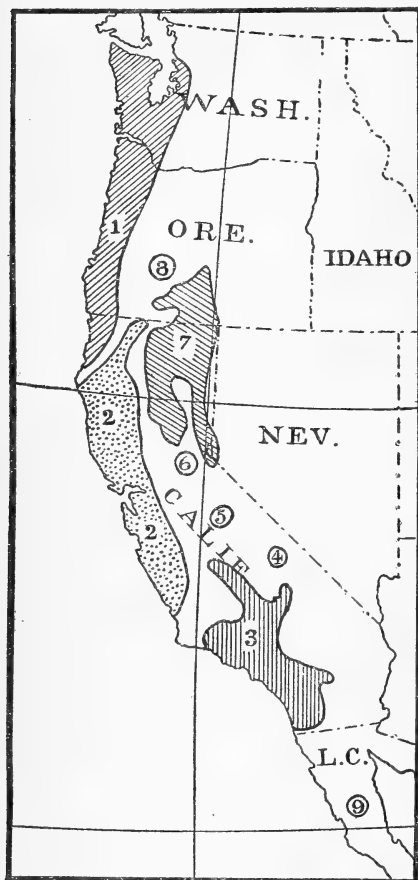
Scaphanus Herrick, Geol. and Nat. Hist. Surv., Minnesota, Bul. 7, p. 55, 1892.

Scapasius Beddard, Cambridge Nat. Hist., vol. 10, p. 518, 1902.

Type species.—*Scalopus townsendii* Bachman.

Geographic range.—Southwestern British Columbia (Fraser River region), western and southern Washington, western Oregon, extreme western Nevada, California (except the southeastern desert region), south to San Pedro Martir Mountains, Lower California (figs. 7 and 12).

External characters.—Body robust, depressed; tail short, round, thick and fleshy, tapering apically and slightly constricted proximally, indistinctly annulated, scantily haired with coarse hairs



B2013-103

FIG. 7.—Geographic range of the species and subspecies of *Scapanus* except *S. orarius* (see fig. 12).

- | | |
|------------------------------------|------------------------------|
| 1. <i>S. townsendii</i> . | 6. <i>S. l. minusculus</i> . |
| 2. <i>S. latimanus latimanus</i> . | 7. <i>S. l. dilatus</i> . |
| 3. <i>S. l. occultus</i> . | 8. <i>S. l. alpinus</i> . |
| 4. <i>S. l. grinnelli</i> . | 9. <i>S. anthonyi</i> . |
| 5. <i>S. l. sericatus</i> . | |

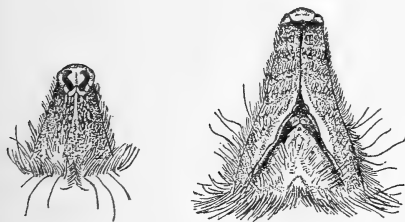
(fig. 8). Head conoidal, depressed. Nose elongated into a snout (shorter and less truncate than in *Scalopus*), the apical portion naked to line of anterior edge of nasals; nostrils superior, crescentic, with concavities turned in laterally (fig. 9). Eyes minute, concealed in fur. Auricular orifice small. Legs short and stout. Feet large, fleshy, scantily haired above, naked below. Fore feet handlike, the palms as broad as long (fig. 10). Soles of hind feet with one to three (usually two) distinct tubercles. Fore toes and hind toes not webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and weak (fig. 11). Fur dense, soft, silky, the hairs nearly equal in length, producing a velvetlike pelage. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.

Skeletal characters.—Clavicle short and heavy, about three-fourths as broad as long, distinctly notched on the inferior border, not penetrated by a foramen. Humerus heavy, about three-fourths as broad as long. Pelvis narrow, bones of opposite sides scarcely touching under acetabula; two osseous bridges, each bifurcate posteriorly, connect sacral vertebræ with ischium and produce six foramina or openings, a large one in each of the anterior angles formed by median lines of acetabula and sacral vertebræ and two smaller ones in each of the posterior angles. Superior surface of last sacral vertebra without longitudinal process. Os falciforme relatively broad and long, reaching proximal end of terminal phalange of first digit, gently incurved, not much tapering distally.



B2014-103

FIG. 8.—Tail of *Scapanus latimanus latimanus* ($\times 1\frac{1}{2}$). No. 105258, U. S. Nat. Mus.; from Colma, San Mateo County, Cal.

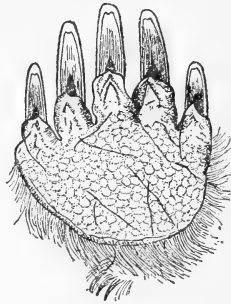
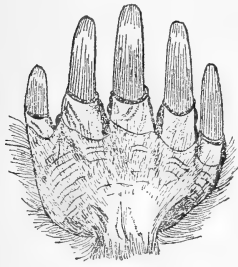


B2015-103

FIG. 9.—Snout of *S. l. latimanus* ($\times 1\frac{1}{2}$). Individual referred to in fig. 8.

Skull conoidal, flat, with relatively broad braincase, and slightly constricted interorbitally. Mastoids moderately heavy, not prominent. Interparietal large, somewhat rectangular, breadth (anteroposterior diameter) about one-third the length, slightly convex anteriorly and concave posteriorly with a posterior median projection. Frontal region flat, not much sloping; frontal sinuses somewhat swollen. Rostrum moderately long; anterior ends of premaxillæ slightly thickened and extending beyond nasals, forming a notch (acute to truncate) anterior to nasals. Anterior nares opening forward. Zygomata moderately long and heavy, rather sharply curved inward anteriorly, the posterior end attached about medially on squamosal. Foramen magnum oval, of moderate size. Infraorbital

foramen relatively small (larger than in *Scalopus*), the plate forming its outer wall moderately broad. Audital bullæ complete, depressed; auditory meatus short (more developed than in *Scalopus*). External pterygoid region moderately inflated both posteriorly and anteriorly. Mesopterygoid space moderately broad and relatively long, the sides nearly straight and slightly converging posteriorly. Palate moderately elongate, terminating at a distance posterior to the last molar about equal to half the diameter of that tooth; posterior border of palate truncate or slightly emarginate, usually with a slight median notch. Anterior palatine foramina moderate, oval to elliptical-oval; posterior palatine foramina small (the



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FIG. 10.—Fore foot of *S. l. latimanus* ($\times \frac{1}{2}$). Individual referred to in fig. 8.

first pair larger than the second), round to oval. Horizontal ramus of mandible moderately heavy, somewhat curved upward at posterior end, nearly straight at anterior end; coronoid moderately elongate, quadrate, truncate, directed almost perpendicular to median line of horizontal ramus; angle of mandible large and heavy (relatively longer than in *Scalopus*); inferior mandibular notch large, subcircular, relatively broad and deep.

Dental characters.—First upper incisor long and broad, convex anteriorly, flat posteriorly; second and third upper incisors and upper canine simple, conical, of moderate size, subequal, about two-thirds as long as first incisor. First, second, and third upper premolars similar to second and third incisors, the third premolar usually with a small postero-basal cusp; fourth premolar much larger than third, more cuspidate, with a large posterior cusp, usually with an intero-basal cusplike process, and frequently with a more or less developed antero-basal cusplike process. Upper molars W-shaped in transverse section, with an antero-internal V-shaped cusplike shelf (not lobed); first and second molars subequal, the third much smaller.



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FIG. 11.—Hind foot of *S. l. latimanus* ($\times \frac{1}{2}$). Individual referred to in fig. 8.

First seven lower teeth (incisors, canine, and first, second, and third premolars) small, conical, the first and third incisors smaller than the other teeth, which are subequal; premolars each with a

slight cusplike process posteriorly; fourth premolar much larger, more cuspidate. Lower molars M-shaped in transverse section, the antero-internal cusp bilobed; first molar with a postero-internal basal accessory cusp; second molar with a postero- and an antero-internal basal accessory cusp; third molar with an antero-internal basal accessory cusp; first and second molars subequal, the third much smaller. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{4}{4}$;¹ m. $\frac{3}{3}$; total 44.

Key to Species and Subspecies of Scapanus.

[Based upon specimens of adult animals in fresh pelage.]

- a¹. Unicuspid teeth evenly spaced and not crowded; rostrum relatively long and narrow; color dark, almost black (except in *Scapanus orarius schefferi*).
- b¹. Total length more than 200 mm.; greatest length of skull more than 40 mm.; sublachrymal-maxillary ridge distinct.....*Scapanus townsendii* (p. 58).
- b². Total length less than 200 mm.; greatest length of skull less than 40 mm.; sublachrymal-maxillary ridge not much developed.
- c¹. Color darker; rostrum narrow; interorbital breadth of skull 8.2 mm. or less,
Scapanus orarius orarius (p. 61).
- c². Color paler; rostrum relatively broad; interorbital breadth of skull 8.2 mm. or more.....*Scapanus orarius schefferi* (p. 63).
- a². Unicuspid teeth usually crowded and not evenly spaced; rostrum relatively short and broad; color usually brown or gray, seldom almost black.
- b¹. Total length usually less than 165 mm.; greatest length of skull 33.5 mm. or less.
- c¹. Greatest length of skull less than 31 mm.; premolars $\frac{3}{3}$,
Scapanus anthonyi (p. 75).
- c². Greatest length of skull 31 mm. or more; premolars $\frac{4}{4}$.
- d¹. Interorbital constriction more than 7.6 mm.; breadth of skull across mastoids more than 16.2 mm.....*Scapanus latimanus grinnelli* (p. 69).
- d². Interorbital constriction 7.6 mm. or less; breadth of skull across mastoids 16.2 mm. or less.
- e¹. Inferior mandibular notch deep; geographic range south of latitude 37° N.....*Scapanus latimanus occultus* (p. 68).
- e². Inferior mandibular notch shallow; geographic range north of latitude 37° N.....*Scapanus latimanus minusculus* (p. 72).
- b². Total length usually more than 165 mm.; greatest length of skull more than 33.5 mm.
- c¹. Geographic range, California west of Sacramento and San Joaquin Valleys, including also Klamath Canyon.....*Scapanus latimanus latimanus* (p. 64).
- c². Geographic range, Oregon and California east of Sacramento and San Joaquin Valleys, except Klamath Canyon.
- d¹. Color dark; interorbital constriction less than 7.6 mm.,
Scapanus latimanus sericatus (p. 71).
- d². Color pale; interorbital constriction more than 7.6 mm.
- e¹. Greatest length of skull less than 36 mm.,
Scapanus latimanus dilatus (p. 72).
- e². Greatest length of skull more than 36 mm.,
Scapanus latimanus alpinus (p. 75).

¹Pm. $\frac{3}{3}$ in the type and only specimen of *Scapanus anthonyi*.

Descriptions of Species and Subspecies of *Scapanus*.

SCAPANUS TOWNSENDII (Bachman).

TOWNSEND'S MOLE.

(Pl. IV, fig. 1; Pl. V, figs. 1, 1a; Pl. VI, fig. 10.)

Scalops canadensis Richardson, Fauna Boreali-Amer., part 1, p. 9, 1829. (Not of Desmarest or Harlan.)

Scalops Townsendii Bachman, Journ. Acad. Nat. Sci., Philadelphia, vol. 8, part 1, p. 58, 1839.

Scalops Townsendi Bachman, Boston Journ. Nat. Hist., vol. 4, p. 31, January, 1842.

Scapanus Townsendii (sic) Pomel. Archiv. Sci. Physiques et Nat., vol. 9, p. 247, 1848.

Scalops metallescens Cassin, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 242, 1854. (Nomen nudum.)

Scalops æneus Cassin, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 299, 1854. Type locality, Oregon.

[*Talpa*] *ænea* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Talpa Townsendii Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Talpa tæniata Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854. Type locality, banks of Columbia River.

[*Scapanus*] *Townsendi* Peters, Monatsber. Königl. Preuss. Akad. Wissensch., Berlin, 1863, p. 656, 1864.

Scapanus Townsendii True, Proc. U. S. Nat. Mus., vol. 7, p. 607, 1885.

Type locality.—"Banks of the Columbia River." Probably from the vicinity of Fort Vancouver, Clarke County, Washington, which it seems well to consider the type locality.

Type specimen.—Cotype, No. 449, Acad. Nat. Sci. Philadelphia; collected May 9, 1835,¹ by J. K. Townsend.

Geographic range.—Extreme northwestern California, Oregon, and Washington west of the Cascade Mountains.

General characters.—Size largest of the genus; color dark, almost black; skull large, mastoids relatively heavy, rostrum long; unicuspid teeth evenly spaced and not crowded. The young of *S. townsendii* in superficial skin characters often resemble adults of *S. orarius*, but are easily separated from the latter by their large fore feet, with thick, heavy claws.

Color.—*Winter pelage*: Upperparts blackish brown, fuscous-black, sooty black, to almost black, usually with a purplish sheen; underparts very slightly paler than the back and frequently stained with brown. *Summer pelage*: Much like winter pelage, but very slightly paler, with purplish sheen more pronounced.

Skull.—Large (greatest length of smallest skulls more than 40 mm.), flat, and angular; mastoids angular and rather heavy; interparietal relatively narrower antero-posteriorly than in *S. latimanus*; slight but distinct sagittal crest between anterior portions

¹ The date is not on the labels now attached to the specimen, but Bachman (loc. cit.) states it was collected May 9, 1835.

of parietals in adults; zygomata heavy; rostrum long and relatively narrow; sublachrymal-maxillary ridge well developed; dentition heavy; unicuspid teeth, both maxillary and mandibular, evenly spaced and not crowded as in *latimanus*; mandible relatively weaker than in *latimanus*.

Measurements.—Average of 3 young adult females from vicinity of Portland, Oreg.: Total length, 206 (195–222); tail vertebrae, 48.3 (45–51); hind foot, 26.3 (24–28). Average of 7 adult males from Ferndale, Humboldt County, Cal.: 224.1 (217–237); 41.1 (34–50); 26.7 (26–27). Average of 4 adult females from Ferndale, Cal.: 208 (202–210); 41.8 (37–46); 26.8 (26–27). *Skull:* Average of 10 skulls of adult males from Puyallup, Wash.: Greatest length, 43.6 (42.3–44.6); palatilar length, 18.1 (17.4–18.8); mastoidal breadth, 20.8 (20.3–21.4); interorbital breadth, 9.2 (9.1–9.4); maxillary tooth row, 14.1 (13.7–14.4); mandibular molar-premolar row, 13.8 (13.5–14.4). Average of 10 skulls of adult females from Puyallup, Wash.: Greatest length, 42.3 (41.5–44.1); palatilar length, 17.6 (16.9–18.1); mastoidal breadth, 19.9 (19.3–20.4); interorbital breadth, 8.9 (8.4–9.2); maxillary tooth row, 13.9 (13.5–14.4); mandibular molar-premolar row, 13.6 (13.2–14). Average of 3 skulls of young adult females from the vicinity of Portland, Oreg.: Greatest length, 41.8 (41.2–42.1); palatilar length, 17.6 (17.3–18); mastoidal breadth, 19.8 (19.4–20); interorbital breadth, 9 (8.7–9.1); maxillary tooth row, 13.4 (13.3–13.5); mandibular molar-premolar row, 13.2 (13.1–13.3). Average of 7 skulls of adult males from Ferndale, Humboldt County, Cal.: Greatest length, 42.9 (42.3–44.2); palatilar length, 18.3 (17.7–18.7); mastoidal breadth, 20.9 (20–21.8); interorbital breadth, 9 (8.7–9.5); maxillary tooth row, 13.9 (13.5–14.2); mandibular molar-premolar row, 13.7 (13.2–14.1). Average of 4 skulls of adult females from Ferndale, Cal.: Greatest length, 41.5 (41.2–41.9); palatilar length, 17.9 (17.8–18); mastoidal breadth, 20 (19.9–20.2); interorbital breadth, 8.9 (8.7–9.1); maxillary tooth row, 13.7 (13.5–13.9); mandibular molar-premolar row, 13.3 (13.2–13.5).

Remarks.—The presence of moles in the Pacific northwest was known to some of the early explorers, but the first one described was by Richardson,¹ who, though very accurately describing the animal now known as *Scapanus townsendii*, referred his specimens to the common mole of eastern United States, then known as *Scalops canadensis* Desmarest. It was not until ten years later that the species was named, when Bachman² published his description based upon two specimens. One specimen was a normally colored individual received from Nuttall from a locality not stated; the other was collected by Townsend and according to Bachman (loc. cit.) was

¹ Richardson, J., Fauna Boreali-Amer., part 1, pp. 9–12, 1829.

² Bachman, J., Journ. Acad. Nat. Sci. Philadelphia, vol. 8, part 1, pp. 53–60, 1839.

labeled "Banks of the Columbia River, May 9, 1835." The latter specimen is a partial albino, having a narrow, irregular white streak extending from chin to abdomen, and another from forehead to snout; this specimen (No. 449) is now in the Academy of Natural Sciences of Philadelphia, where sometime in later years it was marked "Type of *Scalops townsendii*." It is not the type, since Bachman's description was based in part if not primarily on the specimen submitted by Nuttall; it may well be considered a cotype, however, since Bachman does not designate a type; that he considered the two specimens one and the same species is evident in his remark: "I subsequently received from Mr. Townsend another specimen, a little larger in size, which I presume to be a mere variety, although very singularly marked" (loc. cit., p. 58). This same abnormal specimen became, in 1854, the type of *Talpa tæniata* Le Conte. Cassin exhibited and described a mole which he called "*Scalops metallescens*" before the Philadelphia Academy in 1853, but in the published account¹ of his talk and exhibition, which appeared the next year, the name "*Scalops metallescens*" occurs without any description. Subsequently, however, Cassin² described the animal under the name "*Scalops æneus*;" the type³ is now in the United States National Museum. Cassin states: "In its dentition and otherwise it is a strict congener of *Scalops townsendii*, but is much smaller and of a different color. Its black claws are especially remarkable, and distinguish it from all other species of the genus" (loc. cit.). Unfortunately the skull has been lost, but the skin seems to show that it is of a rather young specimen of *Scapanus townsendii* which has been shrunk and discolored by some chemical, possibly corrosive sublimate. The general tone of color of the back is between Brussels brown and Prout's brown; the underparts are mostly buckthorn brown, and on chin and ankles is a suspicious tinge of sulphine yellow. The claws are heavy as in *townsendii* and do not indicate specific relationship with *S. orarius*; both claws and soles of the feet are black, which might readily be accounted for by the presence of mercuric sulphid from the combination of carbon bisulphid and corrosive sublimate used in preserving specimens.

Townsend's mole, though showing considerable individual variation in size and in proportions and shape of skull, is subject to very little geographic variation. In a large series of skulls from Puyallup, Wash., are four which have supernumerary premolars. Three of these have each an extra premolar between the second and third premolars of the right mandible; the other specimen has a supernumerary tooth between the second and third premolars of the left

¹ Cassin, J., Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 242, 1854.

² Cassin, loc. cit., p. 299, 1854.

³ No. 3725 U. S. Nat. Mus., skin without skull; collected in Oregon, by "U. S. Exploring Expedition."

mandible, and a minute extra tooth between the third and fourth right lower premolars. This is interesting since *Scapanus* normally has the theoretically complete mammalian dentition of 44 teeth.

Specimens examined.—Total number, 203, as follows:

California: Crescent City, 6; Ferndale, 11;¹ Smith River, 2.

Oregon: Beaverton, 3; Coquille, 1; Drain, 1; Goldbeach, 2; Grants Pass, 1; Netarts, 1;² Oregon City, 3; Portland, 24; ^{2, 3, 4} Salem, 3; Seaton, 1; "U. S. Exploring Expedition," 1; Wells, 1.

Washington: Columbia River (type locality), 1;⁵ Hot Springs Trail, Olympic Mountains, 1;⁶ Lake Cushman, 2; La Push, 1; Puyallup, 108;⁷ Renton, 1;¹ Roy, 1; Sauk, 1; Seattle, 1; Skykomish, 1; South Bend, 5; Steilacoom, 3; Tacoma, 1;⁵ Tenino, 3; Vancouver, 11; Vancouver Barracks (probably exact type locality), 1.

SCAPANUS ORARIUS ORARIUS True.

COAST MOLE.

(Pl. IV, fig. 2; Pl. V, figs. 2, 2a; Pl. VI, fig. 11.)

Scapanus orarius True, Proc. U. S. Nat. Mus., vol. 19, p. 52, December 21, 1896.

Type locality.—Shoalwater Bay, Pacific County, Washington.

Type specimen.—No. $\frac{1381}{37434}$, U. S. Nat. Mus.; ♀ young adult, skin and skull (posterior portion of braincase broken and incomplete); collected August 30, 1855, by J. G. Cooper.

Geographic range.—Humid coast region of northern California (north of Mendocino), Oregon, and Washington.

General characters.—Size medium; color dark. The subspecies *orarius* is somewhat smaller than *S. l. latimanus*, with relatively smaller fore feet, and slenderer claws; darker than *latimanus*. Similar in color to *S. townsendii*, but very much smaller, with actually and relatively smaller feet and claws. The skull of *S. o. orarius* can always be easily distinguished from that of *townsendii* by its much smaller size, without reference to any other characters; from that of *latimanus* it differs in its evenly spaced and uncrowded unicuspid teeth, its very narrow rostrum, undeveloped and indistinct sublachrymal-maxillary ridge, and very weak mandible; teeth, particularly the first incisors, smaller than in *latimanus*.

Color.—General tone much the same as in *S. townsendii*. *Winter pelage*: Upperparts fuscous-black, chætura black, blackish brown, to nearly black; underparts slightly paler and more grayish. *Summer pelage*: Much like winter pelage but usually more brownish.

Skull.—Size medium (average greatest length of skulls of adult males about 34 to 35 mm.); mastoid region weak; sublachrymal-maxillary ridge only slightly developed; rostrum very narrow;

¹ Collection Mus. Vert. Zool., Univ. California.

² Collection Oregon State Game Comm.

³ Collection of H. E. Anthony, New York City.

⁴ Collection of S. G. Jewett, Portland, Oreg.

⁵ Collection Acad. Nat. Sci. Philadelphia.

⁶ Collection Field Mus. Nat. Hist.

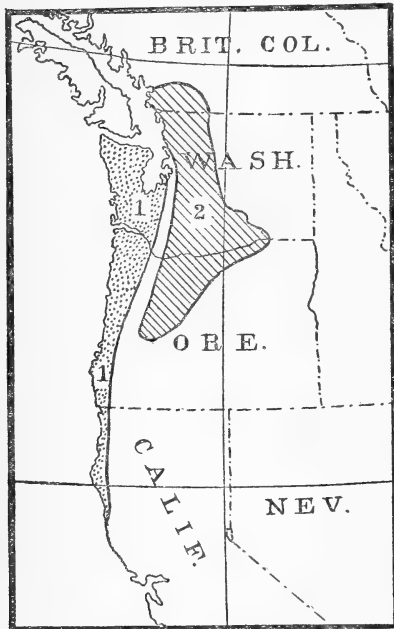
⁷ One hundred, skulls only; two skeletons.

horizontal ramus of mandible narrow and weak; teeth, especially first incisors, small.

Measurements.—Average of 3 adult males from Eureka, Humboldt County, Cal.: Total length, 167 (163–175); tail vertebræ, 33.7 (31–35); hind foot, 20.7 (20–22). *Skull:* Average of 2 skulls of adult males from Ferndale, Humboldt County, Cal.: Greatest length, 34.3 (33.5–35); palatilar length, 13.5 (13.3–13.7); mastoidal breadth, 16.4 (16.3–16.4); interorbital breadth, 8.1 (8–8.1); maxillary tooth row, 10.7 (10.5–10.9); mandibular molar-premolar row, 10.4 (10.3–10.5).

Remarks.—Judged by the specimens examined, *Scapanus orarius* (including the subspecies *schefferi*) has a more extensive geographic range than *S. townsendii*; it occurs both farther north and farther south, as well as much farther east (fig. 12). The ecological relationship of the two forms is unknown; its solution would involve most valuable and interesting research for some student favorably situated.

The few specimens of *S. o. orarius* available from the region of the type locality are mostly of young animals or have imperfect skulls. However, there seems to be very little geographic variation, either chromatic or cranial, in



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FIG. 12.—Geographic range of the subspecies of *Scapanus orarius*.

1. *S. o. orarius*. 2. *S. o. schefferi*.

specimens taken throughout the whole coastal strip extending from Juan de Fuca to Mendocino County, Cal.

Specimens examined.—Total number, 46, as follows:

California: Crescent City, 3; Cuddeback, 1;¹ Eureka, 6;¹ Ferndale, 2;¹ Mendocino, 1;² Orick, 1; Smith River, 1.

Oregon: Astoria, 1;³ Myrtle Point, 1; Newport, 1; Portland, 3;⁴ Yaquina Bay, 4.

Washington: Chehalis County, 1; King County, 1;⁵ La Push, 1; Neah Bay, 2; Pacific County, 1;⁶ Port Townsend, 1; Puyallup, 6; Shoalwater Bay (type locality), 2; South Bend, 5; Steilacoom, 1.

¹ Collection Mus. Vert. Zool., Univ. California.

² Collection Field Mus. Nat. Hist.

³ Collection Univ. Michigan Mus.

⁴ Collection of H. E. Anthony, New York City.

⁵ Collection Milwaukee Public Mus.

⁶ Collection Amer. Mus. Nat. Hist.

SCAPANUS ORARIUS SCHEFFERI subsp. nov.¹

SCHEFFER'S MOLE.

(Pl. IV, fig. 3; Pl. VI, fig. 12.)

Type locality.—Walla Walla, Walla Walla County, Washington.

Type specimen.—No. 204997, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected August 8, 1914, by Theodore H. Scheffer.

Geographic range.—Extreme southwestern British Columbia, northwestern Washington (east of Puget Sound and north of latitude 48° N.), central and southern Washington from the west slopes of the Cascade Mountains east to Walla Walla, and both slopes of the Cascade Mountains in northern and east-central Oregon.

General characters.—Similar to *S. o. orarius* but much paler, slightly larger, with both hind and fore feet relatively larger, and claws heavier. Skull about the size of that of *orarius*, with relatively shorter and broader rostrum and greater interorbital breadth.

Color.—*Fresh autumn pelage*: Upperparts glossy deep mouse gray; underparts slightly paler and more grayish. *Worn summer pelage*: Upperparts hair-brown to pale fuscous; underparts mouse gray.

Skull.—Compared with that of *S. o. orarius*, the skull of *schefferi* is broader interorbitally and has a relatively and actually shorter and broader rostrum, more evident sublachrymal-maxillary ridge, heavier mandible, and heavier dentition.

Measurements.—Type (adult male): Total length, 170; tail vertebrae, 35; hind foot, 23. Average of 3 adult males (including type) from type locality: 168.7 (165–171); 34.7 (34–35); 23 (23–23). *Skull*: Type (adult male): Greatest length, 34.7; palatilar length, 14.6; mastoidal breadth, 16.7; interorbital breadth, 8.4; maxillary tooth row, 11.2; mandibular molar-premolar row, 10.9. Average of 3 skulls of adult males (including type) from the type locality: Greatest length, 34.4 (34.2–34.7); palatilar length, 14.4 (14.2–14.6); mastoidal breadth, 16.4 (16.2–16.7); interorbital breadth, 8.3 (8.2–8.4); maxillary tooth row, 11.1 (11–11.2); mandibular molar-premolar row, 10.8 (10.8–10.9). Average of 2 skulls of adult females from the type locality: Greatest length, 32.9 (32.8–39); palatilar length, 13.7 (13.6–13.8); mastoidal breadth, 15.9 (15.8–15.9); interorbital breadth, 8.2 (8.2–8.2); maxillary tooth row, 10.6 (10.6–10.6); mandibular molar-premolar row, 10.4 (10.3–10.5).

Remarks.—Typical specimens of *schefferi* are easily distinguishable from *S. o. orarius*, its most closely allied form. The type specimen has fresh autumn pelage on the upperparts, the underparts still retaining the worn summer pelage. On the face of the type specimen

¹ Named for Theodore H. Scheffer in recognition of his careful investigations of the habits and ecology of American moles.

is a small spot of ochraceous-buff and a faint wash of the same color on the throat. Similar chromatic abnormalities crop out in several specimens from the type locality, and one specimen (No. 204998, U. S. Nat. Mus.) has as a dental abnormality a supernumerary left upper premolar.

Intergradation of this form with *orarius* is clearly indicated in specimens from the west slope of the Cascade Mountains in Oregon and Washington. Specimens from Vida, McKenzie Bridge, and Three Sisters, in Oregon, approach *orarius* in color and in cranial characters, though distinctly referable to *schefferi*. Specimens from Mount Vernon, Wash., are slightly darker in color than specimens from Walla Walla, but the skulls are almost identical in essential characters with the type series. Specimens from Skykomish, Wash., are nearly as dark as typical *orarius*, but are referred to *schefferi* because of cranial characters which, although approaching *orarius*, are much nearer *schefferi*.

Specimens examined.—Total number, 59, as follows:

British Columbia: Chilliwack Valley, 2; Chiloweyuck Depot, 2; Fraser River (near New Westminster), 1;¹ Sumas, 6.

Oregon: McKenzie Bridge, 2; Three Sisters, 2; Vida, 4.

Washington: Easton, 4; Fort Walla Walla, 4; Lester, 4; Merritt, 5; Mount Vernon, 2; North Yakima, 5; Skykomish, 6; Walla Walla (type locality), 5; Wenatchee, 5.

SCAPANUS LATIMANUS LATIMANUS (Bachman).

CALIFORNIA MOLE.

(Pl. IV, fig. 4; Pl. V, figs. 3, 3a; Pl. VI, fig. 13.)

Scalops latimanus Bachman, Boston Journ. Nat. Hist., vol. 4, p. 34, 1842.

Scalops californicus Ayres, Proc. California Acad. Sci., vol. 1, p. 54, 1856. Type locality, San Francisco, California.

Scapanus californicus True, Proc. U. S. Nat. Mus., vol. 19, p. 52, December 21, 1896.

Scapanus latimanus Osgood, Proc. Biol. Soc. Washington, vol. 20, p. 52, April 18, 1907.

Scapanus latimanus latimanus Miller, U. S. Nat. Mus., Bul. 79, p. 9, December 31, 1912.

Type locality.—Probably Santa Clara, Santa Clara County, California.²

Type specimen.—Mounted specimen, with imperfect skull, in the Berlin Museum; collected during October, 1834.

Geographic range.—Western California west of the San Jacinto and Sacramento Valleys, from Santa Maria River north to Cape Mendocino, thence northeasterly to Klamath Canyon, Siskiyou County.

General characters.—Size medium (length of adults usually about 170 to 180 mm.); color fuscous or drab to chætura black, most frequently chætura drab; skull flat, rather massive in the maxillary

¹ Collection Amer. Mus. Nat. Hist.

² Vide Osgood, W. H., Proc. Biol. Soc. Washington, vol. 20, p. 52, 1907.

region; rostrum short and relatively heavy; unicuspid teeth irregular and crowded.

Color.—*Fresh winter pelage:* Above, fuscous-black, chætura drab, or chætura black; old and faded specimens more brownish, fuscous to mummy brown; beneath, much as above but paler, usually slightly more grayish, and frequently stained with brown mid-ventrally. *Summer pelage:* Usually paler and slightly more brownish than winter pelage, drab, hair-brown, or chætura drab, paler beneath. *Young:* Usually darker and more grayish than adults.

Skull.—Size medium, flat; sublachrymal-maxillary ridge heavy and well defined; rostrum short and broad; unicuspid teeth irregular in size, and crowded; second lower incisor caninelike, larger, and longer than either the first or the third incisor. The skull of *S. l. latimanus* is very much smaller than that of *S. townsendii*, the skulls of large adult males of *latimanus* being smaller than the skulls of small adult females of *townsendii*; the rostrum of *latimanus* is relatively shorter and broader than that of *townsendii*, and the unicuspid teeth are more irregular in size and shape, and more crowded. Compared with *S. o. orarius* the skull of *latimanus* is wider and much heavier, with less rounded and more truncate braincase, much shorter and broader rostrum, much heavier sublachrymal-maxillary ridges, larger teeth, and heavier horizontal rami of mandibles. The skull of typical *latimanus* is larger than that of any other subspecies of *S. latimanus* except *S. l. alpinus*, from which it is indistinguishable.

Measurements.—Adult male from Gilroy, Santa Clara County, Cal.: Total length, 173; tail vertebræ, 35; hind foot, 23. Average of 4 young adult males from Santa Cruz, Cal.: 175.8 (173–181); 33.3 (32–38); 20.8 (20–21). Average of 4 young adult females from Santa Cruz, Cal.: 171.5 (162–185); 32.5 (31–35); 20.8 (20–21). *Skull:* Adult male from Gilroy, Santa Clara County, Cal.: Greatest length, 36.2; palatilar length, 14.4; mastoidal breadth, 17.3; interorbital breadth, 7.8; maxillary tooth row, 11.2; mandibular molar-premolar row, 10.9. Average of 4 skulls of young adult males from Santa Cruz, Cal.: Greatest length, 36.1 (35.7–36.6); palatilar length, 14.2 (13.8–14.6); mastoidal breadth, 17 (16.9–17.3); interorbital breadth, 7.8 (7.5–8); maxillary tooth row, 11 (10.8–11.1); mandibular molar-premolar row, 10.6 (10.5–10.8). Average of 7 skulls of adult males from Nicasio, Cal.: Greatest length, 37.1 (36.6–37.4); palatilar length, 14.5 (14.3–14.7); mastoidal breadth, 17.3 (17–17.8); interorbital breadth, 7.8 (7.5–7.9); maxillary tooth row, 11.3 (11.1–11.6); mandibular molar-premolar row, 11 (10.7–11.4). Average of 4 skulls of young adult females from Santa Cruz, Cal.: Greatest length, 34.7 (34.4–35); palatilar length, 13.8 (13.4–14.1); mastoidal breadth, 16.8 (16.6–17); interorbital breadth, 7.8 (7.7–8); maxillary

tooth row, 10.7 (10.4–10.9); mandibular molar-premolar row, 10.3 (10.1–10.5). Average of 5 skulls of adult females from Nicasio, Cal.: Greatest length, 36 (35.3–36.6); palatilar length, 14.1 (13.7–14.5); mastoidal breadth, 16.9 (16.7–17.2); interorbital breadth, 7.7 (7.4–8.1); maxillary tooth row, 11.1 (10.8–11.4); mandibular molar-premolar row, 10.8 (10.3–11.1).

Remarks.—Bachman's name *latimanus* was placed in synonymy under *Scapanus townsendii* by Peters¹ where it remained until Osgood showed that it did not apply to *townsendii* but to the mole of west-central California, then known as *Scapanus californicus* (Ayres). Osgood writes:

As stated by Peters (loc. cit.), it [the type specimen] was transmitted by Deppe from Monterey, California. It was collected in October, 1834, at Santa Clara, not a Mexican locality,² as suggested by Peters, but doubtless the town of that name in California not very distant from Monterey. Only one species of mole is known to occur at this locality, and the specimen is typical of this species. The hind foot to end of claws measures 18.7 mm. The fragmentary skull, which Dr. Matschie caused to be removed from the mounted specimen, presents the following measurements, all decidedly smaller than *S. townsendii*: Length of upper tooth row from front of incisor to back of last molar, 15.4; of lower tooth row, 13.7; outside width at second upper molar, 10.2.³

The measurements given by Osgood are somewhat less than those of skulls of adults from the vicinity of Santa Clara, Cal., but this may possibly be due to immaturity of the type specimen. The animal is certainly not *townsendii*, and it seems best to accept Osgood's verdict and place *californicus* in synonymy under *latimanus*.

A skeleton⁴ of this species in the United States National Museum has been set aside as the type of *Scalops californicus* Ayres, and of it Lyon and Osgood state: "This skeleton is one of Dr. Ayres's original specimens, and probably the only one of them now in existence. It seems well to treat it as a type, although it was not so indicated by the original describer."⁵ However, there seems to be no good reason for designating this specimen as the type of *californicus*; it was entered in the museum catalogue February 14, 1857, but in the collection are two other specimens (alcoholic) which Lyon and Osgood apparently overlooked. One⁶ of these, without the date of collection, was entered in the catalogue May 4, 1857; the other,⁷ collected several weeks after Ayres had read his description before the California Academy of Sciences, was entered in the museum catalogue

¹ Peters, W., Monatsber. Konig. Preuss. Akad. Wissensch., Berlin, 1863, p. 656, 1864.

² At the time the specimen was collected California was part of Mexico. Peters, however, states "in Sta. Clara (Sonora?) gesammelt worden."

³ Osgood, W. H., Proc. Biol. Soc. Washington, vol. 20, p. 52, 1907.

⁴ No. 3111, U. S. Nat. Mus., skeleton (lacking right manus and forearm, and left last upper molar); collected at San Francisco, Cal., by Dr. W. O. Ayres.

⁵ Lyon, M. W., and Osgood, W. H., U. S. Nat. Mus., Bul. 62, p. 234, 1909.

⁶ No. 2673, U. S. Nat. Mus., alcoholic; collected at San Francisco, Cal., by Dr. W. O. Ayres.

⁷ No. 1288, U. S. Nat. Mus., alcoholic; collected at San Francisco, Cal., September, 1855, by Dr. W. O. Ayres.

February 4, 1856. Nothing in the original description would indicate that Ayres had any one particular specimen in mind; in the only place in his description where specimens are mentioned, he refers to the "color of fur, in the specimens seen."¹ Furthermore if Ayres set aside any specimen as the type it was probably in the Museum of the California Academy of Sciences, since preceding his original description the donation of five moles to the Academy was acknowledged and the following statement made concerning them: "In connection with these, Dr. Ayres presented the following description" (loc. cit.). It seems, therefore, that the specimens in the United States National Museum are not a part of Ayres's original series.

Slight local variations in size and shape of skull of *latimanus* might be worthy of subspecific recognition were they constant over any considerable geographic area. However, they are so slight and inconstant, and crop out so frequently, that to recognize them by subspecific appellation would only be confusing, and add nothing to the knowledge of the relationships of the group. Specimens from the coast region north of San Francisco Bay seem to average slightly larger and darker than typical specimens, but the difference is not sufficiently pronounced to warrant subspecific designation. Specimens examined from Klamath Canyon show little approach in color toward *S. l. dilatatus*, but the skulls are shorter than in typical *latimanus*, showing in this respect intergradation with *dilatatus*. Specimens from Lower Lake and Mount Sanhedrin are paler than typical *latimanus*, probably indicating an approach toward *dilatatus*. Intergradation with *S. l. occultus* occurs in the region between Santa Margarita, in San Luis Obispo County, and Santa Barbara; a specimen from the former locality is clearly intermediate, but appears to be nearer *latimanus*.

Specimens examined.—Total number, 171, as follows:

California: Aptos, 1; Bells Station, 1; Berkeley, 8; Berryessa, 1; Beswick, 2; Bodega, 1; Bolinas, 1;² Boulder Creek, 1; Brentwood, 1; Briceland, 1; Cahto, 2; Carmel Point, 1;³ Cazadero, 1; Colma, 1; Cuddeback, 2;² Eldridge, 7; Fort Bragg, 2; Freestone, 3;² Gilroy, 1; Gualala, 1; Guerneville, 3;² Haywards, 5; Hornbrook, 1; Inverness, 1; King City, 1; La Honda, 3;^{2,3} Lower Lake 2;⁴ Marin County, 1; Mendocino, 3;^{2,5} Menlo Park, 8;² Monterey, 1;⁴ Mount Sanhedrin, 1;² Napa, 1;² Nicasio, 54; Oakland, 4;⁶ Pacific Grove, 1; Palo Alto, 1;⁴ Petaluma, 2; Petrolia, 2; Piedmont, 1;² Point Arena, 1;² Point Reyes, 1; Red Bluff, 2;² Rockport, 2; San Francisco, 10; San Leandro, 3;² Santa Cruz, 9; Santa Margarita, 1;² Santa Rosa, 1;⁶ Scott River, Siskiyou County, 1;² Snow Mountain, Colusa County, 1;⁴ Stanford University, 1;² Stevens Creek, San Mateo County, 1;⁵ Walnut Creek, Contra Costa County, 2.²

¹ Ayres, W. O., Proc. California Acad. Sci., vol. 1, p. 54, 1856.

² Collection Mus. Vert. Zool., Univ. California.

³ Collection Amer. Mus. Nat. Hist.

⁴ Collection Mus. Comp. Zool., Harvard College.

⁵ Collection Field Mus. Nat. Hist.

⁶ Collection Milwaukee Public Mus.

SCAPANUS LATIMANUS OCCULTUS Grinnell & Swarth.

SOUTHERN CALIFORNIA MOLE.

(Pl. IV, fig. 5; Pl. VI, fig. 14.)

Scapanus latimanus occultus Grinnell & Swarth, Univ. California Publ. Zool., vol. 10, p. 131, April 13, 1912.

Type locality.—Santa Ana Canyon, west slope of north end of Santa Ana Mountains, Orange County, California; altitude 400 feet.

Type specimen.—No. 2369, Mus. Vert. Zool., Univ. California; ♀ young adult, skin and skull; collected September 20, 1908, by H. S. Swarth.

Geographic range.—Southern California west of the deserts, from Olancha, at the south end of Owens Lake, in Inyo County; Sanger, in Fresno County; and Santa Barbara, in Santa Barbara County, south to the San Diegan region.

General characters.—Size small (length of adults usually about 145 to 160 mm.); color in winter pelage paler and slightly more brownish than that of *S. l. latimanus*; color in summer pelage much like that of *latimanus*; skull small, weak; rostrum usually relatively longer and narrower than that of *latimanus*.

Color.—*Winter pelage*: In most specimens paler and more brownish than corresponding pelage of *S. l. latimanus*; upperparts chætura drab or fuscous, and occasionally, in much faded specimens, olive-brown or mummy brown; underparts somewhat paler and more grayish. *Summer pelage*: Very slightly paler than winter pelage; essentially like summer pelage of *latimanus*.

Skull.—Very similar to that of *S. l. latimanus* in general shape and proportions, but much smaller, and in most specimens with relatively longer and narrower rostrum.

Measurements.—Average of 13 young adult males from Compton, Los Angeles County, Cal.: Total length, 151.9 (140–165); tail vertebræ, 25.3 (22–29); hind foot (measured, from relaxed foot of dry skin, by the writer), 18.3 (17.5–19.5). Type (young adult female): 150; 33; 18. Two young adult females from Olancha, Owens Lake, Cal.: Total length, 148, 155; tail vertebræ, 30, 36; hind foot, 18, 19. *Skull*: Average of 13 skulls of young adult males from Compton, Los Angeles County, Cal.: Greatest length, 31.6 (30.7–32.8); palatilar length, 12.3 (12.1–12.8); mastoidal breadth, 15.4 (15–16); interorbital breadth, 7.1 (6.9–7.4); maxillary tooth row, 10 (9.7–10.3); mandibular molar-premolar row, 9.5 (9.3–9.9). Average of 4 skulls of adult males from Witch Creek, Cal.: Greatest length, 32.9 (32.6–33.5); palatilar length, 12.9 (12.7–13.2); mastoidal breadth, 15.8 (15.5–16.1); interorbital breadth, 7.3 (7.2–7.5); maxillary tooth row, 10.3 (10.1–10.5); mandibular molar-premolar row, 9.8 (9.6–10). Skull of type (young adult female): Greatest length, 31.5; palatilar

length, 12.3; mastoidal breadth, 15.6; interorbital breadth, 7.1; maxillary tooth row, 9.9; mandibular molar-premolar row, 9.4. Skulls of 2 young adult females from Olancha, Cal.: Greatest length, 31, 31.5; palatilar length, 12.2, 12.6; mastoidal breadth, 15.1, 15.6; interorbital breadth, 7.2, 7.3; maxillary tooth row, 9.9, 10; mandibular molar-premolar row, 9.4, 9.6.

Remarks.—The mole of southern California is constant in characters over its entire range. The type of *occultus* is a young adult female; it has abnormal mandibular teeth; the right first lower premolar is absent, and the left first lower premolar is crowded back and inward, close to the second premolar and in the same enlarged socket with it. Specimens from Witch Creek are slightly larger than those from the type region. Toward the northern border of its range the subspecies shows a gradual increase in size until it intergrades with *S. l. latimanus* in the region north of Santa Barbara County. A young adult male from Tehachapi and a specimen from Santa Barbara approach *latimanus* in size. A male from Porterville, Tulare County, is larger and slightly darker than typical specimens of *occultus*, and has a relatively narrower skull, probably showing in these respects a tendency towards *S. l. sericatus*. An imperfect skeleton, with broken skull, from Sanger, Fresno County, is provisionally referred to *occultus*; in dentition and in the size and proportions of the mandible it is indistinguishable from specimens from the type region. Two females from the south end of Owens Lake are almost indistinguishable from typical *occultus*, their only approach toward *S. l. grinnelli* being in slightly higher braincase. The relationships of *occultus* with *Scapanus anthonyi* are not clear, but the differences in size and color alone are sufficient to separate the two forms, even though it should ultimately be proven that the dentition of the type of *anthonyi* is abnormal (p. 76).

Specimens examined.—Total number, 73, as follows:

California: Alhambra, 10; Canyada Laga, 4 miles north of Ventura, 1;¹ Compton, 21; Julian, 2;² Los Angeles, 3; Olancha, 2; Pasadena, 2;² Porterville, 1; Riverside, 1; San Bernardino, 5; San Bernardino Peak, 1; San Diego County, 5; San Gabriel, 1; Sanger, 1;² San Jacinto Mountains, 2;² Santa Ana Canyon (type locality), 1;² Santa Barbara, 1; Sierra Madre, Los Angeles County, 1;² Somerset, 4; Tehachapi, 1; Ventura, 1;² Warner Pass, San Diego County, 1;² Witch Creek, 5.

SCAPANUS LATIMANUS GRINNELLI Jackson.

GRINNELL'S MOLE.

(Pl. IV, fig. 6; Pl. VI, fig. 15.)

Scapanus latimanus grinnelli Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 56, March 20, 1914.

Type locality.—Independence, Inyo County, California; altitude 3900 feet.

¹ Collection Milwaukee Public Mus.

² Collection Mus. Vert. Zool., Univ. California.

Type specimen.—No. 17785, Mus. Vert. Zool., Univ. California; ♂ adult, skin and skull; collected May 8, 1912, by H. A. Carr.

Geographic range.—Known only from type locality.

General characters.—Size small; very slightly larger than average specimens of *S. l. occultus* or *S. l. minusculus*; smaller than *S. l. sericatus*; color darkest of the *latimanus* group; skull short and high, broad interorbitally and through mastoids; rostrum short and wide.

Color.—Type, in worn and somewhat faded *winter pelage*: Upperparts between fuscous and fuscous-black; underparts more grayish, stained on the throat and chest with Dresden brown. Topotype, in *fresh summer pelage*: Upperparts fuscous-black; underparts dark mouse gray.

Skull.—Short and high, not much depressed postorbitally, broad interorbitally and through the mastoids; posterior base of zygoma with a small inconspicuous process on outer lateral margin; rostrum short and wide; angle of mandible short and heavy. The skull of *grinnelli* is about the size of large skulls of *S. l. occultus*, but differs from them, in its higher braincase, its shorter and much broader rostrum, and in being much wider interorbitally and through the mastoids. It is much smaller and relatively shorter and wider than the skull of either *S. l. latimanus* or *S. l. sericatus*.

Measurements.—Type (adult male): Total length, 156; tail vertebræ, 31; hind foot, 21. Topotype (adult female): Total length, 158; tail vertebræ, 36; hind foot, 20.5 *Skull*: Type (adult male): Greatest length, 33; palatilar length, 13.1; mastoidal breadth, 17; interorbital breadth, 7.8; maxillary tooth row, 10.4; mandibular molar-premolar row, 10. Skull of topotype (adult female): Greatest length, 32.2; palatilar length, 12.8; mastoidal breadth, 16.4; interorbital breadth, 7.8; maxillary tooth row, 10.3; mandibular molar-premolar row, 9.9.

Remarks.—This form is a well-marked subspecies which can be separated from *S. l. occultus* either by skin or skull characters. Intergradation with *occultus* probably occurs in the region north or west of Owens Lake; a very slight indication of such intergradation is noticeable in specimens of *occultus* from Olancha. The topotype is peculiar in that the left upper tooth row contains a supernumerary premolar, apparently the one immediately posterior to the canine and probably derived from the anlage of the first premolar. As is the case in some specimens of *S. townsendii*, previously mentioned, this is especially interesting, since it gives this individual one more tooth than the theoretically complete mammalian dentition of 44 teeth.

Specimens examined.—Two, from type locality.¹

¹ Collection Mus. Vert. Zool., Univ. California.

SCAPANUS LATIMANUS SERICATUS Jackson.

YOSEMITE MOLE.

(Pl. IV, fig. 7; Pl. VI, fig. 16.)

Scapanus latimanus sericatus Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 55, March 20, 1914.

Type locality.—Yosemite, Yosemite Valley, Mariposa County, California.

Type specimen.—No. 109548, U. S. Nat. Mus., Biological Survey collection; ♀ adult, skin and skull; collected August 20, 1901, by W. K. Fisher.

Geographic range.—Yosemite region, Mariposa County, Cal.

General characters.—Smaller than *S. l. latimanus*, darker and more grayish in fresh pelage; larger and darker than *S. l. occultus* or *S. l. minusculus*; claws, especially of fore feet, longer and more slender than those of *latimanus*; skull relatively long, narrow, and flat.

Color.—*Fresh summer pelage*: Upperparts fuscous-black; underparts more grayish, dark mouse gray. *Worn summer pelage*: Upperparts glossy olive-brown, underparts slightly paler.

Skull.—Relatively long, narrow, especially through mastoids; smaller than that of *S. l. latimanus*; larger than that of *S. l. occultus*, *S. l. minusculus*, or *S. l. grinnelli*; about equal in length to that of *S. l. dilatus*, but much narrower, and not so high through the braincase.

Measurements.—Two adult females, type and virtual topotype: Total length, 165, 171; tail vertebræ, 36, 34; hind foot, 21, 22. *Skull*: Skulls of two adult females, type and virtual topotype: Greatest length, 34.3, 34; palatilar length, 13.3, 13.7; mastoidal breadth, 16.2, 15.9; interorbital breadth, 7.2, 7.5; maxillary tooth row, 11, 10.8; mandibular molar-premolar row, 10.4, 10.4.

Remarks.—The skulls of the type and topotype¹ of *sericatus* show minor differences, but in essential features they are remarkably alike. They are very unlike the skull of *S. l. minusculus*, being distinctly larger, and with different proportions. The subspecies *sericatus* is intermediate in size between *S. l. latimanus* and *S. l. occultus*, and in fresh pelage is darker than either. The type of *sericatus* is mostly in worn summer pelage, fresh pelage appearing on the abdomen and flanks; the topotype is in fresh summer pelage. An adult male from Bower Cave, Mariposa County, is not typical of the subspecies; it has a shorter tail than specimens from the Yosemite Valley, and the skull is flatter and wider through the braincase than that of typical *sericatus*.

Specimens examined.—Total number, 3, as follows:

California: Bower Cave, 1; Yosemite (type locality), 1; Yosemite Valley, 1.²

¹ No. 12980, Mus. Vert. Zool., Univ. California.² Collection Mus. Vert. Zool., Univ. California.

SCAPANUS LATIMANUS MINUSCULUS Bangs.

SIERRA MOLE.

(Pl. IV, fig. 8; Pl. VI, fig. 17.)

Scapanus californicus minusculus Bangs, Proc. New England Zool. Club, vol. 1, p. 70, July 31, 1899.

Scapanus latimanus minusculus Miller, U. S. Nat. Mus., Bul. 79, p. 10, December 31, 1912.

Type locality.—Fyffe, El Dorado County, California.

Type specimen.—No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ young adult, skin and skull; collected July 15, 1897, by W. W. Price and E. M. Nutting.

Geographic range.—Known only from type locality.

General characters.—Similar in size and color to *S. l. occultus*, possibly very slightly larger; skull higher and narrower through braincase than that of *occultus*; inferior mandibular notch very shallow, the angle of mandible being much shorter than in *occultus*.

Color.—Type, in *summer pelage*: Upperparts hair-brown; underparts deep mouse gray.

Skull.—Much like that of *S. l. occultus*, but braincase narrower, higher, and more rotund; inferior mandibular notch very shallow, much shallower than in *occultus*; angle of mandible short and weak.

Measurements.—Type (young adult female): Total length, 160; tail vertebræ, 31; hind foot, 21. *Skull*: Type (young adult female): Greatest length, 31.9; palatilar length, 12.6; mastoidal breadth, 15.3; interorbital breadth, 7.1; maxillary tooth row, 10; mandibular molar-premolar row, 9.7.

Remarks.—The type and only-known specimen of *minusculus* is a female, barely adult, the status of which can not be determined until more specimens are obtained from the type locality. The essential differences from *S. l. occultus* are in the skull, which is relatively narrower and higher and with the inferior mandibular notch very shallow; the hind foot is longer than that of *occultus*. This form, however, seems to be isolated from *occultus* by the interception of *sericatus*. In color the type of *minusculus* is much like some specimens of *S. l. dilatus*.

Specimen examined.—One, the type.

SCAPANUS LATIMANUS DILATUS True.

KLAMATH MOLE.

(Pl. IV, fig. 9; Pl. VI, fig. 18.)

Scapanus dilatus True, Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

Scapanus truei Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 102, April 26, 1897.

Type locality, Lake City, Modoc County, California.

Scapanus truei (sic) Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 469, 1905.

Type locality.—Fort Klamath, Klamath County, Oregon.

Type specimen.—No. 186628, U. S. Nat. Mus., Merriam collection; adult, sex unknown, skeleton; collected in 1883 by Charles E. Bendire.

Geographic range.—South-central Oregon and Upper Sonoran and Transition Zones of northeastern California and adjacent parts of Nevada.

General characters.—Similar to *S. l. latimanus*, but much paler and averaging slightly smaller; skull shorter, higher, and more rotund than in *latimanus*.

Color.—*Summer pelage*: Upperparts mouse gray, light drab, or drab, in some specimens becoming more brownish on the nose; underparts neutral gray, mouse gray, or smoke gray, sometimes tinged with light drab and occasionally stained in midventral line with Dresden brown.

Skull.—Smaller than that of *S. l. latimanus* or *S. l. alpinus*, relatively shorter, higher through the braincase, and relatively wider through the mastoids. About equal in length to the skull of *S. l. sericatus*, but relatively much wider and higher through the braincase.

Measurements.—Two adult males from McCloud, Cal.: Total length, 178, 170; tail vertebræ, 36, 42; hind foot, 21, 21. *Skull*: Type (sex unknown): Greatest length, 34.3; palatilar length, 13.6; mastoidal breadth, 16.8; interorbital breadth, 7.8; maxillary tooth row, 10.4;¹ mandibular molar premolar row, 10.3. Skulls of two adult males from McCloud, Cal.: Greatest length, 34.7, 35.2; palatilar length, 13.2, 13.7; mastoidal breadth, 17.3, 17.3; interorbital breadth, 7.8, 7.9; maxillary tooth row, 9.8, 10.3; mandibular molar premolar row, 9.5, 9.5.

Remarks.—True based his description of this form entirely upon the cranial characters of a specimen with abnormal dentition, there being in the type only three maxillary premolars. Later he placed the name in synonymy² under *Scapanus californicus* (= *S. l. latimanus*). The skull of the type, however, is relatively shorter and broader than that of typical *latimanus*. Unfortunately the exact color of the mole found at Fort Klamath, Oreg., is not known, there being no skins available from that locality; two alcoholics from the type locality, however, seem to indicate that the animal is pale, like the mole of northeastern California; from a geographic view point this is what one would anticipate; specimens from Ashland and Fremont, Oreg., are pale, like specimens from northeastern California, and those from Ashland have skulls inseparable from the skull of the type of *dilatatus*. The type of *Scapanus truei* Merriam, which is now placed in synonymy under *dilatatus*, is a rather

¹ Upper tooth formula abnormal: i. 3, c. 1, pm. 3, m. 3.

² True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 52, 1896.

young adult collected at Lake City, Modoc County, Cal.; in the original description Merriam mentions the following cranial and dental characters:

Skull similar to that of *S. californicus*, but slightly smaller, with narrower palate and decidedly narrower and more slender rostrum. Last upper premolar with a strongly developed, trenchant inner cusp, not present in *californicus*.¹

The narrowness of the palate and rostrum is probably due in part to immaturity; the skull of a young adult female, which has been removed from an alcoholic specimen² from Fort Klamath, has the rostrum as narrow as that of the type of *truei* though it is slightly shorter. The presence of an inner cusp on the last upper premolar is not of diagnostic value. In any large series of *Scapanus* from a single locality this cusplike process may be present in various stages of development in about half the specimens; it appears more frequently in skulls of young individuals and seems to be absorbed with age. In the type of *truei* this accessory cusp has about reached its maximum development, yet in a specimen³ collected as nearby as Cedarville, Modoc County, there is a barely perceptible trace of a cusp.

Considerable local geographic variations are observed in this form, but to recognize them by subspecific names would only be confusing. With a large series of specimens available from each of many localities it would be possible to learn more of the extent and relationships of these variations. Specimens from the upper Sacramento Valley show intergradation with *S. l. latimanus*, the color darkening and the skulls becoming larger and more elongate. A specimen from Fremont, Oreg., has certain cranial characters which suggest that *dilatatus* may possibly intergrade with *S. o. schefferi* in central Oregon.

Specimens examined.—Total number, 44, as follows:

California: Auburn, 1; ⁴ Baird, 1; Bald Mountain, 1; Cedarville, 1; ⁵ Chico, 1; Fort Crook, 1; Hayden Hill, 1; Lake City, 1; McCloud, 2; McCloud River, 1; ⁶ Millford, 2; Mosquito, El Dorado County, 1; ⁶ Mount Shasta, 1; Nevada City, 1; Parker Creek, Warner Mountains, 1; ⁵ Plumas County, 1; ⁷ Prattville, 1; Quincy, 4; Red Point, 1; ⁴ Round Mountain, Shasta County, 1; Sisson, 6; ⁵ Susanville, 4; ⁴ Tower House, Shasta County, 1.⁵

Nevada: Holbrook, 1.

Oregon: Ashland, 3; Fort Klamath (type locality), 3; Fremont, 1.

¹ Merriam, C. H., Proc. Biol. Soc. Washington, vol. 11, p. 102, 1897.

² No. 186627, U. S. Nat. Mus., Merriam collection.

³ No. 16723, Mus. Vert. Zool., Univ. California.

⁴ Collection Stanford Univ.

⁵ Collection Mus. Vert. Zool., Univ. California.

⁶ Collection Amer. Mus. Nat. Hist.

⁷ Collection Carnegie Mus.

SCAPANUS LATIMANUS ALPINUS Merriam.

MOUNT MAZAMA MOLE.

Scapanus alpinus Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 102, April 26, 1897.

Type locality.—Crater Lake, Mount Mazama, Klamath County, Oregon; altitude about 7000 feet.

Type specimen.—No. 79967, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected August 18, 1896, by Vernon Bailey.

Geographic range.—Known only from type locality.

General characters.—About the size of large specimens of *S. l. latimanus*, but much paler; hind foot large; indistinguishable in color from *S. l. dilatatus*, but larger; skull like that of large specimens of *latimanus*, and much larger, flatter, and relatively longer and narrower than that of *dilatatus*.

Color.—Worn summer pelage (type): Upperparts mouse gray; underparts (much worn) deep mouse gray; faded unworn pelage on throat and chest with a distinct buffy sheen.

Skull.—Similar to that of *S. l. latimanus*; indistinguishable from skulls of large adult males of *latimanus*.

Measurements.—Type (adult male): Total length, 188; tail vertebrae, 38; hind foot, 24.5 *Skull*: Type (adult male): Greatest length, 36.9; palatilar length, 14.6; mastoidal breadth, 17; interorbital breadth, 7.9; maxillary tooth row, 11.4; mandibular molar-premolar row, 11.3.

Remarks.—The subspecies *alpinus* is a poorly differentiated form having the color of *S. l. dilatatus* and the size and skull proportions of large specimens of *S. l. latimanus*; it is not strictly intermediate between these two forms, however, since specimens of *latimanus* from southwest of Klamath Lake do not reach the maximum size. The type is a very old male with much-worn teeth; the skull is flattened by age and the cusps of the teeth are reduced through wear and absorption.

Specimen examined.—One, the type.

SCAPANUS ANTHONYI Allen.

ANTHONY'S MOLE.

(Pl. IV, fig. 10; Pl. V, figs. 4, 4a; Pl. VI, fig. 19.)

Scapanus anthonyi Allen, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, August 18, 1893.

Type locality.—San Pedro Martir Mountains, Lower California; altitude 7000 feet.

Type specimen.—No. $\frac{6313}{4947}$, Amer. Mus. Nat. Hist.; ♂ adult, skin and skull; collected May 8, 1893, by A. W. Anthony.

Geographic range.—Known only from type locality.

General characters.—Size, smallest of the genus; feet and hands small; in superficial appearance much like *S. l. occultus*, but smaller and darker; skull smaller than that of *occultus*, flatter, and with relatively shorter rostrum; premolars $\frac{3}{3}$.

Color.—Type: Upperparts between fuscous and fuscous-black; underparts hair-brown to fuscous.

Skull.—Smallest of the genus; in general appearance and proportions similar to that of *S. l. occultus*, but smaller, flatter, and with relatively shorter rostrum; each of the parietals of *occultus* has a small posterior projection, extending between the interparietal and the mastoid, which is not present on the parietals of the type of *anthonyi*; premolars, $\frac{3}{3}$.

Measurements.—Type (adult male): Total length, 135; tail vertebrae, 26; hind foot (measured by the writer from relaxed foot of dry skin), 17. *Skull:* Type (adult male): Greatest length, 30.1; palatilar length, 12; mastoidal breadth, 16.2; interorbital breadth, 7; maxillary tooth row, 9.3; mandibular molar-premolar row, 9.

Remarks.—As previous descriptions of the type and only-known specimen of *anthonyi* have been somewhat inaccurate, particular care has been taken in the present description and measurements. Allen¹ gave the breadth of the interorbital constriction as 7.6 mm., an error probably due to inaccurate measuring instruments. Allen (loc. cit.) claimed that the fourth premolar on one side was wanting and on the other was rudimentary; True² in a footnote states that he finds "only three premolars on either side," but elsewhere (loc. cit., p. 51) gives the premolar formula as $\frac{3}{4}$. As a matter of fact, the premolar formula is $\frac{3}{3}$; True has correctly indicated this in his sketch (loc. cit., pl. 3, fig. 6) of the mandible. It is not the fourth premolar that is lacking, but either the first or second, probably the first. It seems possible that the dentition of the type is abnormal; however, the reduction of the premolars by one occurs uniformly in each tooth row. It will be impossible to know the exact status of the form until more specimens are available from the region of the type locality. Full specific rank is here given the form because of the absence of evidence showing intergradation with the nearest geographic neighbor, *S. l. occultus*. The type of *anthonyi* is a fully adult male, and if it represents an average specimen of the form, its size and color alone are sufficient characters by which to separate it from *occultus*.

Specimen examined.—One, the type.

¹ Allen, J. A., Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, 1893.

² True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 53, 1896.

Genus PARASCALOPS True.

Parascalops True, Proc. U. S. Nat. Mus., vol. 27, p. 242, April 26, 1894.

Parascalops Beddard, Cambridge Nat. Hist., vol. 10, p. 518, 1902.

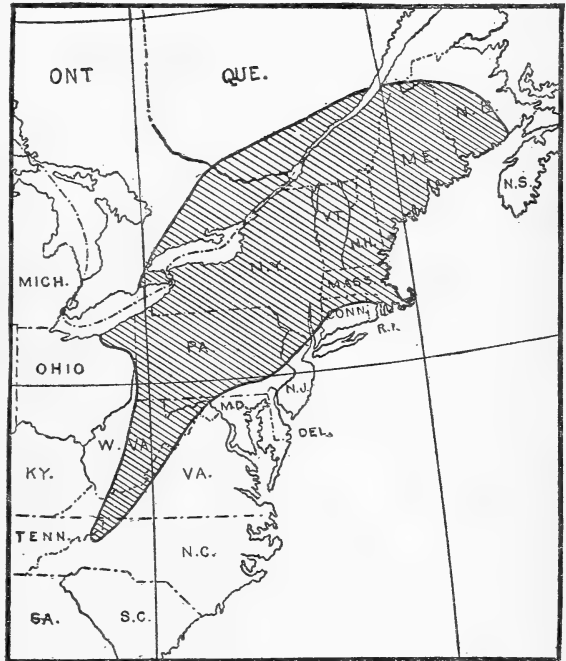
Type species.—*Scalops breweri* Bachman.

Geographic range.—Southeastern Canada and northeastern United States from southern New Brunswick, southern Quebec, and eastern Ontario, south to northeastern Ohio and southern Pennsylvania; and in the Appalachian Mountains to western North Carolina (fig. 13).

External characters.—Body robust, not much depressed; tail short (relatively longer than in *Scalopus*), round, thick, and fleshy, slightly constricted at base,

annulated, densely covered with rather long, coarse hairs (fig. 14). Head conoidal, depressed. Nose developed into a conical snout (shorter than in *Scalopus* or *Scapanus*), with a superior longitudinal median groove extending the anterior half of its length; nostrils lateral, crescentic, with concavities upward (fig. 15). Eyes minute, concealed in fur. Auricular orifices relatively large. Legs short. Feet large, fleshy, sparsely haired above, naked below. Fore feet handlike, the palms as broad as long (fig. 16). Soles of hind feet each with two tubercles and a distinct heel-pad (fig. 17). Toes not webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and slender. Fur dense, soft, and silky (coarser than in *Scalopus* or *Scapanus*), the hairs nearly equal in length, producing a velvetlike pelage. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.

Skeletal characters.—Clavicle relatively longer and weaker than in *Scalopus* or *Scapanus*, length about equal to breadth, penetrated antero-posteriorly by a foramen near the inferior border. Humerus



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FIG. 13.—Geographic range of the species *Parascalops breweri*.

heavy, about two-thirds as broad as long. Pelvis narrow, bones of opposite sides not touching under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra with a small, cuneate, longitudinal process. Os falciforme short, reaching proximal end of first metacarpal; broad and triangular at base, abruptly tapering into a narrow apical process.



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FIG. 14.—Tail of *Parascalops breweri* ($\times 1\frac{1}{2}$). No. 186618, U. S. Nat. Mus., Merriam collection; from Locust Grove, N. Y.

Skull conoidal (less so than in *Scalopus*), flat (less so than in *Scalopus* or *Scapanus*), somewhat elongate, with moderately broad braincase, slightly constricted inter-orbitally. Mastoids moderately heavy. Interparietal moderately large (smaller than in *Scapanus*, larger than in *Scalopus*), somewhat rectangular, breadth about one-third the length, emarginate posteriorly and usually anteriorly also, with a posterior median projection. Frontal region depressed; frontal sinuses moderately swollen. Rostrum moderately long; anterior ends of premaxillæ slightly thickened and extending beyond nasals, forming a truncate notch anterior to nasals. Anterior nares opening forward. Zygomata moderately long, relatively heavy, considerably out-curved, the posterior end attached about medially on squamosal. Foramen magnum oval, of moderate size. Infraorbital foramen relatively small (about as in *Scapanus*), the plate forming its outer wall moderately broad (relatively broader than in *Scalopus* or *Scapanus*). Audital bullæ incomplete; no auditory meatus. External pterygoid region moderately inflated (less so than in *Scapanus*) both posteriorly and anteriorly. Mesopterygoid space relatively long and narrow, the sides nearly straight and slightly converging posteriorly. Palate moderately elongate, relatively narrow, terminating opposite posterior edge of last molar; posterior border of

palate emarginate, without spine or notch. Anterior palatine foramina moderate



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FIG. 15.—Snout of *P. breweri* ($\times 1\frac{1}{2}$). Individual referred to in fig. 14.

(relatively larger than in *Scapanus*), oval; first pair of posterior palatine foramina moderate, oval to elliptical; second pair, minute or obsolete. Horizontal ramus of mandible moderately heavy, curved upward at posterior end and downward at anterior end; coronoid elongate, quadrate, truncate, directed slightly forward; angle of

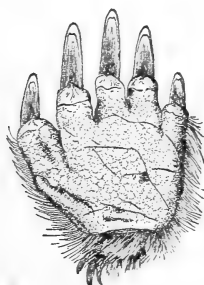
mandible relatively weak (about size of coronoid); inferior mandibular notch broad and shallow.

Dental characters.—First upper incisor short, broad, and flat, with a distinct small external accessory cusp; second and third upper incisors, upper canine, and first, second, and third upper premolars simple, conical, of moderate size, subequal (except canine which is larger), about half as high as first incisor; fourth premolar much larger than third, with anterior cusp, and with narrow interior basal ledge slightly bilobed. Upper molars W-shaped in transverse section, with an internal basal shelf distinctly trilobed in first and second premolars and indistinctly bilobed in the third; second molar slightly smaller than first, the third much smaller than second.

First lower incisor small, simple, slightly flattened; second lower incisor larger than first, conical, somewhat caninelike; third lower



FIG. 16.—Fore foot of *P. breweri* (X1½). Individual referred to in fig. 14.



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FIG. 17.—Hind foot of *P. breweri* (X1½). Individual referred to in fig. 14.

incisor small (about size of first), conical. Lower canine, and first, second, and third lower premolars essentially similar to third incisor. Fourth premolar about one-third larger than third, the posterior base with a small cusplike shelf or heel. Lower molars M-shaped in transverse section, both antero- and postero-internal cusps bilobed; first and second molars each with a postero-internal basal accessory cusp; second and third molars each with an antero-internal basal accessory cusp; first and second molars subequal, the third much smaller. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{4}{4}$; m. $\frac{3}{3}$; total 44.

PARASCALOPS BREWERI (Bachman).

HAIRY-TAILED MOLE.

(Pl. IV, fig. 11; Pl. V, figs. 5, 5a; Pl. VI, fig. 20.)

Talpa Europæa Harlan (nec *Talpa europæa* Linnæus, 1758), Fauna Amer., p. 43, 1825.
Talpa americana Harlan (Bartram ms.) (misidentified with *Talpa europæa* Linnæus, 1758), Fauna Amer., p. 43, 1825.

Scalops Breweri Bachman, Boston Journ. Nat. Hist., vol. 4, p. 32, 1842.

[*Scapanus*] *breweri* Pomel, Archiv. Sci. Physiques et Nat., tome 9, p. 247, 1848.

T[alpa] reposta Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Type locality unknown.

T[alpa] Breweri Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Scapanus americanus Coues (based erroneously on *Talpa americana* Harlan [Bartram ms.], 1825, qui *Talpa europæa* Linnæus, 1758), Amer. Nat., vol. 13, p. 190, 1879.

Scaphanus (sic) *breweri* Herrick, Geol. & Nat. Hist. Surv. Minnesota, Bul. 7, p. 55, 1892.

Parascalops breweri True, Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

Type locality.—Marthas Vineyard, Massachusetts.

Type specimen.—None known to exist.

Geographic range.—That of the genus (see p. 77).

General characters.—Size medium (length averaging about 155 mm.); nostrils lateral, crescentic, with concavity upward; tail short, thick, densely covered with hair; color dark; usually fuscous-black or chætura black; skull flat; audital bullæ incomplete; rostrum slender; first upper incisors with a distinct external accessory cusp.

Color.—General tone, fuscous-black, chætura black, or chætura drab, slightly paler and more grayish on underparts; hairs on feet, and usually on nose and tail, more brownish, often becoming white in old adults; throat and underparts sometimes stained with Dresden brown or Saccardo's umber. The color in study skins soon fades and becomes slightly brownish.

Skull.—Size medium (length about 32 mm.), flat, depressed post-orbitally, especially in adults, slightly constricted interorbitally; zygomata moderately heavy; pterygoids small; audital bullæ incomplete; auditory meatus absent; rostrum narrow; dentition moderate; first upper incisor with distinct outer secondary cusp; internal edge of second upper molar trilobed.

Measurements.—Average of 8 adult males from Magnetic City, N. C.: Total length, 149.5 (139–152); tail vertebræ, 30 (23–36); hind foot, 19.5 (18–20). Average of 2 adult females from Lunenburg, Mass.: 153 (153–153); 29.5 (27–32); 18.5 (18–19). *Skull*: Average of 10 skulls of adult males from Magnetic City, N. C.: Greatest length, 32.4 (31–33.8); palatilar length, 12.6 (12.1–13.1); mastoidal breadth, 14.5 (13.9–15); interorbital breadth, 7.3 (7.1–7.5); maxillary tooth row, 9.9 (9.2–10.2); mandibular molar-premolar row, 9.5 (8.9–9.8). Skull of adult female from Lunenburg, Mass.: Greatest length, 31.2; palatilar length, 12.2; mastoidal breadth, 14.3; interorbital breadth, 7.2; maxillary tooth row, 9.6; mandibular molar-premolar row, 9.3.

Remarks.—Bartram was apparently the first to recognize this form, to which he gave the manuscript name *Talpa americana*. Harlan¹ placed *Talpa americana* (Bartram ms.) in synonymy under *Talpa europæa* Linnæus, apparently failing to distinguish the two forms

¹ Harlan, R., Fauna Amer., p. 43, 1825.

even with the Bartram manuscript in hand. Bachman¹ described the species in 1842 under the name *Scalops breweri*, basing his description upon a specimen "found by Dr. L. M. Yale, at Martha's Vineyard, an Island on the coast of New England." Coues,² however, in 1879 applied the name *Scapanus americanus* to this species on the ground that Harlan's description was "applicable neither to *Scalops* [= *Scalopus*] nor to *Talpa*" and that "he [i. e. Harlan] really had in view an American mole, which he recognized as distinct, both generically and specifically, from our common *Scalops aquaticus*." The name *Talpa americana* Harlan (Bartram ms.), however, is untenable for several reasons: Harlan placed it in synonymy under *Talpa europæa* Linnæus (loc. cit.); Harlan actually misidentified the American animal with *Talpa europæa* Linnæus, as is evident from his mentioning in his introduction a species of mole as common to both continents,³ and, by process of eliminating those species which he distinctly refers in his descriptions to an American distribution, it becomes evident that the animal he meant was *Talpa europæa* Linnæus; furthermore, Harlan's description, as has been shown by True,⁴ is a translation, word for word (with a very few omissions) of Desmarest's⁵ description of *Talpa europæa* Linnæus.

The description of *Talpa reposta* Le Conte is based upon a specimen from an unknown locality and seems to refer to a specimen of *Parascalops breweri* with slightly abnormal teeth.

The hairy-tailed mole shows remarkably little geographic variation, and such as does occur is obliterated by individual variation. This variation is manifest mostly in size, and, in adults, size variation may reach about 5 per cent below or above the average at a given locality. White spots and blotches on the ventral parts of a few specimens of young, as well as of adults, indicate an occasional tendency toward partial albinism. In extreme old age the skull flattens and becomes much depressed postorbitally. A most peculiar change associated with old age is that, in many specimens examined, the hair on the nose and tail is white; in other specimens, somewhat younger but distinctly adult, some of the hairs on the nose and tail are normally colored, others are white. This peculiar senile variation is not confined to any particular region, but seems to be more prevalent north of Pennsylvania.

The hairy-tailed mole is rather rare and local in distribution, and difficult to trap. It is, therefore, quite probable that in the course of time its known geographic range may be extended considerably.

¹ Bachman, J., Boston Journ. Nat. Hist., vol. 4, p. 32, 1842.

² Coues, E., Amer. Nat., vol. 13, pp. 189-190, 1879.

³ Harlan, R., Fauna Amer., p. viii, 1825.

⁴ True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 76, 1896.

⁵ Desmarest, A. G., Mammalogie, 1^{re} partie, p. 160, 1820.

Bachman¹ lists it from Georgia but does not mention any specimen or definite locality. The writer has seen only three specimens from Canada: One from Quebec, Quebec, is in the United States National Museum; another, a flat skin without skull, was collected at Meaches Lake, Quebec, and is in the Victoria Memorial Museum at Ottawa; the third is a skeleton collected at Saint Catharines, Ontario, and is in the exhibition cases of the United States National Museum. Chamberlain² records seeing a specimen from Charlotte County, New Brunswick. Specimens have been collected in Ontario, "near Ottawa,"³ and at Guelph⁴ and Acton.⁵ Nash⁶ records specimens from several counties in Ontario, but mentions no specific localities.

Specimens examined.—Total number, 129, as follows:

Connecticut: West Winsted, 1.

Maine: Lake Umbagog, 1.

Massachusetts: Harvard, 1;⁷ Lunenburg, 3.

New Hampshire: Dublin, 1; Ossipee, 1; Webster, 2.⁸

New York: Elizabethtown, 1;⁸ Lake George, 7; Lansing, 3;^{9, 10} Locust Grove, 16; Oswego, 1;¹⁰ Plateau Mountain, Catskills, 1; Peterboro, 3; Waterville, 1.

North Carolina: Magnetic City, foot of Roan Mountain, 31; Roan Mountain (altitude 3000 feet), 1.

Ohio: Cleveland, 1; Ellsworth, 2; Ravenna, 3.¹⁰

Ontario: St. Catherines, 1.

Pennsylvania: Allegheny County, 1; Brownsburg, 1;¹¹ Carnot, 1;¹² Erie, 1;¹⁰ Leasuresville, 9; New Lexington, 1;¹² Ohiopyle, 1;¹² Pittsburgh, 4;¹² Warren, 1.¹²

Quebec: Meaches Lake, Wright County, 1;¹³ Quebec, 1.

Vermont: East Wallingford, 5.¹⁴

Virginia: Mountain Lake, 1; Mount Rogers, 1.

West Virginia: Cranberry Glades, 1; Franklin, 1; Traveller's Repose, 1; Wetzel County, 1; White Sulphur Springs, 15.^{8, 9, 10, 11}

Genus **CONDYLURA** Illiger.

Condylura Illiger, Prod. Syst. Mamm. et Avium, p. 125, 1811.

Talpasorex Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. *Nec Talpasorex* Lesson, 1827.

Astomycter Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]).

Rhinaster Wagler, Nat. Syst. Amphib., p. 14, 1830.

Condytura Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 994, 1839.

¹ In White, G., Statistics of the State of Georgia, Fauna and Flora, p. 4, 1849.

² Chamberlain, M., Bul. Nat. Hist. Soc. New Brunswick, no. 3, p. 39, 1884.

³ Whiteaves, J. F., Ann. Rept. Dept. Interior Canada for 1888, part 3 (Geol. Surv.), p. 36, 1889.

⁴ Goldie, A., Ontario Nat. Sci. Bul., No. 3, p. 40, 1907.

⁵ Moore, T. J., Ontario Nat. Sci. Bul., No. 3, p. 41, 1907.

⁶ Nash, C. W., Check List of Vertebrates of Ontario, p. 26, 1906.

⁷ Collection of Hartley H. T. Jackson.

⁸ Collection Mus. Comp. Zool., Harvard College.

⁹ Collection Field Mus. Nat. Hist.

¹⁰ Collection Amer. Mus. Nat. Hist.

¹¹ Collection Acad. Nat. Sci. Philadelphia.

¹² Collection Carnegie Mus.

¹³ Collection Victoria Mem. Mus.

¹⁴ Collection of D. E. Kent, Rutland, Vermont.

Astromyctes Gray, List Spec. Mamm. Brit. Mus., p. 76, 1843.

Astromyctes Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863.

Condylus Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913.

Type species.—*Sorex cristatus* Linnæus.

Geographic range.—Southeastern Canada and northeastern United States, from southern Labrador, central Quebec and Ontario, and



FIG. 18.—Geographic range of the species *Condylura cristata*.

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southeastern Manitoba, south to northeastern Illinois and northern Indiana and Ohio; in the Atlantic coast region south to Virginia (Dismal Swamp) and Georgia (Marlow); and in the Appalachian Mountains to western North Carolina (fig. 18).

External characters.—Body semirobust, not much depressed. Tail relatively long (about equal in length to body without head),

distinctly annulated, scaled, and covered with coarse blackish hairs; in summer the tail is slender, slightly depressed, gradually tapering apically, and slightly constricted proximally; in winter it is greatly enlarged, thick and fleshy, gradually tapering apically, and abruptly much constricted at the base (fig. 19). Head narrow, not much depressed. Snout moderately elongate, terminating in a naked disk surrounded on its margin by a fringe of twenty-two nasal processes symmetrically arranged, eleven on each side of a median line (fig. 20). Nostrils nearly circular, situated in anterior surface of nasal disk. Eyes small (relatively large for *Talpidae*; larger than in *Scalopus*, *Scapanus*, or *Parascalops*), concealed in fur. Auricular orifice large. Legs short; weaker than in *Scalopus*, *Scapanus*, or *Parascalops*. Feet large, not especially fleshy, scaled, scarcely haired above, naked below. Fore feet handlike, the palms as broad as long, toes relatively long; first, second, third, and fourth toes each with three flat, triangular processes on outer inferior edge, the basal process on the first toe being small and inconspicuous. Fore claws relatively long, broad (but narrower than in *Scalopus*, *Scapanus*, or *Parascalops*), depressed, the superior surface turned obliquely outward (fig. 21). Hind feet relatively long and narrow, broader apically than basally; a large depressed triangular plantar tubercle lies near the base of the first digit, and distally and inwardly on the sole are five small tubercles. Hind claws relatively long, laterally compressed, the outer surface turned obliquely upward (fig. 22). Toes not webbed. Fur dense, long, and silky (relatively coarser than in *Scalopus*, *Scapanus*, or *Parascalops*); some of the hairs longer and coarser than the major portion, which forms a distinct underfur. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.



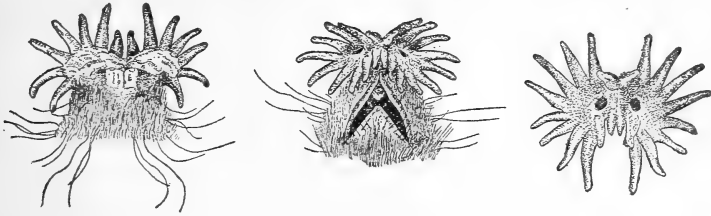
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FIG. 19.—Tail of *Condylura cristata* (X 1½). Autumnal enlargement scarcely begun. No. 144473, U. S. Nat. Mus.; from Egelston township, Muskegon County, Mich., August 20, 1906.

Skeletal characters.—Clavicle relatively long and narrow (for *Talpidae*), length about twice the breadth, slightly concave superiorly and convex inferiorly, not penetrated by a foramen. Humerus about two-thirds as broad as long, much weaker medially than in *Parascalops*. Pelvis narrow, bones of opposite sides not touching under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra with a distinct, flat, deltoid, longitudinal process. Os falciforme small but distinct, short, reaching proximal end of first metacarpal; moderately broad, not much tapering distally.

Skull long and narrow, not much flattened, with relatively high and narrow braincase, not constricted interorbitally, tapering

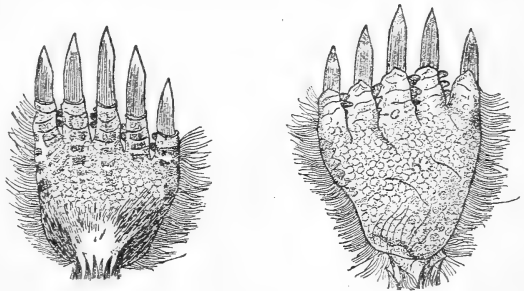
distally. Mastoids weak. Interparietal large, broad, irregularly crescentic, anteriorly deeply emarginate medially, posteriorly broadly



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FIG. 20.—Snout of *C. cristata* ($\times 1\frac{1}{2}$). Individual referred to in fig. 19.

emarginate with a posterior median projection. Frontal region sloping ventrally anteriorly; frontal sinuses scarcely swollen. Rostrum long and narrow, in adults with a distinct basal supero-median crest; infero-anterior ends of premaxillæ extending much beyond nasals; supero-anterior ends of premaxillæ barely reaching beyond nasals; nasals in adults terminating anteriorly in an acute median point.



B2027-103

FIG. 21.—Fore foot of *C. cristata* ($\times 1\frac{1}{2}$). Individual referred to in fig. 19.

Anterior nares opening obliquely upward. Zygomata short, narrow, straight, directed obliquely downward anteriorly, the posterior end well forward on squamosal. Foramen magnum elliptical, large. Infraorbital foramen very large, the plate forming its outer wall relatively very narrow. Audital bullæ incomplete; no auditory meatus. External pterygoid region scarcely inflated. Mesopterygoid space long and broad, the sides converging posteriorly (pterygoids, however, slightly diverging). Palate elongate, very narrow, terminating opposite anterior border of last molar; posterior border of palate deeply emarginate, frequently with a median spine. Anterior palatine foramina minute; posterior palatine foramina very large and conspicuous,



B2028-103

FIG. 22.—Hind foot of *C. cristata* ($\times 1\frac{1}{2}$). Individual referred to in fig. 19.

the first pair¹ reniform or elliptical-oval and about twice as large as the second pair which are usually elliptical. Horizontal ramus of mandible weak, curved upward posteriorly, straight anteriorly; coronoid moderately long, somewhat broad, but relatively weak, erect, slightly acute; angle of mandible very long and slender (much longer and narrower than coronoid), the inferior edge turned inward; inferior mandibular notch large and angular.

Dental characters.—First upper incisor large, semioval, curved inward and directed anteriorly; second upper incisor linear, minute, lying close under base of first incisor; third upper incisor lateral, large, elongate, caninelike, with a small postero-basal tubercle disappearing with age. Upper canine short and slender (less than half dimensions of third incisor), conical. First, second, and third upper premolars small, laterally compressed, successively increasing in size posteriorly, each with an anterior and a posterior basal tubercle; fourth upper premolar similar to third, much larger, with an interior basal cusplike process. Upper molars W-shaped in transverse section, with an interior basal shelf having an indistinctly tricuspidate edge; first and second molars nearly subequal, the third much smaller.

First lower incisor moderate in size, spatulate, flat, directed anteriorly; second incisor close and superior to first, similar in shape, much smaller (about half as large), directed anteriorly; third upper incisor minute, slightly flattened apically, curved downward, directed anteriorly. Lower canine long, slender, curved posteriorly, with a rather large posterior basal accessory cusp and a very small anterior one. Lower premolars small (successively slightly increasing in size posteriorly), compressed laterally, each with a well-developed posterior cusplike heel and a small cusplike development (minute in the first premolar) of anterior portion of cingulum. Lower molars M-shaped in transverse section, laterally compressed; interior shelf narrow, tricuspidate, the median cusp indistinctly bifid; first and third molars subequal, the second slightly larger. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{4}{4}$; m. $\frac{3}{3}$; total 44.

CONDYLURA CRISTATA (Linnæus).

STAR-NOSED MOLE.

(Pl. IV, fig. 12; Pl. V, figs. 6, 6a; Pl. VI, fig. 21.)

Sorex cristatus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 53, 1758.

Talpa longicaudata Erxleben, Reg. Anim., p. 118, 1777. Based on Pennant's long-tailed mole; type locality, North America.

Talpa Cristata Zimmermann, Specimen Zool. Geog., p. 496, 1777.

¹ It may be that these large palatine vacuities are not functional foramina. They have the position, however, of the first pair of posterior palatine foramina, and, whatever their function, they are of considerable generic diagnostic importance.

- Talpa Caudata* Zimmermann (nec *Talpa caudata* of Linnæus and others), Specimen Zool. Geog., p. 497, 1777. Based on Pennant's long-tailed mole; type locality, North America.
- ?*Talpa canadensis* De La Faille, Naturgesch. des Maulwurtes, t. 1, p. 3, 1778. [Not seen.]
- Talpa radiata* Shaw, Gen. Zool., Mamm., vol. 1, p. 523, 1800. New name for *Sorex cristatus* Linnæus.
- Sorex radiatus* Shaw, Gen. Zool., Mamm., vol. 1, p. 531, 1800. Based upon a figure and description of De La Faille. Type locality, Canada.
- Scalopus cristatus* Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.
- Scalops cristatus* Fischer, Zoognosia, vol. 3, p. 156, 1814.
- Condylura cristata* Desmarest, Journ. de Physique, de Chimie, d'Hist. Nat. et des Arts, vol. 89, p. 230, September 1819.
- Condylura longicaudata* Desmarest, Journ. de Physique, de Chimie, d'Hist. Nat. et des Arts, vol. 89, p. 232, September, 1819.
- Talpasorex cristata* Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821.
- Condylura fissipes* Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)
- Talpa flava* Schinz (nec *Talpa flava* Zimmermann), Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)
- [*Talpa purpurascens* Schinz (nec *Talpa purpurascens* Shaw qui *Talpa europæa* Linnæus), Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)
- Condylura macroura* Harlan, Fauna Amer., p. 39, 1825. Type locality, New Jersey.
- Astomycter prasinatus* Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]). Type locality, Maine.
- Condylura prasinata* Harris, Boston Journ. Philos. and Arts, vol. 2, p. 582, July, 1825.
- Talpasor[ex] longicaudata* Schinz, Cuvier's Thierreich, vol. 4, p. 312, 1825.
- ?*Talpasorex fissipes* Minding, Geog. Vertheilung der Säugethiere, p. 64, 1829. (Nomen nudum.)
- astomycter prarinatus* (sic) Rafinesque, Atlantic Journ. and Friend of Knowledge, vol. 1, p. 61, Summer 1832.
- Condylura cristata* Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 996, 1839.
- Rh[inaster] cristatus* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 114, 1841.
- Rh[inaster] macrurus* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 115, 1841.
- Rh[inaster] longicaudatus* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 115, 1841.
- Rh[inaster] macroura* Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 117, 1841.
- Talpa (Condylurus) cristata* Blainville, Osteographie, Atlas 1, tables des planches, p. 4; fasc. 6, Insectivores, pl. 1 (skeleton), pl. 5 (skull), pl. 9 (teeth), 1839-1864.
- Astomydes* (sic) *cristatus* Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863.
- Condylus* (sic) *cristata* Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913.

Type locality.—Eastern Pennsylvania.

Geographic range.—That of the genus (see p. 83).

General characters.—Size medium; color dark, blackish; tail long, about equal in length to body (without head), in autumn and winter much enlarged, slightly shortened, but constricted at base, scaly, haired; nostrils anterior, in nasal disk surrounded by twenty-two fleshy processes; skull relatively long and narrow; audital bullæ incomplete; premaxillæ much extended beyond nasals anteriorly; first upper incisors large, incurved, and projecting anteriorly.

Color.—*Fresh pelage*: Upperparts blackish brown to nearly black; underparts paler and more brownish, fuscous to fuscous-black; tail

similar to back, sometimes indistinctly bicolored. *Worn pelage:* Paler and more brownish than fresh pelage; upperparts fuscous to fuscous-black; underparts fuscous to hair-brown; wrists frequently with a narrow ring varying from pinkish buff to clay color. Nasal disk and processes in live animals rose color. Young usually paler and more brownish than adults.

Skull.—Size medium (length about 34 mm.), elongate, narrow (breadth across mastoids about 13 mm.), not depressed postorbitally; braincase moderately high and arched; interparietal wide anteroposteriorly; audital bullæ incomplete; premaxillæ much extended beyond nasals anteriorly; adults with distinct crest between posterior halves of nasals; zygomata short, narrow, straight, directed obliquely downward anteriorly; palate narrow; dentition weak; first upper incisor broad, incurved, projecting anteriorly; second upper incisor minute; third upper incisor long, narrow, caninelike, in young with a small postero-lateral basal tubercle; upper molars with indistinctly trilobed inner basal ledge.

Measurements.—Average of 10 adult males from Digby, Nova Scotia: Total length, 202.2 (189–211); tail vertebræ (summer), 78.4 (71–83.5); hind foot, 28.1 (26–30). Average of 2 adult males from Washington, D. C.: Total length, 184 (183–185); tail vertebræ (winter), 65.5 (65–66); hind foot, 28 (28–28). *Skull:* Adult (male?) from Holmesburg, Pa.: Greatest length, 34.1; palatilar length, 12.9; mastoidal breadth, 13.1; interorbital breadth, 7; maxillary tooth row, 11; mandibular molar-premolar row, 11.3. Average of 3 skulls of adult males from Locust Grove, N. Y.: Greatest length, 34.6 (34.1–35.2); palatilar length, 13.2 (13–13.3); mastoidal breadth, 13.6 (13.5–13.7); interorbital breadth, 7.2 (7.1–7.2); maxillary tooth row, 11.5 (11.4–11.5); mandibular molar-premolar row, 11.6 (11.5–11.7). Skull of adult female from Locust Grove, N. Y.: Greatest length, 35; palatilar length, 13.3; mastoidal breadth, 13.4; interorbital breadth, 7.3; maxillary tooth row, 11.5; mandibular molar-premolar row, 11.9. Average of 10 skulls of adult males from Digby, Nova Scotia: Greatest length, 33.9 (33.1–35); palatilar length, 13 (12.9–13.6); mastoidal breadth, 13.4 (13–14); interorbital breadth, 7.2 (7–7.4); maxillary tooth row, 11.1 (10.6–11.5); mandibular molar-premolar row, 11.3 (11–11.9). Average of 2 skulls of adult males from Washington, D. C.: Greatest length, 33.8 (33.6–33.9); palatilar length, 13.1 (12.7–13.5); mastoidal breadth, 12.7 (12.6–12.8); interorbital breadth, 6.8 (6.7–6.8); maxillary tooth row, 11.2 (11.1–11.2); mandibular molar-premolar row, 11.2 (11.1–11.3).

Remarks.—Linnæus's description, in 1758, of the star-nosed mole under the name *Sorex cristatus*, appears to be its first mention in literature; on the authority of Kalm, Pennsylvania is given as its

habitat. Pennant,¹ in 1771, described two moles under the names "Radiated Mole" and "Long-tailed Mole"; the former he correctly considered to be the *Sorex cristatus* of Linnæus; his long-tailed species must also be referred to *Condylura cristata* since he describes it as a mole with a radiated nose and a tail two inches long, a description which applies to no other mammal. Pennant's description of the long-tailed mole was probably based upon either a young or a summer specimen in which the diameter of the tail was minimum; as early as 1777 this became the basis for two Latin binomials, *Talpa caudata* Zimmermann² and *Talpa longicaudata* Erxleben.³ The writer has been unable to verify the name *Talpa canadensis* of De La Faille. Shaw⁴ renamed *Sorex cristatus* Linnæus, calling it *Talpa radiata*; he also recognized *Talpa longicaudata*, but in his remarks under *Talpa radiata* states: "It is, perhaps, in reality no other than a variety of the former species (i. e. *T. longicaudata*), or a sexual difference."⁵ Shaw⁶ again renamed the species when he confused a figure and description of it, given by De La Faille, with the genus *Sorex*, and called it *Sorex radiatus*. That Shaw should thus have been misled is strange, since he writes:

One would be inclined to think that the remarkable moniliform appearance of the tail in this animal, as exhibited in M. de la Faille's figure, may be partly owing to the contraction of the interstices of the joints in drying.

It is evidently allied to the radiated Mole, but if the figure given by M. de la Faille be accurate, must surely be a very distinct species.⁷

Schinz,⁸ when substituting the generic name *Talpasorex* for *Condylura*, used the name *Condylura fissipes* in synonymy under *Talpasorex cristatus*; it seems probable that the name *fissipes* had been used in literature previous to this, but the present writer has been unable to find an earlier usage. Schinz (loc. cit.) also placed the names *Talpa flava* and *Talpa purpurascens* in synonymy under *Talpasorex cristatus*; this was probably purely an error on his part, since there is nothing in the original descriptions of *Talpa flava* Zimmermann and *Talpa purpurascens* Shaw, nor in subsequent descriptions of these forms, which would lead one to confuse either with *Condylura* Illiger; the former name is a synonym of *Scalopus a. aquaticus* (Linnæus), the latter of *Talpa europæa* Linnæus. In 1825, two other names were proposed which apply to the star-nosed mole—

¹ Pennant, T., *Quadrupeds*, 1771. The present writer has not seen this work but presumes the descriptions are essentially the same as those in Pennant's *History of Quadrupeds*, ed. 3, vol. 2, p. 232, pl. 90, 1793.

² Zimmermann, E. A. W., *Spec. Zool. Geog.*, p. 497, 1777.

³ Erxleben, J. C. P., *Syst. Reg. Anim.*, p. 118, 1777.

⁴ Shaw, George, *Gen. Zool.*, *Mamm.*, vol. 1, p. 523, 1800.

⁵ Shaw, loc. cit., p. 524.

⁶ Shaw, loc. cit., p. 531.

⁷ Shaw, loc. cit., p. 532.

⁸ Schinz, H. R., *Cuvier's Thierreich*, vol. 1, p. 191, 1821.

Condylura macroura Harlan¹ and *Astromycter prasinatus* Harris.² Both Harlan and Harris based their descriptions upon animals whose tails were in the enlarged winter condition. Harris was further deceived by his specimen being discolored with a shade of green, and proposed the new genus *Astromycter* to include this animal, though later³ he returned it to the genus *Condylura*.

It is to be remarked that *Condylura cristata* has comparatively little geographic variation over a wide zonal range; specimens from the Lower Austral Zone, in Georgia and Virginia, are subspecifically inseparable from those from the Boreal Zone in Quebec and Labrador. A very slight increase in size is noticeable toward the northern part of the range of the species, but it is inconstant, and insufficient for subspecific recognition. Occasional local variations appear, but when a large series is examined from any one locality these prove inconstant, or else crop out in remote localities. Thus, in a series from Digby, Nova Scotia, the skulls have on the average very slightly higher braincases and more abruptly sloping frontals, but the difference is not constant and can be matched perfectly by specimens from New York, Massachusetts, Pennsylvania, and Maryland; the same is true of a small postpalatal process present in the majority of skulls in the series from Digby. A specimen from Marlow, Georgia, is an alcoholic from which the broken and imperfect skull has been removed for study; it offers no characters by which it can be separated from typical specimens from Pennsylvania. Possibly when larger series of adult specimens are available differences of diagnostic value not now discernible will become apparent.

The limits of the geographic range of *Condylura* are not satisfactorily known. Many published records of the star-nosed mole have certainly been based upon erroneous identifications. For example, the species is included among the mammals supposed to occur in Oklahoma,⁴ and Townsend⁵ lists it from "the Territory of the Oregon."

Richardson⁶ describes a specimen said to have been taken by Douglas on the "banks of the Columbia." Richardson's description clearly indicates that the animal he had in hand was *Condylura cristata*, but it is almost certain that it was not collected near the banks of the Columbia River. The most westerly known point of the range of the species is in Manitoba, where, according to Seton,⁷

¹ Harlan, R., Fauna Amer., p. 39, 1825.

² Harris, T. W., Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825.

³ Harris, T. W., Boston Journ. Philos. and Arts, vol. 2, p. 582, July, 1825.

⁴ Woodhouse, S. W., Report of an Expedition Down the Zuni and Colorado Rivers, by Capt. L. Sitgreaves; Mammals, p. 43, 1854.

⁵ Under the names *Condylura longicaudata* and *Condylura macroura*. Townsend, J. K., Narrative of Journey across the Rocky Mountains to the Columbia River, p. 313, 1839.

⁶ Under the name *Condylura macroura*. Richardson, J., Fauna Boreali-Amer., vol. 1, p. 284, 1829.

⁷ Seton, Ernest Thompson, Life-Histories of Northern Animals, vol. 2, p. 1137, 1909.

specimens have been brought to the taxidermist shop of W. R. Hine in Winnipeg. Cory¹ records a specimen from Warsaw, Ill., and Professor Frank Smith, of the University of Illinois, found a dead specimen in the vicinity of Urbana in the same State.²

Specimens examined.—Total number 218, as follows:

Connecticut: East Hartford, 1; Liberty Hill, 1;³ Norfolk, 1.

District of Columbia: Washington, 10.

Georgia: Marlow, 1.

Labrador: Black Bay, 1;³ Hamilton Inlet, 2; Paradise, 2; Saint Michael Bay, 1; Sandwich Bay, 2.

Maine: Eastport, 1; Freeport, 1; Oakland, 1; Penobscot River (East Branch), 2; Small Point, 2.

Maryland: Brookeville, 1; Cabin John, 1; Chevy Chase, 1; College Park, 2; Glendale, 1; Laurel, 2; Marshall Hall, 1; Prince Georges County, 1; Williamsport, 1; Woodside, 2.

Massachusetts: Belmont, 4;³ Gardner, 1; Lunenburg, 4; Medway, 1;³ Middleboro, 2; New Bedford, 1; Newburyport, 2; Seehonk, 1;⁴ Watertown, 2;³ Williamstown, 1; Wilmington, 4.

Michigan: Ann Arbor, 8;⁵ Chelsea, 1;⁵ Douglas Lake, 1;⁵ Geddes, 1;⁵ Gogebic, 1;⁶ Hancock, 1;⁵ Kalamazoo County, 1;⁵ Muskegon County, 1; Porcupine Mountains, 2;⁵ Portage Lake, 6.⁵

Minnesota: Elk River, 1; Fort Ripley, 1; Margie, 1.

New Brunswick: Arthurette, 1;⁷ Hampton, 1.

New Hampshire: Ossipee, 4; Webster.³

New Jersey: Lake Hopatcong, 5;⁴ Tuckahoe, 1.⁴

New York: Cross River, 1; Essex County, 1; Geneva, 2; Highland Falls, 2;⁷ Ithaca, 1;⁸ Lake George, 2; Lansing, 2;^{6,9} Lockport, 1; Locust Grove, 11; Lyons Falls, 1; New York, 2; Nichols, 1; Oswego, 1;⁹ Pelham, 1; Peterboro, 5; Rockland, 1;⁷ Saint Lawrence County, 1; Sing Sing, 3.

North Carolina: Magnetic City, 2; Weaverville, 1.³

Nova Scotia: Barrington Passage, 1;¹⁰ Digby, 18; Halifax, 7; James River, 1;³ Newport, 2.⁷

Ohio: Cleveland, 1; Ellsworth, 1; Garrettsville, 3.

Ontario: Landsowne, 1;⁷ Middlesex County, 1;¹⁰ Moose Factory, 1; Muskoka, 1;⁷ Ottawa, 4.

Pennsylvania: Carlisle, 1; Lake Leigh, 1;⁴ Meadville, 2; New Lexington, 2;^{4,11} Philadelphia, 1;⁴ Radnor, 1.⁴

Quebec: East Main River, 1;¹¹ Godbout, 3; Lake Edward, 1;³ Montreal, 1.

Vermont: East Wallingford, 4;¹² Mount Mansfield, 2; Rutland, 1.¹³

Virginia: Dismal Swamp, 4.

Wisconsin: Colby, 1; Medford, 2;⁶ Merrill, 1;⁶ Newald, Forest County, 1.⁶

¹ Cory, C. B., Field Mus. Nat. Hist., publ. 153, zool. series 11, p. 444, 1912. In a personal letter dated March 20, 1914, Mr. Cory writes in regard to this specimen: "On a number of occasions Mr. Charles K. Worthen sent me boxes of birds and mammals, from which I could select specimens I desired and send back the others. One lot contained a specimen of *Condylura cristata* simply labeled 'Warsaw' (in pencil) with no other data. The specimen was returned to him."

² Wood, F. E., Bul. Illinois State Lab. Nat. Hist., vol. 8, p. 588, 1910.

³ Collection Mus. Comp. Zool., Harvard College.

⁴ Collection Acad. Nat. Sci. Philadelphia.

⁵ Collection Univ. Michigan Mus.

⁶ Collection Milwaukee Public Mus.

⁷ Collection Amer. Mus. Nat. Hist.

⁸ Collection of Hartley H. T. Jackson.

⁹ Collection Field Mus. Nat. Hist.

¹⁰ Collection Victoria Mem. Mus.

¹¹ Collection Carnegie Mus.

¹² Collection of D. E. Kent, Rutland, Vt.

¹³ Collection of G. L. Kirk, Rutland, Vt.

Genus NEÜROTRICHUS Günther.

Neürotrichus Günther, Proc. Zool. Soc. London, 1880, p. 441, October, 1880.

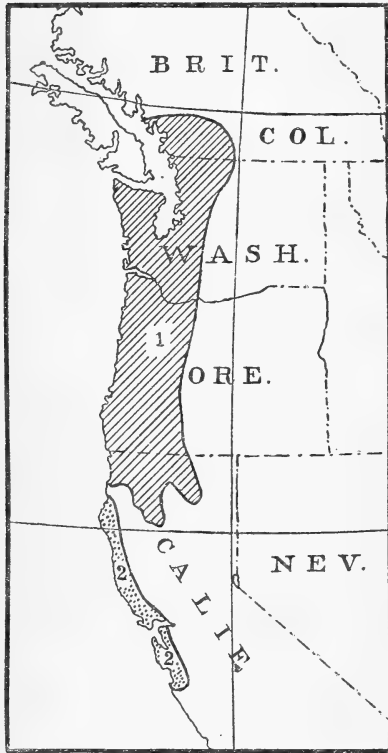
Neurotrichus Günther, Proc. Zool. Soc. London, 1880, plate 42, October, 1880.

Neurotrichus Forbes, Zool. Record, vol. 17, Mammalia, p. 14, 1881.

Neurotrichus Rye, Zool. Record, vol. 17, Index, p. 8, 1881.

Type species.—*Urotrichus gibbsii* Baird.

Geographic range.—Pacific coast region of North America west of the Cascades and Sierra Nevada, from southwestern British Columbia (Fraser River region) south to Fremont Peak, Monterey County, California (fig. 23).



B2029-103

FIG. 23.—Geographic range of the subspecies of *Neürotrichus gibbsii*. 1. *N. g. gibbsii*. 2. *N. g. hyacinthinus*.

External characters.—Smallest of the American Talpidæ; body somewhat robust, not much depressed. Tail moderate in length (about half as long as head and body), moderately fleshy, constricted at base, scaled, very distinctly annulated, sparsely covered with coarse hairs (fig. 24). Head conoidal, relatively long, not much depressed. Snout elongate, terminating in a naked disk or pad, apical superior surface naked to line of anterior edge of nasals; nostrils lateral in terminal pad, slightly crescentic, with anterior end of crescent enlarged and its concavity upward (fig. 25). Eyes minute (relatively about as in *Condylura*), concealed in the fur. Auricular opening large. Legs short, weak (relatively as in *Condylura*). Feet large, not fleshy, scaled, sparsely haired above, naked below. Fore feet hardly handlike, the palms longer than broad, toes relatively long. Fore claws relatively long, not broad, not depressed (fig. 26). Hind feet long and narrow, broader distally than proximally; six tubercles (varying slightly in position) on each hind foot, usually located one at base of third digit, one interdigital between the third and fourth digits, one between the fourth and fifth digits, one postero-interdigital between the second and third digits, and two near the center of the sole. Hind claws moderately long and slender, slightly compressed laterally, acute (fig. 27). Toes not webbed. Pelage similar in general to that of *Condylura*, but shorter, finer, and with

underfur less clearly defined. Mammæ, 8: latero-pectoral, 2-2; latero-abdominal, 1-1; inguinal, 1-1.

Skeletal characters.—Clavicle relatively long and narrow (for the Talpidæ), length about twice the breadth; concave superiorly, inferior surface with a flat process projecting postero-laterally; not penetrated by a foramen. Humerus about three-fifths as broad as long, weaker medially (as in *Condylura*). Pelvis narrow, bones of opposite sides separated by considerable space (about 2 mm.) under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra without process. Os falciforme rudimentary and scarcely perceptible.

Skull conoidal, moderately depressed, without prominent processes and ridges, with moderately broad braincase, scarcely constricted interorbitally. Mastoids weak. Interparietal large, broad, irregularly semicircular, anteriorly deeply emarginate medially, posteriorly slightly emarginate and usually without a posterior median projection. Frontal region scarcely sloping ventro-anteriorly; frontal sinuses very slightly swollen. Rostrum moderately elongate; anterior ends of premaxillæ not much thickened, extending beyond nasals, forming a somewhat truncate notch anterior to the nasals. Anterior nares opening forward. Zygomata short, narrow, slightly out-curved, directed slightly downward anteriorly, the posterior end forward on squamosal (less so than in *Condylura*). Foramen magnum elliptical, relatively large. Infraorbital foramen large, the plate forming its outer wall relatively broad and heavy. Audital bullæ incomplete; no auditory meatus. External pterygoid region scarcely inflated (relatively more than in



FIG. 25.—Snout of *Neürotrichus gibbsii gibbsii* (X $\frac{1}{2}$). No. 83468, U. S. Nat. Mus.; from British Columbia.

B2031-103

Condylura). Mesopterygoid space moderately long and broad, the sides usually gently concave. Palate moderately elongate, relatively narrow, terminating opposite posterior border of last molar; posterior border of palate slightly emarginate, without spine or notch. Anterior palatine foramina moderate, oval; first pair of posterior palatine

foramina moderate, oval to elliptical-oval; second pair minute. Horizontal ramus of mandible slender, nearly straight; coronoid relatively long, erect proximally, curving posteriorly distally into an acute process; angle of mandible relatively short and narrow (smaller than coronoid); inferior mandibular notch relatively shallow and broad.



B2030-103

FIG. 24.—Tail of *Neürotrichus gibbsii hyacinthinus* (X $\frac{1}{2}$). No. 160898, U. S. Nat. Mus., Biological Survey collection; from Aptos, Cal.

Dental characters.—First upper incisors very short, relatively broad; second and third small (about half as large as first incisor), somewhat laterally compressed. Upper canine larger than third incisor, triangular, compressed, two-rooted, with a small postero-basal accessory cusp. First upper premolar similar to canine, slightly smaller; second upper premolar large, triangular, with a postero-basal cusp, a postero-internal basal cusplike heel, and sometimes with an anterior cusplike process on the cingulum, which tends to disappear with age. Upper molars W-shaped in transverse section, with an interior basal shelf having a distinctly bicuspidate edge; first and second molars subequal, the third much smaller.



B2032-103

FIG. 26.—Fore foot of *N. g. gibbsii* ($\times 1\frac{1}{2}$). Individual referred to in fig. 24.

First lower incisor small, spatulate, directed slightly antero-interiorly; second and third lower incisors and lower canine similar to first incisor, smaller, successively decreasing in size posteriorly, directed obliquely anteriorly, the canine with a smaller posterior basal tubercle. Lower premolars triangular, each with a posterior cusplike heel and an indistinct posterior median sulcus, the second about twice as large as first and with a small antero-basal tubercle. Lower molars M-shaped in transverse section, slightly compressed laterally (less so than in *Condylura*); interior shelf low and narrow, tricuspidate, the median cusp not bifid; first molar with minute basal tubercle between posterior and median interior cusps; first and second molars subequal, the third smaller. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{2}{2}$; m. $\frac{3}{3}$; total 36.



B2033-103

FIG. 27.—Hind foot of *N. g. gibbsii* ($\times 1\frac{1}{2}$). Individual referred to in fig. 24.

Key to Subspecies of *Neurotrichus*.

- a.*¹ Size smaller; color paler; length of skull less than 23.2 mm.,
Neurotrichus gibbsii gibbsii (p. 94).
*a.*² Size larger; color darker; length of skull more than 23.2 mm.,
Neurotrichus gibbsii hyacinthinus (p. 97).

Descriptions of species and subspecies of *Neurotrichus*.

NEÜROTRICHUS GIBBSII GIBBSII (Baird).

GIBBS'S MOLE.

(Pl. VI, figs. 1, 1a, 1b, 22.)

Urotrichus gibbsii Baird, Report Pacific R. R. Survey, vol. 8, part 1, Mammals, p. 76, 1857.

Urotrichus Gibbsii Lord, Naturalist in Vancouver Island and British Columbia, p. 338, 1866.

Neurotrichus (sic) *gibbsii* Günther, Proc. Zool. Soc. London, 1880, pl. 42, October, 1880.

Neurotrichus gibbsii True, Proc. U. S. Nat. Mus., vol. 7, p. 607, 1885.

Neurotrichus gibbsii Bryant, Zoe, vol. 1, p. 359, February, 1891.

Neurotrichus gibbsi Merriam, Mazama, vol. 1, p. 228, 1897.

Neurotrichus gibbsi major Merriam, N. Am. Fauna No. 16, p. 88, October 28, 1899.

Type locality, Carberry Ranch, altitude 4100 feet, between Mount Shasta and Mount Lassen, Shasta County, California.

Neurotrichus gibbsii gibbsii Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

Neurotrichus gibbsii major Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

Type locality.—White River Pass, north of Mount Rainier, Pierce County, Washington.

Type specimen.—No. $\frac{662}{1843}$, U. S. Nat. Mus.; immature, sex unknown; poorly made skin and fragmentary skull; collected July 15, 1854, by George Gibbs.

Geographic range.—Extreme southwestern British Columbia, western Washington and Oregon west of the Cascade Mountains, south in the coast region to Eureka, Humboldt County, Cal., and in the interior, west of the Sierra Nevada, to South Yolla Bolly Mountain, Cal.

General characters.—Size small (total length averaging less than 120 mm.); color dark, usually dark mouse gray; tail medium in size (about one-third of total length), scaled in transverse annular rows, covered with a few blackish, coarse hairs; skull small (greatest length usually less than 23 mm.), flat, and not angular.

Color.—General tone dark mouse gray to blackish mouse gray, occasionally dusky neutral gray; upperparts and underparts essentially the same color, the underparts rarely slightly paler than the back; the longer hairs in full pelage frequently tipped with whitish, producing a frosted appearance; recently killed animals and specimens little handled generally show purplish and greenish iridescence. The worn pelage is paler and more brownish than the fresh.

Skull.—Small (greatest length usually less than 23 mm.), smooth, flat, not much depressed postorbitally, not much constricted interorbitally; frontal sinuses slightly swollen; zygomata short, weak; pterygoids short, weak, laterally flattened; audital bullæ incomplete; rostrum moderate in length and width; dentition moderate; first upper incisors flat and rodentlike; upper canine (third lateral tooth) flattened laterally, much like first upper premolar; anterior portion of cingulum of second upper premolar *not* usually developed into a superior cusplike process.

Measurements.—Average of 9 adult males from Sumas, British Columbia: Total length, 113 (107–117); tail vertebræ, 37.1 (34–39); hind foot, 16.6 (15.7–17). Average of 5 adult females from Sumas, British Columbia: 116.6 (111–120); 36.4 (33–40); 17 (17–17). Average of 3 males from Carberry Ranch (type locality of *N. g. major*), Shasta County, Cal.: 119.7 (118–121); 40.3 (39–42); 17 (17–17). *Skull*: Average of 10 skulls of adult males from Sumas, British Columbia: Greatest length, 22.5 (22.1–23); palatilar length, 9.4 (9.1–9.6);

mastoidal breadth, 10.3 (10.1–10.5); interorbital breadth, 5.3 (5.2–5.4); maxillary tooth row, 7.1 (7–7.2); mandibular molar-premolar row, 7.3 (7.1–7.5). Average of 6 skulls of adult females from Sumas, British Columbia: Greatest length, 22.4 (21.5–23); palatilar length, 9.4 (9.2–9.5); mastoidal breadth, 10.2 (9.6–10.5); interorbital breadth, 5.3 (5.1–5.5); maxillary tooth row, 7.1 (6.9–7.2); mandibular molar-premolar row, 7.2 (7–7.3). Average of 2 skulls of males from Carberry Ranch (type locality of *major*), Shasta County, Cal.: Greatest length, 22.7 (22.4–23); palatilar length, 9.3 (9.3–9.3); mastoidal breadth, 10.6 (10.5–10.7); interorbital breadth, 5.4 (5.4–5.4); maxillary tooth row, 7 (6.9–7); mandibular molar-premolar row, 7 (6.9–7.1).

Remarks.—This little mole, the most shrewlike of the American members of the family, shows comparatively little geographic variation throughout its rather extensive range; in fact, the local almost obscures the geographic variation. Southward a tendency appears toward an increase in size and toward the development of a cusplike process upon the anterior portion of the cingulum of the second upper premolar; this reaches the climax in *N. g. hyacinthinus*. The presence of this cusplike process on the second upper premolar, however, is not strictly diagnostic since it occasionally crops out, slightly developed, in specimens taken near the northern limit of the range of *N. g. gibbsii*, or may be absent in specimens of *hyacinthinus* taken near the southern border of its range. Thus, it occurs, weakly developed, in a few specimens from Sumas, British Columbia; it is absent in two specimens from Crescent City, Cal., but is present in five young adults from Eureka, Cal., and in one from Goldbeach, Oreg.; some specimens of *hyacinthinus* from Cuddeback and Aptos, Cal., have the process, while others lack it.

The form *Neurotrichus gibbsii major* Merriam¹ is here placed in synonymy under *N. g. gibbsii*. The type of *major* was collected at Carberry Ranch, altitude 4100 feet, between Mount Shasta and Mount Lassen, Shasta County, Cal.; a careful comparison of the type, topotypes, and other specimens from the Shasta region, with a large number of specimens from Washington and British Columbia fails to show any differences between *major* and *gibbsii* worthy of subspecific recognition; specimens of *major* average very slightly larger than *gibbsii* and in some other respects appear to be intermediate in characters between *gibbsii* and *hyacinthinus*, but in size and general proportions of skull they are much nearer *gibbsii*. The presence of an anterior "cusp" on the cingulum of the second upper premolar in *major* is not of diagnostic value, as has been shown in the preceding

¹ Merriam, C. Hart, N. Am. Fauna No. 16, p. 88, 1899.

paragraph, and at best can be considered only an approach toward *hyacinthinus*; nor does the second lower premolar differ essentially from that of *gibbsii*, since it can be matched almost perfectly in any large series of the genus *Neürotrichus* from any locality.

Five specimens examined from Eureka, Cal., are hardly adult, but are provisionally referred to *gibbsii* on account of color and size of skull; when a larger series of specimens, with more adults, is available from this region, a change of decision may be necessary.

Specimens examined.—Total number, 146, as follows:

British Columbia: Chilliwack Valley, 6; Douglas, 1;¹ Howe Sound, 3; Langley, 1; Sumas, 72; Tammi Hy Creek (Chilliwack Valley), 1;¹ Thurstons, 2.¹

California: Arcata, 1;² Beswick, 1; Carberry Ranch, Shasta County, 3; Crescent City, 2; Eureka, 5;³ Hoopa Valley, 1; Mount Shasta, 4; Salmon Mountains (near Etna Mills), 1; South Yolla Bolly Mountain, 1;² Tower House, Shasta County, 2;² Trinidad, 3.²

Oregon: Anna Creek, Mount Mazama, 1; Astoria, 1; Crater Lake, 1; Elk Head, 1; Eugene, 1; Fort Klamath, 4; Goldbeach, 1;³ McKenzie Bridge, 1; Multnomah Falls, 1; Salem, 1;⁴ Seaside, 1; Siskiyou, 1; Vida, 2; Yaquina Bay, 3.

Washington: Kirkland, 1; Lake Cushman, 4; Mount Rainier, 2; Mount Vernon, 3; Neah Bay, 1; Seattle, 1; Steilacoom, 2; Tenino, 1; White River, Cascade Mountains (type locality), 1.

NEÜROTRICHUS GIBBSII HYACINTHINUS Bangs.

SOUTHERN GIBBS'S MOLE.

(Pl. VI, figs. 2, 2a, 2b, 23.)

Neürotrichus gibbsii hyacinthinus Bangs, Amer. Nat., vol. 31, p. 240, March, 1897.

Neurotrichus gibbsii hyacinthinus Miller & Rehn, Proc. Boston Soc. Nat. Hist., vol. 30, p. 254, December, 1901.

Neurotrichus gibbsii hyacinthinus Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 467, 1905.

Neürotrichus gibbsii hyacinthinus Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

Type locality.—Nicasio, Marin County, California.

Type specimen.—No. 1240, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ adult, skin and skull; collected March 10, 1894, by C. A. Allen.

Geographic range.—Coast region of California from Cuddeback, Humboldt County, south to Fremont Peak, Monterey County.

General characters.—Larger than *N. g. gibbsii*; color usually slightly darker; skull larger, relatively wider through braincase and rostrum, with more angular mastoid region.

Color.—Much like that of *N. g. gibbsii* but averaging darker; usually blackish mouse gray or dusky neutral gray; often almost black, especially in fresh pelage; in full unworn pelage sometimes

¹ Collection Victoria Mem. Mus.

² Collection Mus. Vert. Zool., Univ. California.

³ Collection Field Mus. Nat. Hist.

⁴ Collection Amer. Mus. Nat. Hist.

distinctly overcast with hoary, due to whitish tips of the longer hair; worn pelage paler and more brownish; purplish and greenish iridescence shows in fresh specimens, as in *gibbsii*.

Skull.—Similar to that of *N. g. gibbsii* but larger (greatest length usually over 23.5 mm.) and relatively wider through braincase, interorbitally, and through rostrum; mastoid region usually heavier and more angular than in *gibbsii*; anterior portion of cingulum of second upper premolar usually developed into a superior cusplike process.

Measurements.—Average of 6 males from Aptos, Santa Cruz County, Cal.: Total length, 121.5 (118–126); tail vertebrae, 38.3 (37–39); hind foot, 16.9 (16.5–17). *Skull*: Young adult male from type locality: Greatest length, 24.2; palatilar length, 9.8; mastoidal breadth, 11; interorbital breadth, 5.7; maxillary tooth row, 7.4; mandibular molar-premolar row, 7.3. Skull of young adult female from type locality: Greatest length, 23.5; palatilar length, 9.6; mastoidal breadth, 10.6; interorbital breadth, 5.4; maxillary tooth row, 7.3; mandibular molar-premolar row, 7.3. Average of 6 skulls of males from Aptos, Santa Cruz County, Cal.: Greatest length, 23.8 (23–24); palatilar length, 9.9 (9.6–10); mastoidal breadth, 10.9 (10.7–11.1); interorbital breadth, 5.6 (5.5–5.7); maxillary tooth row 7.6 (7.4–7.8); mandibular molar-premolar row, 7.6 (7.5–7.7).

Remarks.—The southern-coast form of Gibbs's mole, *N. g. hyacinthinus*, differs from the typical northern form, *N. g. gibbsii*, chiefly in its larger size and darker color, though frequently specimens are no darker than typical *gibbsii*. Specimens from the south of San Francisco Bay are not quite so intensely colored as those from the type region, and, on the average, seem to have slightly shorter rostra, but the differences are too trivial for subspecific designation.

Specimens examined.—Total number, 58, as follows:

California: Aptos, 10; Burlingame, 1; Cazadero, 1;¹ Cuddeback, 7;¹ Fairfax, 1;¹ Freestone, 1;¹ Fremont Peak, 1; Gualala, 9; Guerneville, 3;¹ Inverness, 4;¹ Mendocino, 1;¹ Nicasio (type locality), 6; Palo Alto, 1;² Point Arena, 4;¹ San Geronimo, 1;¹ Santa Cruz, 7.

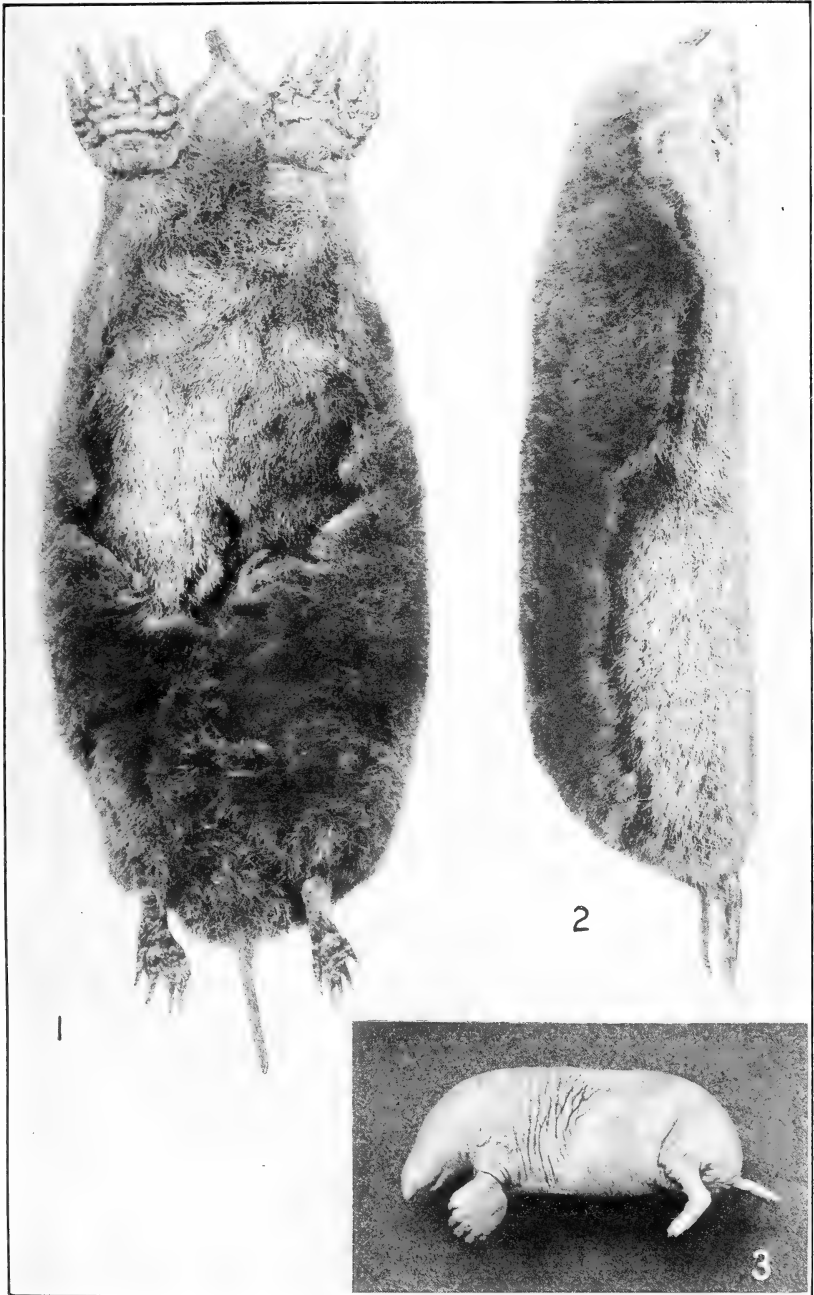
PLATE I.

[Natural size.]

- FIG. 1. Early stage in molting process of *Scalopus aquaticus aquaticus* (Linnæus); ♀ adult; Fort Myer, Va., April 15, 1897. (No. 83686, U. S. Nat. Mus.)
2. Middle stage in molting process of *Scalopus aquaticus aquaticus* (Linnæus); ♀ adult; Falls Church, Va., May 26, 1907. (No. 144453, U. S. Nat. Mus.)
3. Nestling young of *Scalopus aquaticus howelli* Jackson; Jackson, N. C. (No. 7250, U. S. Nat. Mus.)

¹ Collection Mus. Vert. Zool., Univ. California.

² Collection Field Mus. Nat. Hist.



MOLTING AND YOUNG OF SCALOPUS.

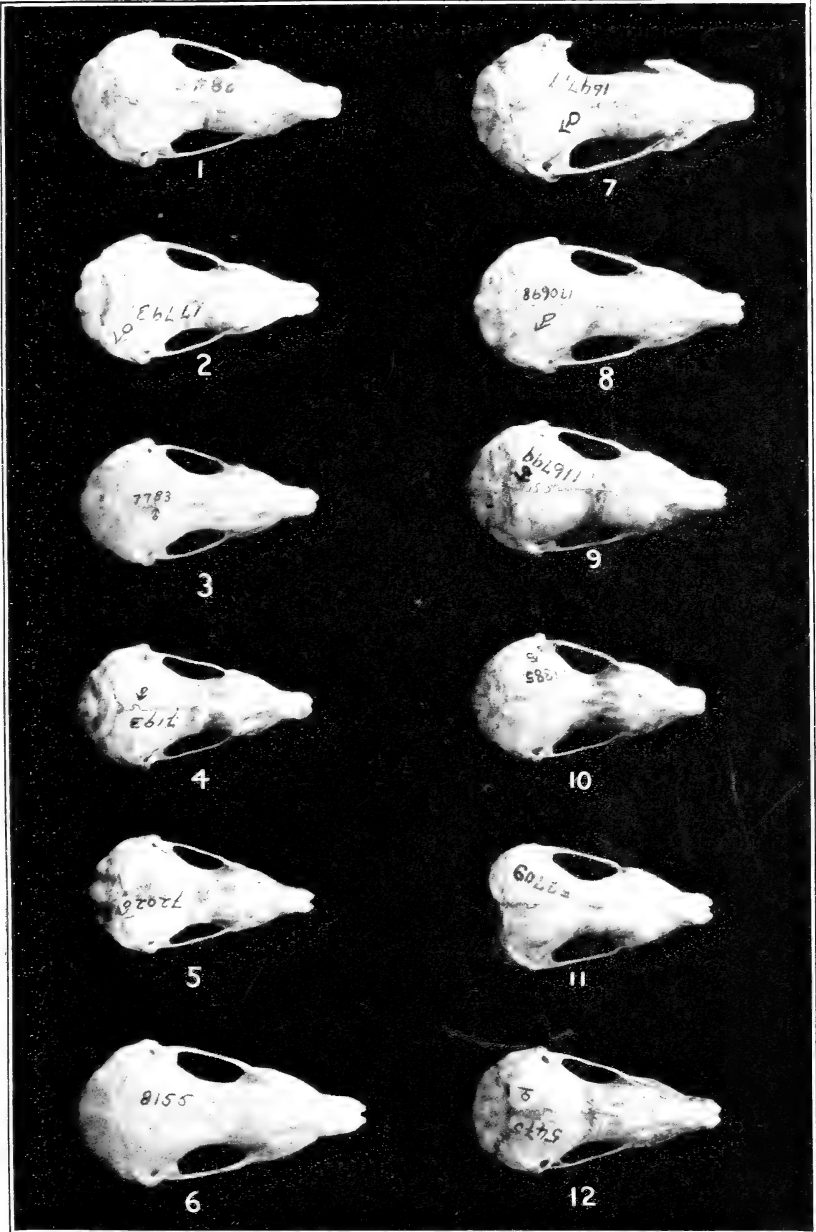
- 1, 2. *Scalopus aquaticus aquaticus*.
3. *Scalopus aquaticus howelli*.

B2001-103

PLATE II.

[Natural size.]

- FIG. 1. *Scalopus aquaticus aquaticus* (Linnæus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)
2. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)
3. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla. (No. 7783, Field Mus. Nat. Hist.)
4. *Scalopus aquaticus anastasæ* (Bangs); topotype; ♂ adult; Point Romo, Anastasia Island, Fla. (No. 7193, Mus. Comp. Zool., Harvard College, Bangs collection.)
5. *Scalopus aquaticus parvus* (Rhoads); ♂ adult; Port Tampa City, Fla. (No. 7202, Mus. Comp. Zool., Harvard College, Bangs collection.)
6. *Scalopus aquaticus machrinus* (Rafinesque); ♂ adult; Oakwoods Cemetery, Chicago, Ill. (No. 8155, Field Mus. Nat. Hist.)
7. *Scalopus aquaticus machrinoides* Jackson; type; ♂ adult; Manhattan, Kans. (No. 169717, U. S. Nat. Mus., Biological Survey collection.)
8. *Scalopus aquaticus pulcher* Jackson; type; ♂ adult; Delight, Ark. (No. 170698, U. S. Nat. Mus., Biological Survey collection.)
9. *Scalopus aquaticus caryi* Jackson; type; ♂ young adult; Neligh, Nebr. (No. 116799, U. S. Nat. Mus., Biological Survey collection.)
10. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)
11. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)
12. *Scalopus æreus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)



B2002-103

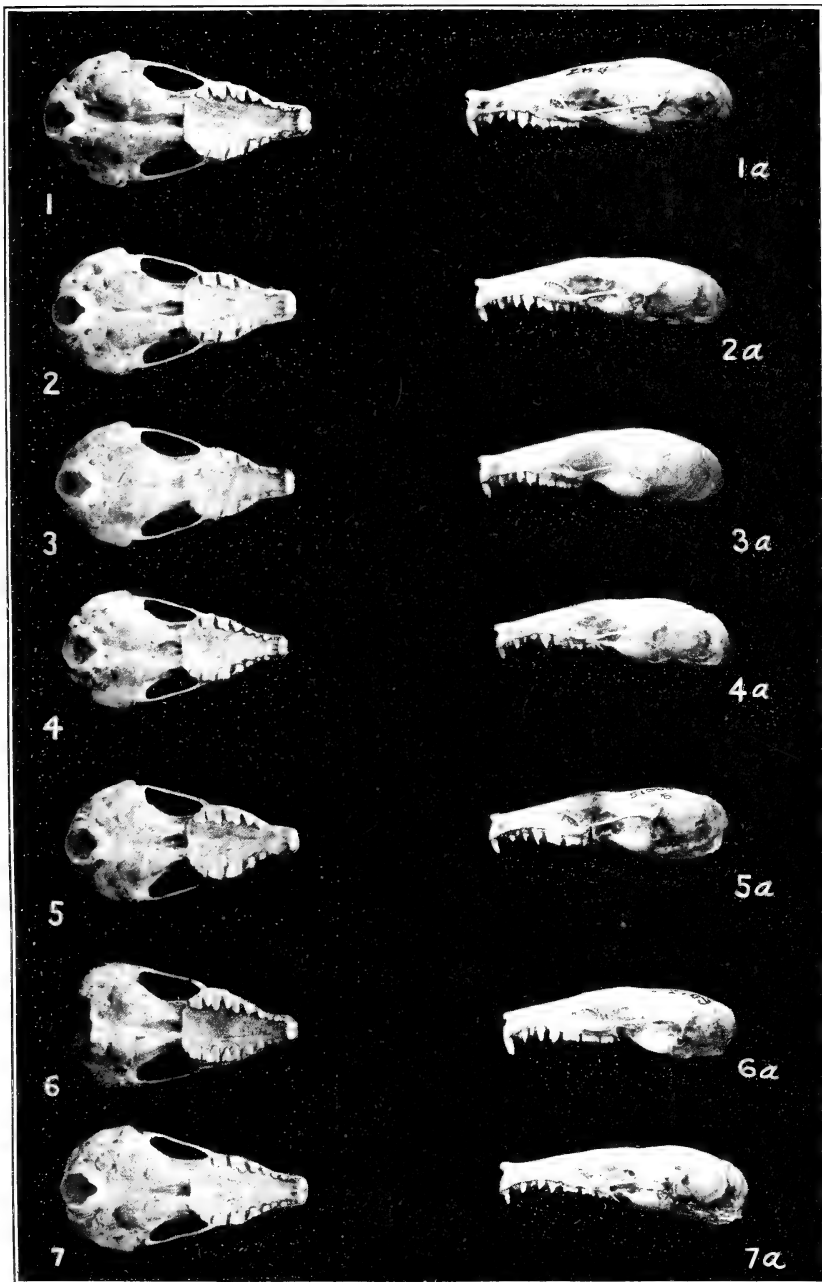
SKULLS OF SCALOPUS AQUATICUS (SUBSP.), S. INFLATUS, AND S. ÆREUS.

- | | | |
|----------------------------|-------------------------------|---------------------------|
| 1. <i>S. a. aquaticus.</i> | 5. <i>S. a. parvus.</i> | 9. <i>S. a. caryi.</i> |
| 2. <i>S. a. howelli.</i> | 6. <i>S. a. machrinus.</i> | 10. <i>S. a. texanus.</i> |
| 3. <i>S. a. australis.</i> | 7. <i>S. a. machrinoides.</i> | 11. <i>S. inflatus.</i> |
| 4. <i>S. a. anastase.</i> | 8. <i>S. a. pulcher.</i> | 12. <i>S. æreus.</i> |

PLATE III.

[Natural size.]

- FIGS. 1, 1a. *Scalopus aquaticus aquaticus* (Linnæus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)
- 2, 2a. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)
- 3, 3a. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla. (No. 7783, Field Mus. Nat. Hist.)
- 4, 4a. *Scalopus aquaticus parvus* (Rhoads); ♂ adult; Port Tampa City, Fla. (No. 7202, Mus. Comp. Zool., Harvard College, Bangs collection.)
- 5, 5a. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)
- 6, 6a. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)
- 7, 7a. *Scalopus æreus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)



B2003-103

SKULLS OF SCALOPUS AQUATICUS (SUBSP.), S. INFLATUS, AND S. ÆREUS.

1, 1a. *S. a. aquaticus*.
2, 2a. *S. a. howelli*.

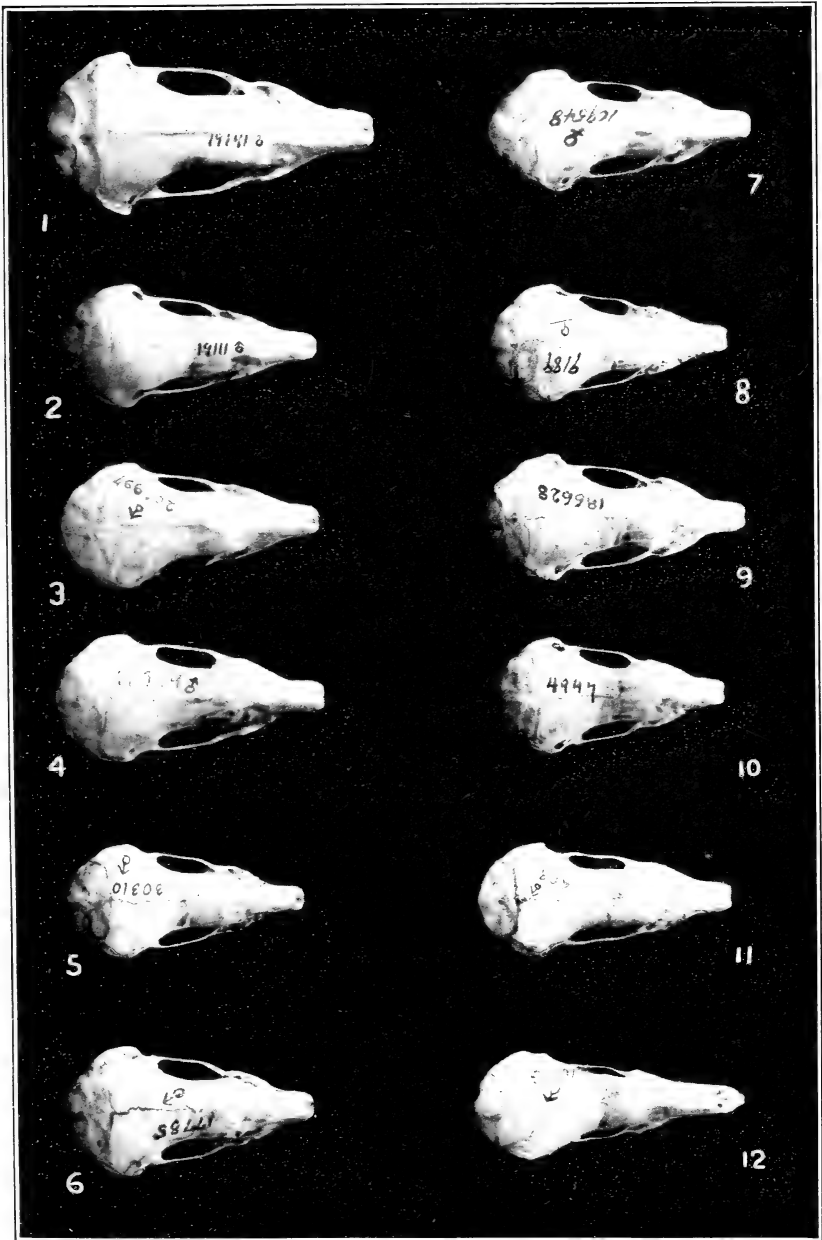
3, 3a. *S. a. australis*.
4, 4a. *S. a. parvus*.
5, 5a. *S. a. texanus*.

6, 6a. *S. inflatus*.
7, 7a. *S. æreus*.

PLATE IV.

[Natural size.]

- FIG. 1. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County, Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)
2. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)
3. *Scapanus orarius schefferi* nobis; type; ♂ adult; Walla Walla, Wash. (No. 204997, U. S. Nat. Mus., Biological Survey collection.)
4. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)
5. *Scapanus latimanus occultus* Grinnell & Swarth; ♂ adult; San Gabriel, Cal. (No. 30310, U. S. Nat. Mus., Biological Survey collection.)
6. *Scapanus latimanus grinnelli* Jackson; type; ♂ young adult; Independence, Cal. (No. 17785, Mus. Vert. Zool., Univ. California.)
7. *Scapanus latimanus sericatus* Jackson; type; ♀ adult; Yosemite, Cal. (No. 109548, U. S. Nat. Mus., Biological Survey collection.)
8. *Scapanus latimanus minusculus* Bangs; type; ♀ young adult; Fyffe, Cal. (No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection.)
9. *Scapanus latimanus dilatus* True; type; young adult, sex unknown, probably ♂; Fort Klamath, Oreg. (No. 186628, U. S. Nat. Mus., Merriam collection.)
10. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)
11. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)
12. *Condylura cristata* (Linnæus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2004-103

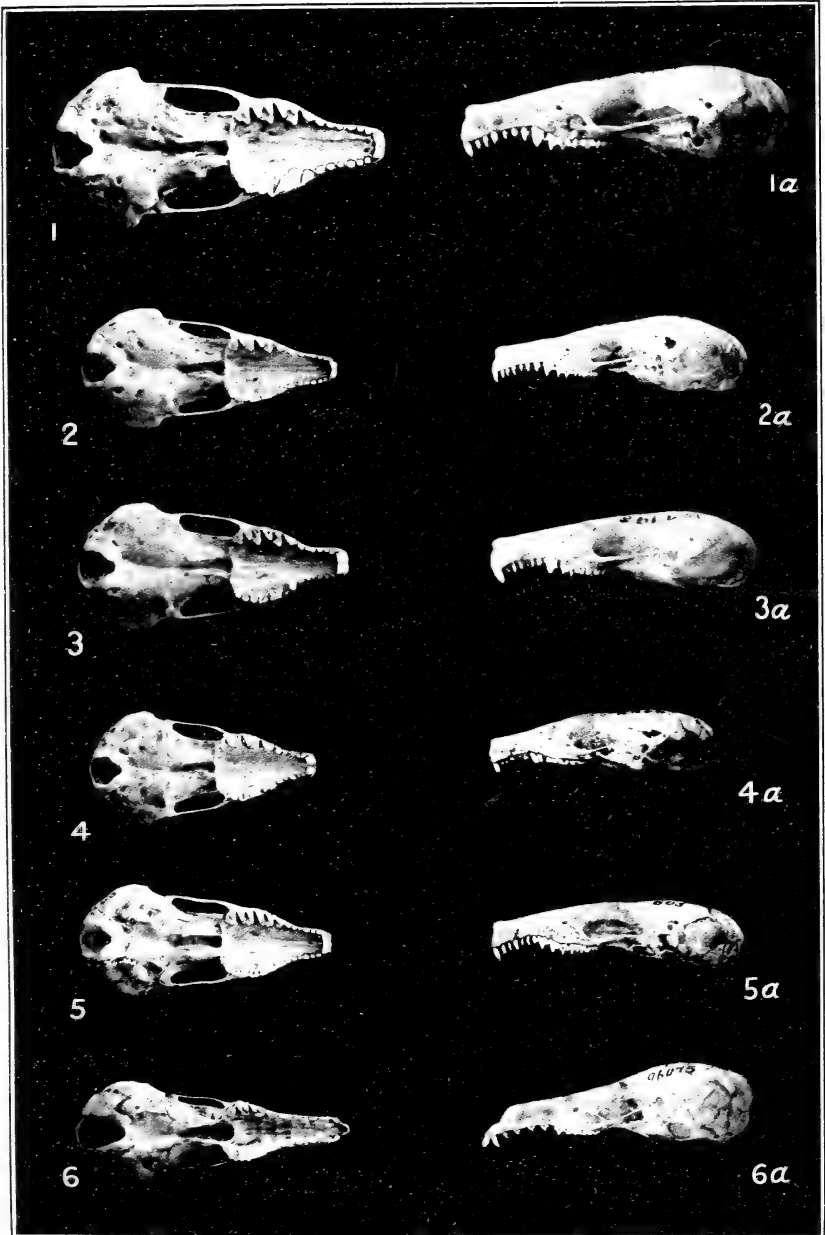
SKULLS OF SCAPANUS, PARASCALOPS, AND CONDYLURA.

- | | | |
|-----------------------------|------------------------------|---------------------------|
| 1. <i>S. townsendii</i> . | 5. <i>S. l. occultus</i> . | 9. <i>S. l. dilatus</i> . |
| 2. <i>S. o. orarius</i> . | 6. <i>S. l. grinnelli</i> . | 10. <i>S. anthonyi</i> . |
| 3. <i>S. o. schefferi</i> . | 7. <i>S. l. sericatus</i> . | 11. <i>P. breweri</i> . |
| 4. <i>S. l. latimanus</i> . | 8. <i>S. l. minusculus</i> . | 12. <i>C. cristata</i> . |

PLATE V.

[Natural size.]

- FIGS. 1. 1a. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)
- 2, 2a. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)
- 3, 3a. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)
- 4, 4a. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)
- 5, 5a. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)
- 6, 6a. *Condylura cristata* (Linnæus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2005-103

SKULLS OF SCAPANUS, PARASCALOPS, AND CONDYLURA.

1, 1a. *S. townsendii*.
2, 2a. *S. o. orarius*.

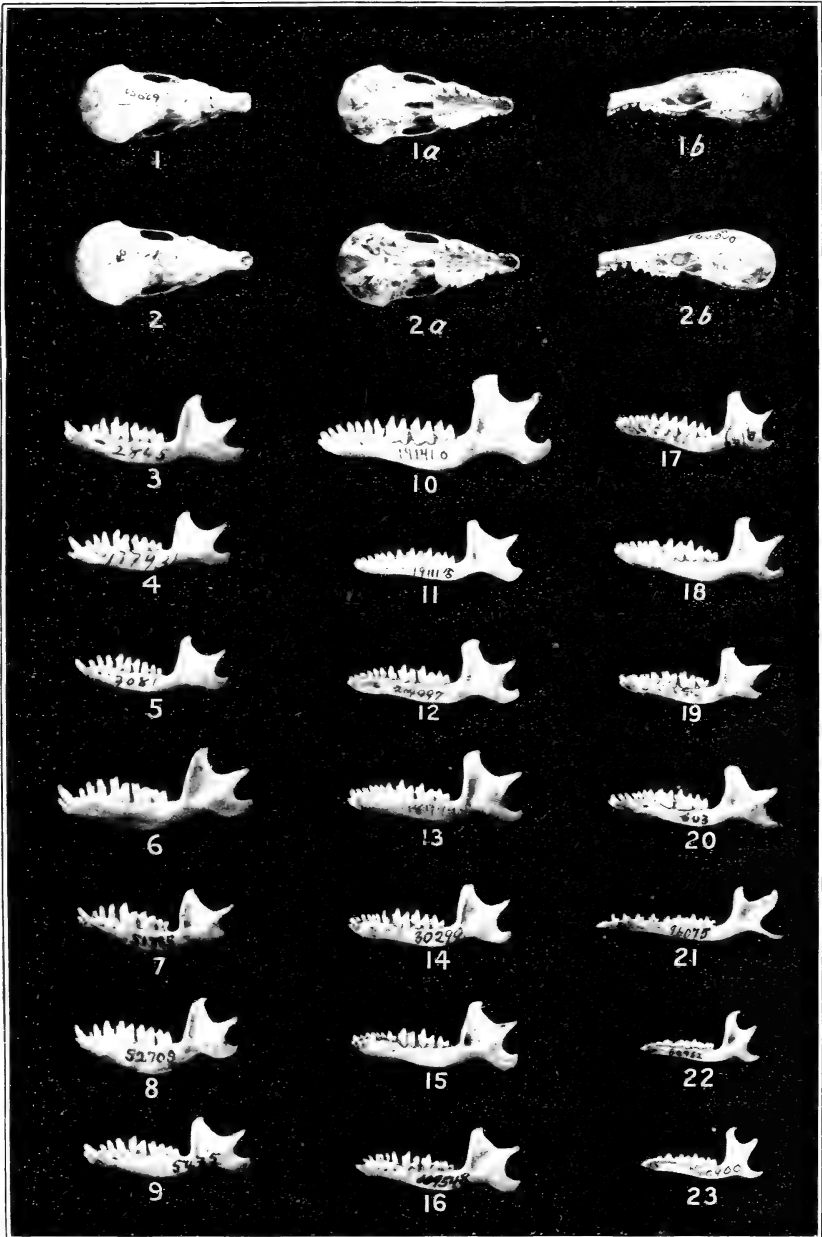
3, 3a. *S. l. latimanus*.
4, 4a. *S. anthonyi*.

5, 5a. *P. breweri*.
6, 6a. *C. cristata*.

PLATE VI.

[Natural size.]

- FIGS. 1, 1a, 1b, 22. *Neurotrichus gibbsii gibbsii* (Baird); ♂ adult; Sumas, British Columbia. (No. 62952, U. S. Nat. Mus.)
- 2, 2a, 2b, 23. *Neurotrichus gibbsii hyacinthinus* Bangs; ♂ young adult; Aptos, Cal. (No. 160900, U. S. Nat. Mus., Biological Survey collection.)
- FIG. 3. *Scalopus aquaticus aquaticus* (Linnæus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)
4. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)
5. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla., (No. 7081, Mus. Comp. Zool., Harvard College, Bangs collection.)
6. *Scalopus aquaticus machrinus* (Rafinesque); ♂ adult; Oakwoods Cemetery, Chicago, Ill. (No. 8155, Field Mus. Nat. Hist.)
7. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)
8. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)
9. *Scalopus æreus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)
10. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County, Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)
11. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)
12. *Scapanus orarius schefferi* nobis; type; ♂ adult; Walla Walla, Wash. (No. 204997, U. S. Nat. Mus., Biological Survey collection.)
13. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)
14. *Scapanus latimanus occultus* Grinnell & Swarth; ♂ adult; Alhambra, Cal. (No. 30299, U. S. Nat. Mus., Biological Survey collection.)
15. *Scapanus latimanus grinnelli* Jackson; type; ♂ young adult; Independence, Cal. (No. 17785, Mus. Vert. Zool., Univ. California.)
16. *Scapanus latimanus sericatus* Jackson; type; ♀ adult; Yosemite, Cal. (No. 109548, U. S. Nat. Mus., Biological Survey collection.)
17. *Scapanus latimanus minusculus* Bangs; type; ♀ young adult; Fyffe, Cal. (No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection.)
18. *Scapanus latimanus dilatus* True; type; young adult, sex unknown, probably ♂; Fort Klamath, Oreg. (No. 186628, U. S. Nat. Mus., Merriam collection.)
19. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)
20. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)
21. *Condylura cristata* (Linnæus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2006-103

SKULLS OF NEÜROTRICHUS, AND MANDIBLES OF AMERICAN TALPIDÆ.

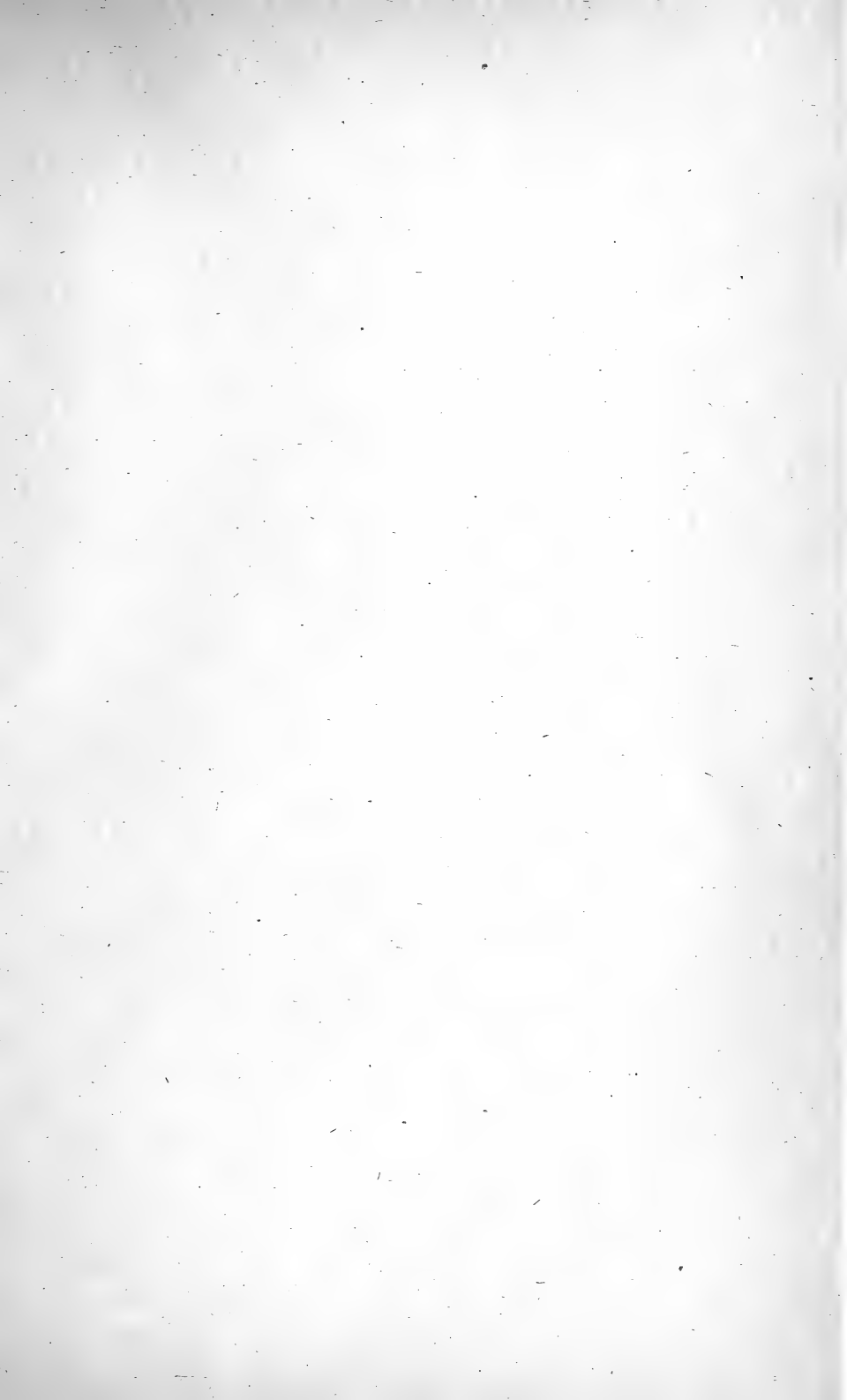
- | | | |
|--|------------------------------------|-------------------------------------|
| 1, 1a, 1b, 22. <i>N. g. gibbsii</i> . | 8. <i>Scalopus inflatus</i> . | 15. <i>Scapanus l. grinnelli</i> . |
| 2, 2a, 2b, 23. <i>N. g. hyacinthinus</i> . | 9. <i>Scalopus æreus</i> . | 16. <i>Scapanus l. sericatus</i> . |
| 3. <i>Scalopus a. aquaticus</i> . | 10. <i>Scapanus townsendii</i> . | 17. <i>Scapanus l. minusculus</i> . |
| 4. <i>Scalopus a. howelli</i> . | 11. <i>Scapanus o. orarius</i> . | 18. <i>Scapanus l. dilatatus</i> . |
| 5. <i>Scalopus a. australis</i> . | 12. <i>Scapanus o. schefferi</i> . | 19. <i>Scapanus anthonyi</i> . |
| 6. <i>Scalopus a. machrinus</i> . | 13. <i>Scapanus l. latimanus</i> . | 20. <i>Parascapulus breweri</i> . |
| 7. <i>Scalopus a. texanus</i> . | 14. <i>Scapanus l. cecultus</i> . | 21. <i>Condylura cristata</i> . |

INDEX.

[New names in **bold-face type**; synonyms in *italics*.

- acquaticus*, *Scalopus*, 33.
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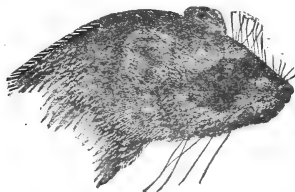


U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY

HENRY W. HENSHAW, *Chief*

NORTH AMERICAN FAUNA
No. 39

[Actual date of publication, November 15, 1915]



REVISION OF THE POCKET GOPHERS OF
THE GENUS THOMOMYS

BY

VERNON BAILEY

CHIEF FIELD NATURALIST, BIOLOGICAL SURVEY



WASHINGTON
GOVERNMENT PRINTING OFFICE

1915



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PRAIRIE POCKET GOPHER (*THOMOMYS TALPOIDES RUFESCENS*.)

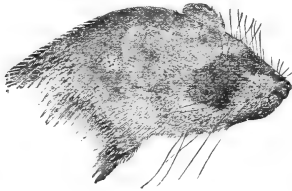
About two-thirds natural size. From colored drawing of a specimen from Carberry, Manitoba, by Ernest T. Seton.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., April 29, 1915.

SIR: I have the honor to transmit herewith for publication as North American Fauna No. 39, a revision of the pocket gophers of the genus *Thomomys*, by Vernon Bailey, chief field naturalist of the Biological Survey.

Pocket gophers are burrowing rodents which in pursuit of food and in running tunnels often damage crops, young trees, and irrigation ditches. Moreover, the heaps of earth ejected from the tunnels not only cover more vegetation than the animals eat, but also obstruct the operation of mowing machines. Gopher burrows frequently penetrate and cut through irrigation-ditch banks, and the escaping water becomes a menace to agriculture and sometimes to human life. The animals are thus of considerable economic importance.

The present paper completes the technical revision of the pocket gophers (family Geomyidæ), the first part of which was prepared by Dr. C. Hart Merriam and published in 1895 as North American Fauna No. 8. The revision will supply definite information regarding the status and geographic distribution of the several forms, which is important in connection with attempts to control or exterminate them.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

HON. DAVID F. HOUSTON,
Secretary of Agriculture.

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REVISION OF THE POCKET GOPHERS OF THE GENUS THOMOMYS.

By VERNON BAILEY.

INTRODUCTION.

Pocket gophers, a group of rodents peculiar to North and Middle America, belong to the family Geomyidæ, which includes the genera *Thomomys*, *Geomys*, *Pappogeomys*, *Cratogeomys*, *Platygeomys*, *Orthogeomys*, *Heterogeomys*, *Macrogeomys*, and *Zygogeomys*. The present revision deals only with the genus *Thomomys*,¹ which is distinguished from the others by the practically ungrooved surface of the upper incisors. The large fur-lined external cheek-pouches are a family character shared by all genera and species, as are the general habits of living in underground burrows and throwing up heaps of earth along their lines of tunnels. The genus *Thomomys* includes 88 recognizable forms of 40 species. These vary in size from that of a small mole to that of a large rat, and in color from light buff to yellow and gray, and from many shades of brown and rusty to dusky and even black. All are short-legged, robust, sturdy little animals, with small ears and eyes, and short, smooth hair.

Gophers of the genus *Thomomys* are abundant over almost the entire western half of the United States, in a great area of southwestern Canada, and over much of Mexico (see fig. 1), covering considerably more territory than all the other members of the family together. The various forms do not overlap in range to any great extent, but in the area occupied they are present in almost every locality, and are especially abundant in fertile and valuable agricultural lands. Their burrows are a constant menace to agricultural operations, irrigation ditches, and reservoirs. Their food is entirely of vegetable matter, and of this roots, bulbs, and cultivated crops are preferred. In destroying crops and fruit trees they cause a heavy loss to western

¹In 1895 Dr. C. Hart Merriam monographed the family Geomyidæ, exclusive of the genus *Thomomys* (N. Am. Fauna No. 8), and also included a chapter on the anatomy and relationships of *Thomomys* and a map of the genus without reference to its specific and subspecific divisions. It was my privilege to assist him in working over the material for his monographic revision and later I was assigned the task of completing the revision of the genus *Thomomys*.

farmers each year, and it is necessary in farming areas to use every possible means of restraining their increase and checking their depletions. In wild land, on the other hand, their presence is highly beneficial, not only because they stir the soil and enrich it by burying vegetation under their mounds, but also because they form a network of underground channels which aid materially in retaining water and carrying it deeper into the ground. Such of their beneficial habits as have operated for ages in enriching the western soils are far overbalanced in agricultural lands by their destructive habits. On lands newly brought under cultivation it is often necessary to wage an active campaign against gophers, in order to render the crops fairly safe. (See footnote, p. 14.)

The present paper describes the recognizable species and subspecies and defines their geographic distribution so far as at present known.

GENERAL HABITS.

BURROWS.

Pocket gophers of the genus *Thomomys* are burrowing animals which spend most of their lives underground. The several species have practically the same habits except as modified by environment. They are sturdy little miners, drifting their tunnels on and on in search of food, throwing out little heaps of earth along the lines of excavation, and then quickly closing the doorway. The tunnels vary from about 6 inches to a foot below the surface, and from about 1½ to 3 inches in diameter, according to the size of the gopher. The length of the tunnels is practically interminable and their course varies from a winding network to long direct lines.

The character of the burrows is determined by the food supply. A row of potatoes may be followed across a field, or the spreading roots of an apple tree may hold the attention of the gopher for some time. If food is scarce the rows of mounds reach in direct lines for long distances, but when it is abundant they wind back and forth within a limited area. While the males move about more freely at the beginning of the breeding season and there are indications of rare migrations, pocket gophers are evidently the most restricted in their habitat of any of our native mammals. Even moles, which live more completely underground, burrow more rapidly and travel more widely. The whole summer's line of hills of one gopher can often be seen at a glance. The animals rarely leave an alfalfa or potato field, but hurry across waste places. Under ordinary circumstances, however, a gopher often spends a year on a single acre, and perhaps the next year on an adjoining one. Most gophers probably never get 40 rods from where they were born, but where environment is less favorable and the gopher is more active, he may extend his tunnels for half a mile or possibly a mile during his career.

Little mounds of earth, thrown out as the burrows are excavated, and varying in bulk normally from a quart to a bushel and in distance from a close proximity to 15 feet apart, mark the lines of the



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FIG. 1.—Map showing the distribution of the genus *Thomomys* (shaded area).

burrows. After the loose soil is pushed out, the openings are securely packed with earth and closed from within as a fortification against enemies. The entrances are often closed so securely that even the experienced trapper has difficulty in locating the burrow beneath.

Usually, however, the opening may be found by the depression where the last load of earth was left, and the direction of its slope downward determined by the position from which the mound of earth was pushed out. This also serves to distinguish a gopher hill from a molehill, as the mole pushes up the earth from below without making an opening to the daylight. Often the opening is near some plant, as the gopher evidently recognizes a choice species by the root and, following it to the surface, devours or carries it away.

These mounds or "gopher hills," frequently cover low vegetation; on wild land this serves to enrich the soil, but in fields and meadows they often cover and destroy the growing grain and forage, and also interfere with mowing and harvesting.

FOOD HABITS.

Gophers of all species of *Thomomys* are strict vegetarians. Their food consists for the most part of roots, bulbs, tubers, and the most edible and nutritious underground parts of plants, but it includes also much green vegetation from aboveground. As they extend their tunnels gophers find wild onions, liliaceous bulbs, wild potatoes, underground beans, grass tubers, and an endless number of edible roots. These are cut in sections or, if of convenient shape and size, tucked in the pockets whole, and when the pockets are well filled are carried to the dining room to be eaten at leisure or deposited in the storeroom for future use. When gophers are trapped their pockets usually contain articles of food, sometimes so much that they stand out on both sides of the head.

The list of plants found in the pockets is long and varied. Some of the fleshy desert plants, as cactuses, yuccas, agaves, and sotol are entered from below and the juicy centers eaten out. Wild clovers and a great many leguminous plants are favorite foods, while grass stems and blades are eaten to some extent. Very small bushes are sometimes cut down near the burrows and the bark eaten, but trees are rarely injured aboveground.

Gophers apparently do not require water, and it is doubtful if they drink at all. Many desert species thrive for long periods, sometimes a year or more, where they can not get water, but green food and juicy roots evidently supply all the moisture they need.

DAMAGE TO CROPS.

Pocket gophers show a keen appreciation of man's efforts in agriculture and horticulture by resorting to cultivated areas. They revel in potato fields, and one gopher will destroy a long row of the tubers, taking one hill after another from the time they first appear until they are harvested. They quickly attack newly planted areas,

and where potatoes are stored in the field they often enter the pits to eat the tubers or carry them away. All kinds of garden vegetables and also most field crops are eagerly eaten, either below or above the surface of the ground. Gophers sometimes burrow up into pumpkins or squashes and eat out the insides without the mischief being detected until the empty shells dry up. They will work all summer in grain fields, cutting and eating the leaves, stems, and grain heads and covering with their hills of earth even more grain than they eat. In alfalfa and clover fields and in grass meadows they destroy both roots and tops and pile their mounds over much of the crop, and in addition, by leaving their mounds full of small stones, they dull and break the knives of mowing machines. Their mischief is perhaps most exasperating in orchards and nurseries, as they often injure or kill choice fruit trees by their underground operations. They are very fond of the roots of apple, pear, and fig trees.

In irrigation areas gophers have an annoying habit of burrowing through the ditch banks and letting the water cut its way out, of filling up the smaller ditches with their mounds, and of interfering generally with the most efficient use of water. It is reported that in the spring of 1915 their burrows caused two reservoir dams on the Little Colorado River, near St. Johns, Ariz., to give way, causing the death of eight persons by drowning, and damage to crops to the extent of half a million dollars.

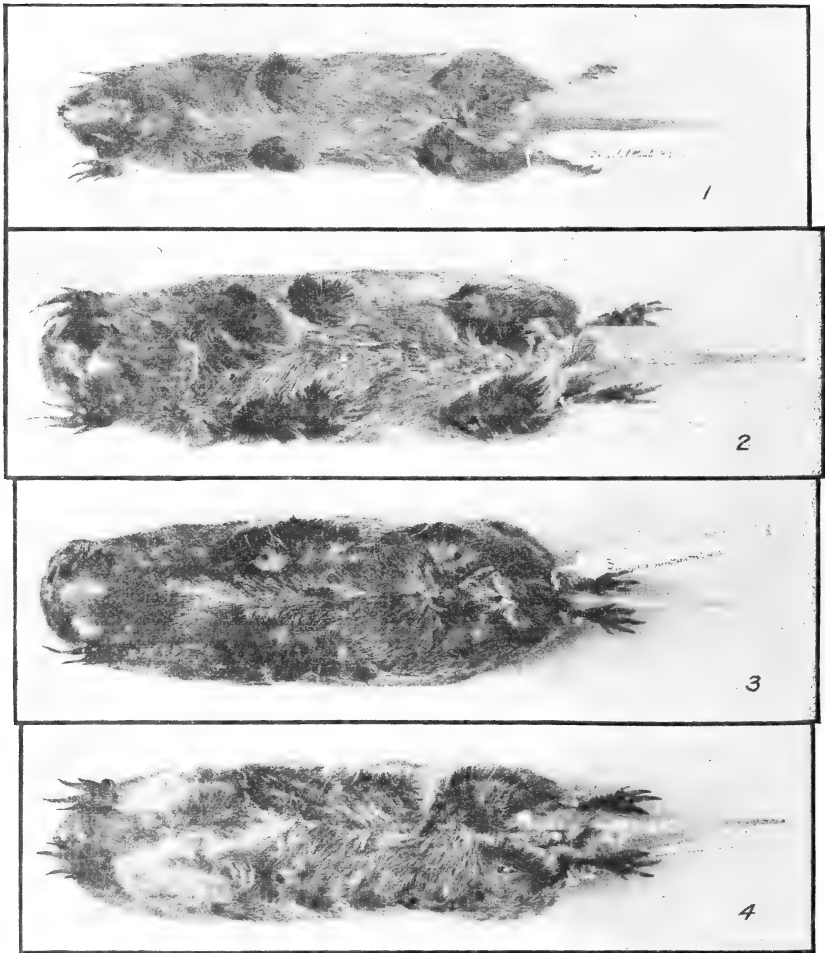
WINTER HABITS.

Apparently none of the pocket gophers hibernate, and in spring, as the deep snows melt, their old burrow-molds are seen snakelike over the surface of the ground as evidence of winter activity. They work below the frost and instead of throwing out mounds they tunnel under the snow along the surface of the ground, probably gathering some green plants as they go, and then fill these snow tunnels with earth from their burrows. This earth freezes and hardens and often remains all summer as earth casts of gopher burrows in the snow. The long safe winter under protection of the snow has probably done much to conserve the species and facilitate their wide dispersal and abundance in high mountains and northern areas.

BREEDING HABITS.

The little known of the breeding habits of *Thomomys* barely suffices for a few general conclusions. In northern and more elevated portions of the country female gophers usually contain small embryos in June, and early in that month a male and female are occasionally caught in the same burrow. This rarely happens later in summer, and it is evident that only one litter of young is regularly raised in a year. In warmer climates the young are

born earlier, and in some regions two litters may be raised. Though I have collected many specimens, I have never seen one younger than the nearly half-grown stage, when they begin to move about, nor have I found specimens of young in any of the museum collections. During July and August many half-grown gophers are



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FIG. 2.—Skins of adult females of *Thomomys*, showing number and position of mammae in different groups and species. (Exact location of nipple indicated by black dot. Relative position of posterior pairs often distorted by method of sewing up skin.) 1, *Thomomys umbrinus umbrinus*; 2, *T. bottæ bottæ*; 3, *T. fossor*; 4, *T. talpoides rufescens*.

caught in traps, but then they are working in the parent burrow or starting new lines for themselves. A little later old and young are in independent burrows.

The number of young in a litter varies in the different species, as might be expected from the variation in the number of mammae

in the females (fig. 2). In the *umbrinus* group from Mexico, with 3 pairs of mammæ, the number of embryos has been recorded as 2 and 3. In other species, with 4 pairs of mammæ, the number of embryos has been recorded as 4 and 5, while in the *clusius* and *ocius* groups, with 6 and 7 pairs of mammæ, 6 and 7 embryos seem to be the rule. Judging from nearly matured fetuses the young are born helpless and naked, and must remain for some time in the nest while cared for by the mother. Apparently nothing is known of their nests or breeding quarters.

DISPOSITION.

Like all of the family, gophers of the genus *Thomomys* are pugnacious and fight man or dog as quickly as they would an animal of their own size. To the gopher everything that moves is an enemy and is attacked with vicious wheezing and savage bites. The toe of a boot or a stick is seized, and the heavy incisors make deep cuts into wood or quickly cut through leather. The weasel is probably the gopher's only enemy of its own size that successfully attacks and masters it in its burrows. The gopher's vision is extremely limited, and it seems not to see an object until very close, when its instinct of self-preservation suggests prompt attack.

POCKET GOPHERS AS FOOD.

These gophers are not only strict vegetarians, but are in every way cleanly and exemplary in their food habits. Their flesh is tender and well flavored, and were the animals large enough they might be made a valuable adjunct to our meat supply. They have furnished me with many a palatable meal in the mountains when other food was not available, and would have been of great value to early explorers, who suffered from starvation, had a few gopher traps been carried across the mountains and deserts. Two or three gophers broiled over the coals of the camp fire furnish a fairly substantial and palatable meal, especially if accompanied by a stew of wild onions and bulbs of the camas. Gophers are hardly large enough to be worth catching for the market, however, but where large numbers must be destroyed to protect crops, some may be utilized for the table. The meat is rather dark and fine-grained, tender, and in flavor not unlike that of the squirrel. Sometimes it is rather strongly flavored with wild onions, but to some this is not unpleasant.

NATURAL ENEMIES.

While the underground life of pocket gophers would seem to render them safe from attacks of enemies, yet they are preyed upon by a great variety of animals. Hawks and owls pick up so many of them at their doorways that gopher bones are among the most abundant

in the pellets of these birds. Coyotes, foxes, and bobcats pounce upon them as they push out their loads of earth, and badgers occasionally dig them out. Weasels are probably their greatest enemies, and when one gets into a gopher burrow there is no escape for the occupant. Snakes also prey upon them to such an extent that one common species is known as the gopher snake. The protection of such natural enemies of the gopher as prove least harmful in other ways, notably hawks, owls, weasels, and badgers, is of the utmost importance as an adjunct in the control of what is proving in many sections one of the worst of our rodent pests.

DESTRUCTION OF POCKET GOPHERS.

Pocket gophers are easily trapped and poisoned, and on limited areas may be reduced to harmless numbers by systematic, intelligent effort. In extensive fields and meadows and along systems of irrigation ditches or reservoirs their control often presents problems of considerable magnitude. The Biological Survey has made special study of the many conditions under which injuries from gophers occur and of the most economical and efficient means of their control. The results have appeared in several publications of the United States Department of Agriculture.¹

GENERAL CHARACTERS.

The short legs, strong frame, and powerful muscles of pocket gophers peculiarly fit them for subterranean life. The long front claws vary considerably in size with the different species, being largest in *T. talpoides* and *T. rufescens*, which are medium-sized species, and relatively smallest in *T. bulbivorus*, the largest of the genus; but in all they are well adapted to rapid digging. The stout hind feet, with wholly naked, plantigrade soles and stout nails are well adapted to pushing, while the delicate naked soles of all the feet are doubtless of great advantage as a substitute for eyes in an animal which spends most of its life in utter darkness. Fringes of stiff bristles bordering the fingers and palms evidently assist in holding together the loose earth as it is pushed out of the burrow. The very small eyes and ears are keen at close range, but are of little use in the burrow where most of the animal's life is spent. The stubby and seemingly rather useless tail is slightly tapering, thinly haired, and often naked near the tip. It probably serves as a substitute for eyes in the animal's rapid backward progress through its burrow, as has been shown

¹ Pocket Gophers of the United States, by Vernon Bailey. Bul. No. 5, Division Ornithology and Mammalogy, 1895.

Directions for Destroying Pocket Gophers, by David E. Lantz. Circular No. 52, Biological Survey, 1908.

Harmful and Beneficial Mammals of the Arid Interior, by Vernon Bailey. Farmers' Bulletin 335, 1908.
Pocket Gophers as Enemies of Trees, by David E. Lantz. Yearbook Separate No. 506, 1909.

by Dr. Merriam to be the case with the very similar and closely related genus *Geomys*.¹ The vibrissæ are of just sufficient length to span the diameter of the burrow and doubtless serve as a further substitute for eyes.

The general pelage is fine and silky, becoming long, full, and soft in winter in cold climates and again becoming thin and harsh in summer. In the southern tropical or subtropical species the fur, if it may be called fur, seems not to attain the full soft winter coat. The pelage consists of a fine all-plumbeous underfur through which rises a longer, coarser coat with plumbeous base and colored tips which give the dominant shade characterizing the species. This usually varies considerably with the season, in some species becoming much darker in winter, in others much paler. The covering on the underparts is usually much thinner, often allowing the skin to show through. The tail, ears, and tops of feet are but thinly clothed with short, stiff hairs. The small nose-pad is naked.

The construction of the mouth is such that both upper and lower incisors protrude from fur-incased mandibles, allowing perfect freedom for cutting roots, digging in hard earth, or prying out stones without danger of the earth entering the real mouth, which opens vertically well back of the incisors and closes automatically as the incisors are spread wide apart. The fur-bordered lips close in a vertical slit in front of the real mouth or draw back and expose an ample cavity and a thick, fleshy tongue.

The pockets, which give the animal unusual interest, have been the cause of much speculation and misapprehension. Some of the specimens first seen by naturalists were stuffed with the pockets wrong side out, Say's genus *Pseudostoma* being based on such a specimen, while Kuhl's *Saccophorus* was based on a specimen showing the pockets in their real position. The use of the pockets is still often misunderstood. They are external invaginated folds of skin, fur lined, and opening along each cheek parallel with the mouth and extending approximately $1\frac{1}{2}$ to 2 inches back under the skin of the shoulder. They are very elastic and when empty might pass unnoticed, but when filled they more than double the apparent size of the animal's head. I have often thrust two fingers half their length into the two pockets of a small-sized gopher, reaching back almost to the middle of the animal's body. In large species the thumb fits nicely in the empty pocket. In removing a gopher's skin a thin band of muscle is discovered attached to the apex of each pocket and by it they are drawn back and kept in place. The pockets can not be fully everted without greatly stretching or possibly breaking this muscular attachment, but they can be drawn out so that a large fold of the lining will hang out of the pocket when the animal's muscles are relaxed. It is a common belief that the pockets are used

in carrying earth from the burrows, but such is not the case as, in preparing many hundreds of specimens, I have never found earth in the pockets, except for minute particles from roots and bulbs. Other naturalists have given the same negative evidence. On the other hand, the pockets are commonly stuffed full of vegetation. I have often watched the gopher come to the surface, opening a new doorway as he came, and begin to draw down one plant after another, cutting and tucking away the sections in his pockets as he drew them down. His motions are quick as a flash, and that the hands are used in filling the pockets is about all one can be sure of. Dr. Merriam found by watching a captive specimen of *Geomys* that the hands were used for both filling and emptying the pockets.¹

CRANIAL CHARACTERS.

In Dr. Merriam's very full discussion of the morphology of the skull in his Monographic Revision of the *Geomyidæ*² numerous figures and illustrations of the genus *Thomomys* are included. In the present work it is therefore necessary only to mention some of the variations and general characters useful in the separation of the various forms.

In all, the cranium is wide and low, with spreading zygomatic arches for the accommodation of powerful muscles. The mandibles are heavy and irregular, and the incisors above and below are long, curved, deeply embedded tools of labor and weapons of defense. The relative length and breadth of the skull vary greatly in different species: shortening of the total length generally implies a relatively wider skull; elongation a relatively narrower. In some species, however, the rostrum alone is elongated or shortened, in others the braincase varies in length and breadth. The generally wedge-shaped nasals are extremely variable in length and form, especially in form of termination at posterior tips. The premaxillæ in some terminate even with the posterior line of the nasals, in others they extend well back into the frontals with pointed, beveled, or truncate tips.

The interparietal furnishes a convenient character for the recognition of many forms, varying from a minute oval to a large quadrate bone covering nearly half the basal width of the skull. In some species, however, it is obscured in old age until completely obliterated in a high sagittal crest, in others advanced age produces no appreciable change. The various forms of the line of junction between the base of the zygomatic processes of the maxillæ and the premaxillæ and frontal and lachrymal bones furnish excellent specific as well as group characters. In the *umbrinus* group the bases of these bones are forked or concave; in most others convex, straight, or doubly curved. There are often good characters in the symphysis of the zygomatic process

¹ N. Am. Fauna No. 8, 18, 1895.

² Ibid., 33 and 198, 1895.

of the maxilla and the jugal, but this changes considerably with age and is not much used in diagnoses. The pterygoids have a wide range of variation and furnish excellent characters in many species. The large and concave pterygoids of *T. bulbivorus* have been used as the main basis for a subgenus (*Megascapheus*),¹ but while unique they certainly do not carry more than specific distinction. The general variation is in elevation or depression of the wings of the pterygoids, wide or narrow, and sharply V-shaped or widely U-shaped fossa. The audital bullæ vary greatly in relative size and form, the largest being smoothly rounded and globose, the smaller more elongated and angular. The basioccipital varies greatly in relative length and width, generally becoming narrower as the bullæ increase in size and crowd upon its margins. Many slight detailed differences can also be used to advantage as characters. Many excellent characters in the lower mandibles are not generally used in diagnoses, as in most forms there are others more convenient.

DENTITION.

The dental armature of *Thomomys* is included and fully discussed with the other genera in Dr. Merriam's revision of the Geomyidæ.² Throughout the genus *Thomomys* there is surprising uniformity of tooth form and enamel pattern in the molariform teeth; while many minute variations furnish distinctive specific characters, the necessity of studying them with a lens renders them inconvenient for general use, and they rarely serve to separate closely related forms. On the contrary, the incisors furnish conspicuous group as well as specific characters. The angle of the upper incisors to the axis of the skull varies from the very protruding incisors of *T. bulbivorus*, *T. leucodon*, and *T. umbrinus* to the abruptly incurved incisors of *T. pygmæus*, *T. idahoensis*, and *T. ocius*. A narrow groove near the inner edge of each upper incisor is deepest and most conspicuous in the *monticola* group, but so slight and obscure in other groups as to be detected only by critical examination with a lens; it is usually most obscure in species with projecting upper incisors. In some species the incisors are rather slender, and in others relatively stout.

SEXUAL VARIATION.

The male in most species is considerably larger than the female and its skull is heavier, more angular, and more heavily ridged in old age. This sexual difference is greatest in the *bottæ* group and apparently least in the *monticola* and *fuscus* groups, but is noticeable in all.

The functional mammæ vary in fully adult females of different species from 3 to 7 pairs, usually arranged in 2 pairs of inguinal, 2 or

¹ Elliot, Field Columb. Mus., zool. ser. III, 190, 1903. Type, *Diplostoma bulbivorum* Richardson.

² N. Am. Fauna No. 8, 69-108, 1895.

none of abdominal, and 1, 2, or 3 of pectoral. The usual number of embryos ranges from 3 to 7.

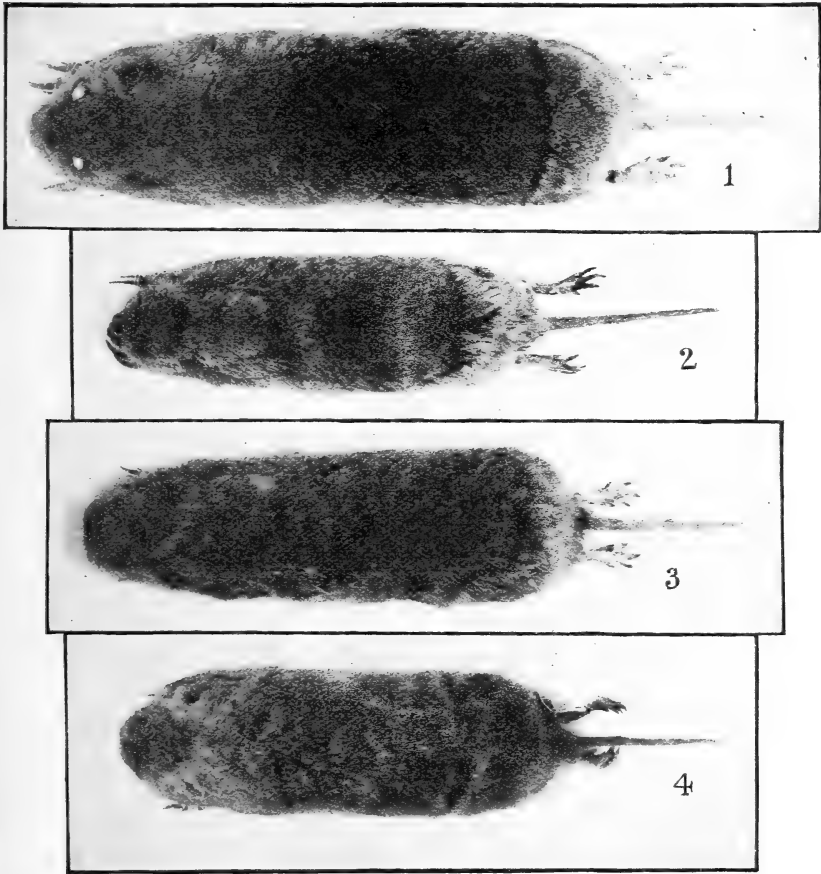
MOLT.

In the genus *Thomomys* there seem to be normally two complete changes of pelage during the year, from the winter to the summer coat during spring or early summer, and from the summer to the winter coat in fall. The time of these changes varies in different species and often in the same species with different climatic conditions, and apparently also with the varying physical condition of individuals, as age and bodily vigor. In the northern and more elevated areas the molt is more pronounced and its progress more rapid, owing to greater extremes of climate; while in the equable climate of the west-coast areas and in the Tropics of western Mexico very gradual and slight change of pelage occurs. The progress of the molt is normally from the nose over the head and body to the base of the tail along a crescentic line, a little faster on the back than on the sides. On the belly the molt lags behind and is less regular.

The spring molt is most conspicuous, as each succeeding wave of hair is shorter than that displaced and leaves a dark line of plumbeous basal color exposed on the old hair. The change is a creeping process. New hair displaces old on the nose, apparently pushing out the old and worn and taking its place along the line of advance backward and downward. The line is normally a semicircle, but it often becomes distorted by one part progressing more rapidly than another. In some cases the change is complete as it progresses, all the old hair being replaced, but in others the molt is only partial, a thinning or filling-up process, but always progressing along the line in the same way. In spring the first molt wave and often those up to the fifth are but slight changes, a thinning like the removal of one winter shirt after another, but the final, perhaps fifth or sixth, change to the thinnest summer clothing is a complete change as it progresses. The number of molt waves is not easily determined from specimens, as they often overtake and run into each other. The long winter coat is retained on the rump often until late summer, and the successive molt waves strike against this until the short summer coat pushes it off at the base of the tail just before, or sometimes, in high or northern localities, not until, the next winter coat has begun to make its appearance on the nose. There are at least five waves in the spring molt, as this number appears on many specimens taken in May or June. Those taken later in summer usually show a less number of coats but with more deeply marked division lines due to the combination of several waves into one or more.

The fall molt is different. The winter coat is put on more rapidly with the appearance of really cold weather, and apparently the full change is accomplished in two molt waves that begin at the nose and

progress over the animal along a semicircular line. The line is not so conspicuous, however, as the longer hair overlaps the short summer coat which it is crowding out, and does not exhibit the plumbeous color along its margin. Often before the first coat has reached the



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FIG. 3.—Skins of *Thomomys* (U. S. Nat. Mus. specimens) showing waves of pelage during molt.

1. *Thomomys talpoides rufescens*, male adult, No. 180486, Valley City, N. Dak., May 17, 1912, showing five waves of pelage during spring molt.
2. *Thomomys quadratus fisheri*, male adult, No. 94411, Ruby Valley, Nev., June 23, 1898, showing four waves of pelage during spring molt.
3. *Thomomys talpoides clusius*, female adult, No. 160396, Shirley Mountains, Wyo. (8,800 feet altitude) Aug. 21, 1909, showing three waves of spring molt, with coat of previous winter on rump and two waves of fall molt coming in on head: two winter coats at one time.
4. *Thomomys quadratus fisheri*, male adult, No. 80721, Cottonwood Range, Nev., Sept. 17, 1896, showing first wave of fall molt back to rump, second wave back to ears.

base of the tail the second has begun on the nose and is following the first (fig. 3). This seems not to replace the first but to fill up and thicken the coat, while both may increase in length as the weather becomes more severe.

Climatic conditions control the time and nature of molt, but not its general plan. Species from high in the mountains and from well north wear heavy winter coats for a longer time: *T. talpoides* from October to April; *T. fossor* and *T. fuscus* from October to May; while those from low hot valleys—*T. perpallidus*, *T. albatu*s, and *T. chrysonotus*—wear thinner winter coats from about the first of December to the first of March. Species from the California coast show the usual molts, but with slight contrast between summer and winter, and with considerable individual variation in dates of change. The one fully tropical species, *T. atrovarius*, from western Mexico, is represented by specimens taken from April 5 to August 3, in most of which one molt line appears across the back, and none shows more than one, while there are several without any trace of molt. This condition is rarely found in any other species in summer pelage and is probably due to the tropical climate. Specimens showing a molt line seem to be changing from one thin, harsh pelage to another exactly like it, and whether there is any change to a winter pelage in this species remains to be shown by winter specimens.

When the young, which are evidently born naked, are old enough to begin moving about, they have a fine, short coat of silky hair, which a little later becomes longer and more lax as well as finer and softer than in adults, and when they are about half grown the molt begins on the nose and progresses slowly as in adults, with but one molt to adult summer pelage. This change is not completed until the animal is almost grown, and while it resembles the faded and old worn pelage of adults, it can be recognized by its finer, softer texture.

The number and sequence of molt waves can be satisfactorily determined only by a study of living animals as a supplement to the large series of specimens available.

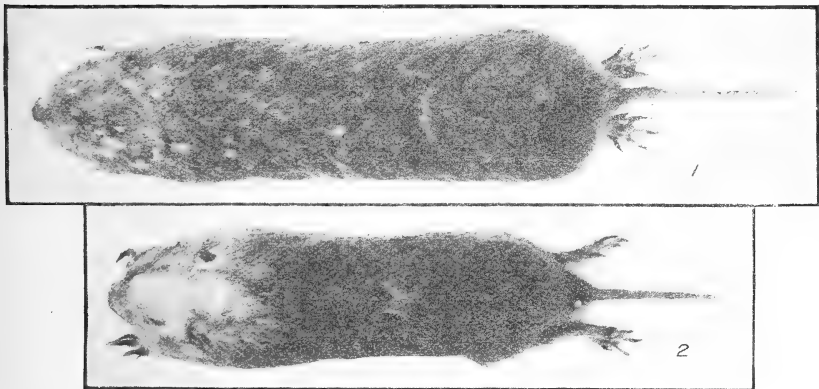
ABNORMAL PELAGE CONDITIONS.

ALBINISM.

Albinism is rare in the genus *Thomomys*, but a number of specimens examined are fully albinistic and others partially so. One albino of *T. bottæ* from San Francisco is in the U. S. National Museum collection, and Townsend speaks of a "perfect albino" presented to him at San Diego.¹ Two specimens of *T. fuscus* in the Biological Survey collection from Shuswap, British Columbia, are pure white all over. A pure white specimen lacking all of the skull except the front teeth was given me at Scottsburg, Oreg., but the species was not identifiable; it was probably *T. niger*, a species otherwise known only from pure black specimens. Specimens of *T. awahnee* from the Yosem-

¹ Proc. U. S. Nat. Mus. X, 177, 1887.

ite, *T. mewa* from Fresno Flat, Cal., and *T. pascalis* from Fresno, Cal., show large white patches on backs, arms, and breasts, and one of *T. yelmensis* from Tenino, Wash., shows white patches on one side. The white patches below, on chin, breast, or belly, are often constant and furnish good specific or subspecific characters. Two specimens of *T. aureus* from Shiprock, N. Mex., are light gray all over from a predominance of white or light gray hairs. One of *T. nevadensis* from Battle Mountain, Nev., is hoary over the head and back from a generous sprinkling of white hairs. A specimen of *T. fossor* from the Cochetopa Forest, Colo., is also gray over the head and back in the same manner, but this may belong to another series of abnormal color variation, caused by ticks or skin disease (fig. 4).



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FIG. 4.—Skins of *Thomomys* (U. S. Nat. Mus. specimens), showing abnormal pelage conditions.

1. *Thomomys fossor*, No. 137661, female adult, Arapahoe Pass, Colo., July 5, 1905. The abnormal white speckling is probably due to tick bites.
2. *Thomomys fuscus fuscus*, No. 72949, female adult, Tobacco Plains, Mont., July 8, 1895. The white on head may be due to ticks, mange, or skin disease.

MELANISM.

Melanism is much more common than albinism, as one species, *T. niger*, is known only from pure black individuals, and six other species are more or less melanistic. In *T. townsendi*, from southern Idaho, there are 5 black specimens and 12 of the normal gray. The Biological Survey series contains 36 normal yellow-gray, 18 black, and 10 dark gray individuals. In *T. orizabæ*, of southern Mexico, 14 out of 16 specimens from the type locality on Mount Orizaba are black. Of 8 specimens of *T. umbrinus* from Boca del Monte 4 are almost black and 4 are dark brown. In a series of 11 specimens of *T. atrovarius*, 3 are almost black. One specimen of *T. peregrinus* is fully melanistic, but dichromatism may be rare in the species, as specimens from many other localities are normal. In a large series of specimens of *T. alticola* from southern Lower California 4 are so dark

as to be considered partially melanistic. There are two black skins of *T. talpoides* from Red Deer, Alberta; one of *T. rufescens* from Fish Lake, in the Turtle Mountains, N. Dak.; one of *T. fulvus* from Trumbull Mountains, Ariz.; one of *T. toltecus* from Fairbanks, Ariz.; and several specimens of *T. bottæ* from widely separated localities in California. This is by no means an exhaustive list of melanistic specimens, but merely serves to show how common and widely represented is this variant phase.

Abnormal marking of another type is undoubtedly caused by tick bites. In many specimens of *T. fossor* from the mountains of Colorado, Wyoming, and New Mexico small white specks occur scattered irregularly over the top of head and shoulders, giving the animal a speckled appearance similar to that of tick-bitten Texas horses. The fact that these occur only on the parts of the gophers' bodies not to be reached by their teeth strongly suggests as their origin the presence of small ticks which engorge and remain attached to the skin long enough to produce sores, which when healed are covered with white instead of normal hair. Gophers with speckled heads are represented from Colorado by specimens from 3 and 7 miles east of Cochetopa Pass, from Hahns Peak, Rabbit Ear Mountains, Elk Head Mountains, Longs Peak, Estes Park, Baxter Pass, and Pearl; from Wyoming, by a specimen from Bridger Peak; from Utah, by specimens from the Beaver Mountains; and from New Mexico, by specimens from Costilla Pass, Costilla River (near source), Red River (near source), Taos Mountains, and Twining.

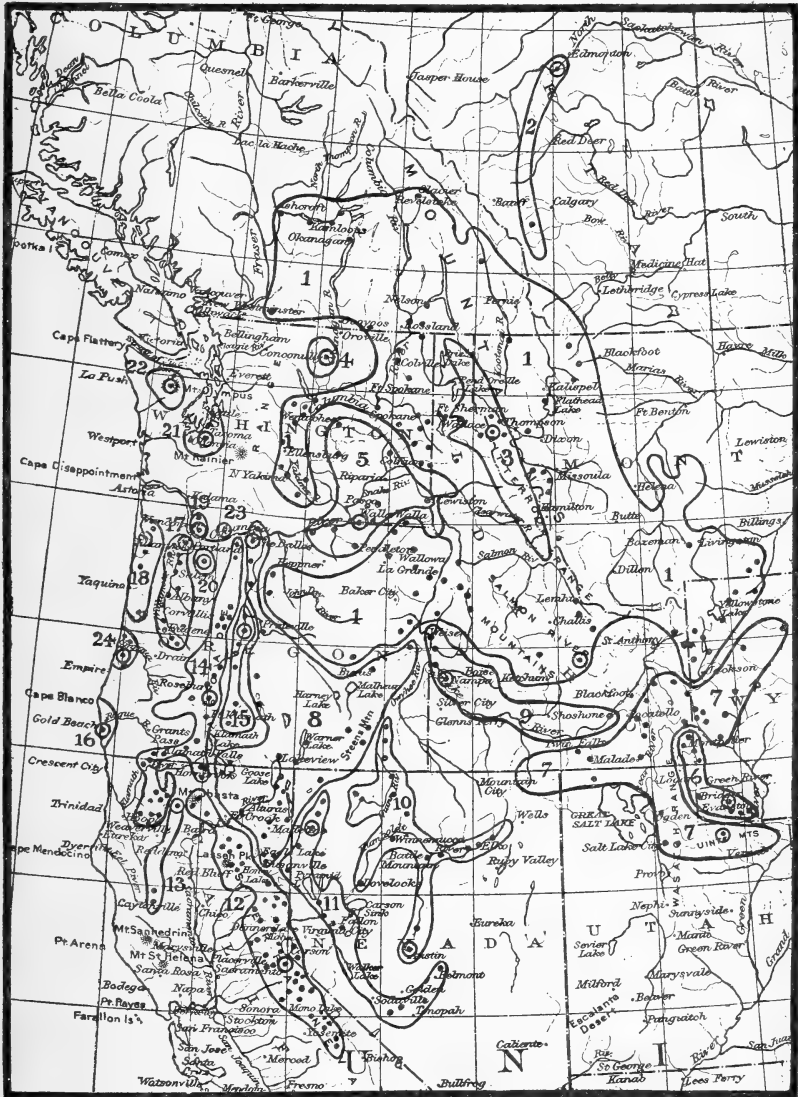
A somewhat similar abnormal condition is found in a few specimens of *T. fuscus* from northwestern Montana. The top of the head and shoulders becomes gray from a considerable mixture of white hairs. The hair has a thin and unnatural appearance, the result, it has been suggested, of mange or a similar skin disease.

VARIATION AND DISTRIBUTION.

The great variety of slight characters and lack of more trenchant characters over a wide range, the abundance and almost continuous dispersal of the genus in this range, and the evident uniform vigor of the whole group indicate that the genus is at the height of its development. It has pushed out from the other perhaps older, more widely differentiated genera of the Geomyidæ and covered more territory and produced more species and subspecies than all the rest of the family. In 1895 Dr. Merriam recognized in the Geomyidæ, exclusive of *Thomomys*, 8 genera embracing 37 species. The genus *Thomomys*, without even a valid subgenus,¹ contains at least 88 recognizable forms of 40 species, and occupies about twice the area of the rest of the family. (See figs. 5 to 10.)

¹ See first footnote, p. 17.

Thomomys shows its vigor and adaptability by occupying the territory not inhabited by other more robust members of the family, which



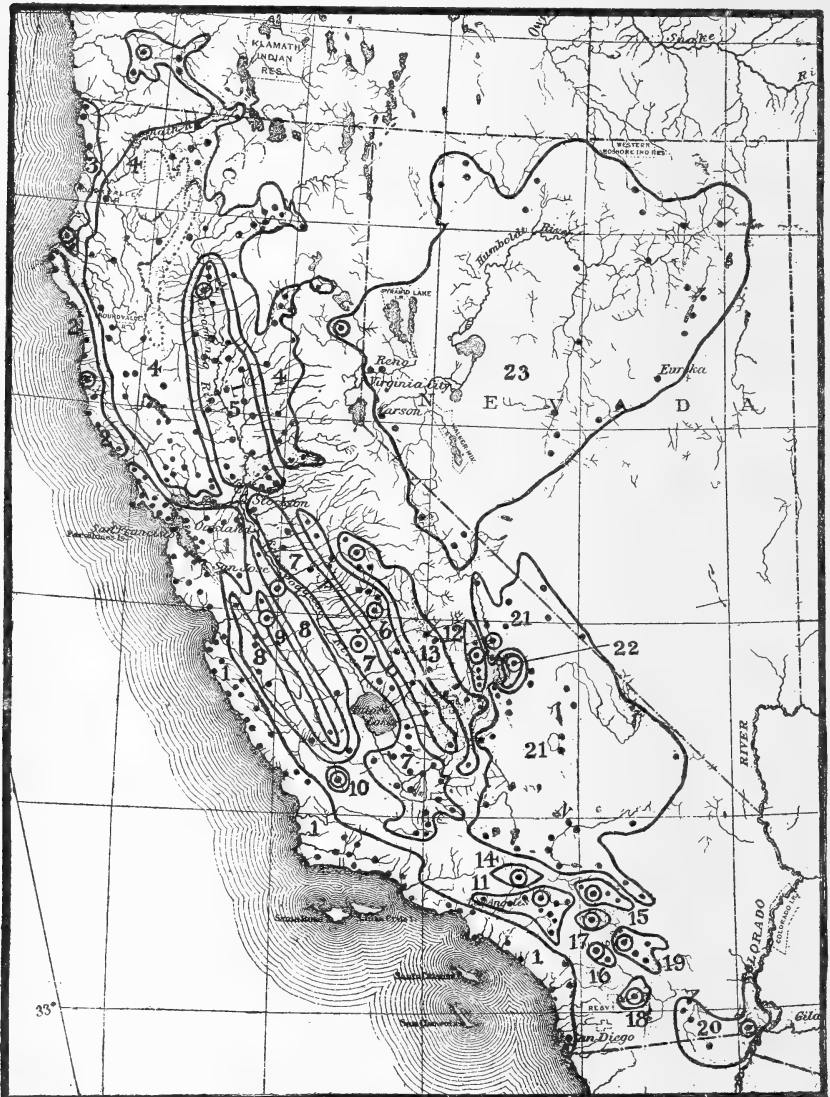
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FIG. 5.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

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|-------------------------|-------------------------|------------------------|--------------------------|----------------------|
| 1. <i>fuscus</i> . | 6. <i>bridgeri</i> . | 11. <i>canus</i> . | 16. <i>helleri</i> . | 21. <i>yelmensis</i> |
| 2. <i>loringi</i> . | 7. <i>vinta</i> . | 12. <i>monticola</i> . | 17. <i>bulbivorus</i> . | 22. <i>melanops</i> |
| 3. <i>saturatus</i> . | 8. <i>quadratus</i> . | 13. <i>pinetorum</i> . | 18. <i>hesperus</i> . | 23. <i>limosus</i> . |
| 4. <i>myops</i> . | 9. <i>townsendi</i> . | 14. <i>mazama</i> . | 19. <i>douglasi</i> . | 24. <i>niger</i> . |
| 5. <i>columbianus</i> . | 10. <i>nevadensis</i> . | 15. <i>nasicus</i> . | 20. <i>oregonensis</i> . | |

hold the milder, more luxuriant valleys. It lives in almost every desert valley and rugged desert range of mountains, as well as on the

semiarid plains and stony slopes of the great mountain ranges, and even up through the mountain forests to timber line and often far



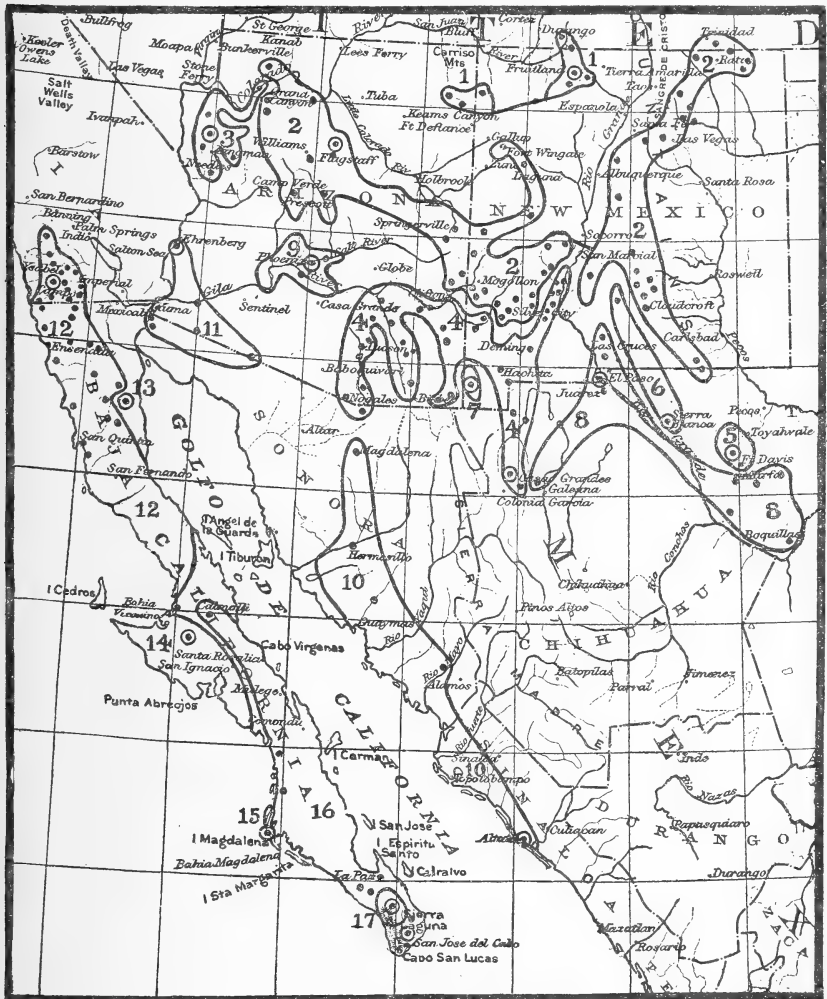
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FIG. 6.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

- | | | | | |
|----------------------|----------------------------|--------------------------|--------------------------|------------------------|
| 1. <i>bottæ</i> . | 6. <i>mewa</i> . | 11. <i>palleescens</i> . | 16. <i>jacinteus</i> . | 21. <i>perpes</i> . |
| 2. <i>minor</i> . | 7. <i>pascalis</i> . | 12. <i>alpinus</i> . | 17. <i>cabezonæ</i> . | 22. <i>operarius</i> . |
| 3. <i>laticeps</i> . | 8. <i>angularis</i> . | 13. <i>awahnee</i> . | 18. <i>puertæ</i> . | 23. <i>fisheri</i> . |
| 4. <i>leucodon</i> . | 9. <i>diaboli</i> . | 14. <i>neglectus</i> . | 19. <i>perpallidus</i> . | |
| 5. <i>navus</i> . | 10. <i>infrapallidus</i> . | 15. <i>altivallis</i> . | 20. <i>abatus</i> . | |

above on the peaks and crests of high ranges. That these gophers however, prefer comfortable conditions and thrive on mellow

soil and an abundant food supply is shown by the development of more robust species under such favorable environment. All the larger species inhabit rich valley bottoms. The smaller are mainly



B2048-122

FIG. 7.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

- | | | | |
|------------------------|-------------------------|--------------------------|------------------------|
| 1. <i>apache</i> . | 6. <i>baileyi</i> . | 10. <i>sinaloæ</i> . | 14. <i>russeolus</i> . |
| 2. <i>fulvus</i> . | 7. <i>mearnsi</i> . | 11. <i>chrysonotus</i> . | 15. <i>magdalena</i> . |
| 3. <i>desertorum</i> . | 8. <i>luchiguilla</i> . | 12. <i>nigricans</i> . | 16. <i>anite</i> . |
| 4. <i>toltecus</i> . | 9. <i>cervinus</i> . | 13. <i>martirensis</i> . | 17. <i>alticolus</i> . |
| 5. <i>texensis</i> . | | | |

from deserts where food is scarce and conditions for underground life hard and unfavorable.

For unknown reasons there is practically no overlapping in range of either genera or species in the family. This may be due to the

ferocious dispositions of all members of the family. For about 2,000 miles the ranges of *Geomys* and *Thomomys* meet across the Middle West from Pembina, N. Dak., to the lower Rio Grande, apparently without actual overlapping. The same conditions occur along the ranges of large and small species of *Thomomys*, as at Fort Bridger,



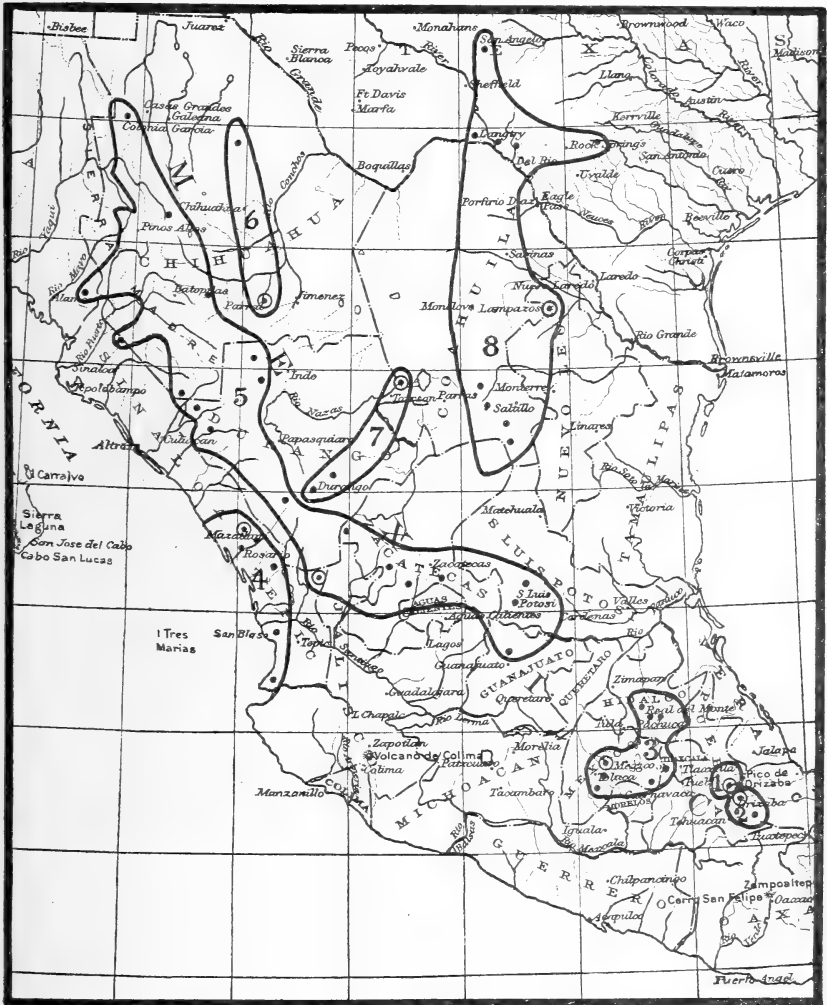
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FIG. 8.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

- | | | |
|----------------------|-------------------------|-------------------------|
| 1. <i>fossor</i> . | 4. <i>desertorum</i> . | 7. <i>chrysonotus</i> . |
| 2. <i>agrestis</i> . | 5. <i>aurus</i> . | 8. <i>cervinus</i> . |
| 3. <i>pervagus</i> . | 6. <i>latirostris</i> . | 9. <i>intermedius</i> . |

Wyo., where *T. bridgeri* is abundant in meadows and the little *T. ocivus* in sagebrush only a few rods away; at Bear River, Wyo., where *T. pygmaeus* holds the same relation to *T. bridgeri*; in western Nevada, where the small *T. fisheri* evidently keeps out in the sagebrush to avoid the big *T. nevadensis*; and in Idaho, where *T. townsendi* holds the rich bottoms and the little *T. idahoensis* the dry sagebrush borders. Where

T. monticola meets the various forms of the *bottæ* group along the west slope of the Sierra Nevada, and other species along the east slope of the range, the line of demarcation seems to be sharp, without actual overlapping of the species, although one form may lap well past the



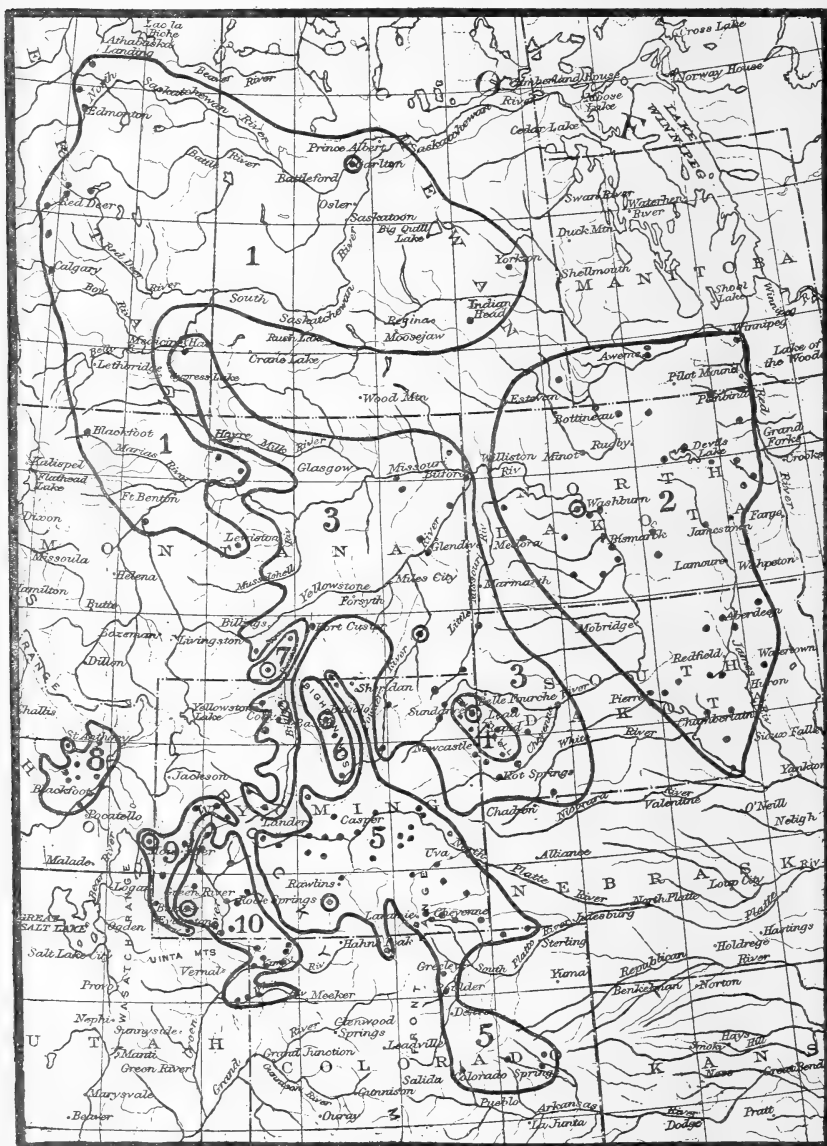
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FIG. 9.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

- | | | |
|------------------------|------------------------|----------------------|
| 1. <i>umbrinus</i> . | 4. <i>atrovarius</i> . | 7. <i>goldmani</i> . |
| 2. <i>orizabæ</i> . | 5. <i>sheldoni</i> . | 8. <i>perditus</i> . |
| 3. <i>peregrinus</i> . | 6. <i>nelsoni</i> . | |

other in close juxtaposition, showing an apparent but not real overlapping of range. The two forms generally occupy different life zones, or different types of ground, or else divide the territory on

some other logical basis. This peculiarity of distribution is exemplified by many species and seems to be universal between the slender-



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FIG. 10.—Map showing distribution of certain species and subspecies of *Thomomys*, and localities at which specimens were collected.

- | | | |
|-----------------------|------------------------|----------------------|
| 1. <i>talpoides</i> . | 5. <i>clusius</i> . | 9. <i>pygmaeus</i> . |
| 2. <i>rufescens</i> . | 6. <i>caryi</i> . | 10. <i>ocius</i> . |
| 3. <i>bullatus</i> . | 7. <i>pryori</i> . | |
| 4. <i>nebulosus</i> . | 8. <i>idahoensis</i> . | |

and deep-rostrum groups. Further and more careful study, however, is needed to determine its cause.

The more nearly related forms generally intergrade or coalesce where their ranges join, some gradually, others abruptly, according to the change of physiographic or climatic conditions.

In Dr. Merriam's phylogenetic tree of the Geomyidæ,¹ *Thomomys* is given as one of the lower branches. The great numbers of genera and species of the family represented in southern Mexico and Central America are spoken of as of the utmost interest in view of the time and place of origin of the family to which they belong.² If, as seems probable, the family originated in tropical Mexico and Central America, *Thomomys* has pushed out to the greatest distance of any genus in the family and now reaches from Boca del Monte (near Orizaba), Vera Cruz, Mexico, north to Edmonton, Alberta, and from eastern North Dakota to the Pacific coast.

Over this vast region the species occupy every life zone from the Tropical to the Arctic Alpine, and the greatest extremes of heat and cold, dryness and humidity, light and shade to which the area is subject. Although living underground and being partially nocturnal in habits, the animals respond perfectly to environmental conditions and vary in color according to light and shade, in claws and incisor teeth according to soil texture, in length of fur according to temperature, and in size and form of ears in accordance with length of fur. Thus the great number of recognizable forms is a direct result of the wide distribution and adaptation of a plastic group. The temptation to theorize beyond the limits of actual knowledge in treating such a group is difficult to resist.

The boundaries of ranges of the recognized forms follow closely the border lines of known physiographic or climatic areas. Many forms occupy definite divisions of a life zone, or, in some cases, as on a mountain slope or on several different mountain slopes, extend regularly through a section of two or rarely three life zones, maintaining their boundary lines with surprising accuracy. On some steep and narrow mountain peaks or ranges, however, a valley species will extend up and down the sides through several climatic zones without undergoing noteworthy change.

Permanent residence in a given region seems necessary for noticeable change of characters, and even very restricted but very strongly characterized areas have developed well-marked forms. Species with the widest range are *T. talpoides* and *T. rufescens* of the great plains and prairies of the Saskatchewan and Dakota regions, or *T. fuscus* and *T. fossor* of the Canadian Zone areas of the Rocky Mountains. Some interior valley forms also have extensive ranges, but to the south and west, as the country becomes more broken and irregular, the recognizable forms of *Thomomys* become more numerous and local. California leads in the number of species, partly from its size and

¹ N. Am. Fauna No. 8, 24, 1895.

² *Ibid.*, 28.

great diversity of climatic and physical features and partly from the fact that it has been the most thoroughly studied of the Western States. The magnificent series of specimens in the Museum of Vertebrate Zoology of the University of California has not only added to the number of species known in the State, but has greatly helped in defining the ranges of local species and correlating them with the distribution areas.

MATERIAL EXAMINED.

In the present study of the genus *Thomomys* over 7,300 specimens have been examined. Of these, 4,166 are in the Biological Survey collection and 475 in the other collections of the National Museum. Of the remaining specimens examined, 1,755 are in the Museum of Vertebrate Zoology, 276 in the American Museum of Natural History, 234 in the Field Museum of Natural History, 177 in the Museum of Comparative Zoology, 131 in the Stanford University collection, 90 in the Academy of Natural Sciences of Philadelphia collection, and smaller numbers from the Victoria Memorial Museum, the Provincial Museum of British Columbia, the Kansas University collection, the Oregon Fish and Game Commission collection at Reed College, the California Academy of Sciences collection, the North Dakota Agricultural College Museum collection, and private collections of Mr. E. R. Warren, Mr. Stanley G. Jewett, Mr. W. D. Hollister, Dr. William Bebb, and Mr. Ernest Thompson Seton.

For the use of this material, which has in every case been most cordially loaned, my appreciation is elsewhere expressed.

All of the types now in America (83 in number) have been examined, and through the courtesy of Mr. Oldfield Thomas a good photograph of the skull of the type of *T. umbrinus* has been provided and also notes on the old types in the British Museum. Of the eight types not examined, five (*T. talpoides*, *T. umbrinus*, *T. atrovarius*, *T. alticola*, and *T. anitæ*) are in the collection of the British Museum. Good series of topotypes of all of these have been available for study, and also topotypes of *T. bulbivorus* and *T. douglasi*, the types of which appear to be no longer in existence. Unfortunately the type of *T. talpoides* is imperfect, lacking most of the skull, but a good series of virtual topotypes have been available for study.

The type of *T. bottæ* in the Museum d'Histoire Naturelle, at Paris, has not been seen, but large series of specimens from the type region have been examined.

The study of this material shows many localities where a few specimens would throw much light on the zonal distribution and relationships of species, and brings up many problems that can be settled only by careful field study and the collection of specimens at many

localities. The distribution maps show many wide areas in which no gophers have been collected and in which the resident species is still unidentified.

The character of the specimens has generally been such as to render the study most profitable. Well-made skins with cleaned skulls, in series sufficient to show variation due to sex, age, and abnormalities, have greatly simplified the task of classification. The skulls of a few specimens collected on early expeditions have been removed and cleaned and for the first time studied in relation to ample material. In this way errors in the former use of names have been corrected.

ACKNOWLEDGMENTS.

The greater part of the present revision was completed through a study of specimens in the Biological Survey collection, but without the additional material in other museums and private collections the results would have been very imperfect. The friendly assistance and cordial cooperation of the leading museums in the United States and Canada and of private collectors have done much toward making possible the results thus far obtained.

It is with great pleasure that I acknowledge my indebtedness to Dr. Joseph Grinnell, director of the Museum of Vertebrate Zoology, University of California; Mr. Gerrit S. Miller, jr., curator of mammals, United States National Museum; Dr. J. A. Allen, curator of mammals and birds, American Museum of Natural History; Mr. Charles B. Cory, curator of the Department of Zoology, Field Museum of Natural History; Mr. Samuel Henshaw, curator of mammals, Museum of Comparative Zoology; Dr. Witmer Stone, curator of the Academy of Natural Sciences of Philadelphia; and Prof. J. C. Branner, in charge of the biological collections at Stanford University; not only for the use of the large collections under their care, but for courtesies and assistance in working on the collections at these respective museums. For the use of specimens borrowed I am indebted to Mr. Francis Kermode, curator of the Provincial Museum, Victoria, British Columbia; Mr. P. A. Taverner, of the Victoria Memorial Museum, Ottawa, Ontario; Prof. C. D. Bunker, in charge of the collection of the Kansas University Museum; Prof. William B. Bell, of the North Dakota Agricultural College; Dr. B. W. Evermann, director of the Museum of the California Academy of Sciences; Mr. William L. Finley, of the Oregon Fish and Game Commission; and Prof. John F. Bovard, in charge of the University of Oregon Museum. To private collectors my thanks are especially due to Mr. E. R. Warren, Mr. Stanley G. Jewett, Dr. William Bebb, Mr. W. D. Hollister, and Mr. Ernest Thompson Seton.

Genus THOMOMYS Wied.

Thomomys Wied, Nova Acta Acad. Cæs. Leop.-Carol., XIX, pt. 1, 378, 1839. Type, *Thomomys rufescens* Wied.

GENERIC CHARACTERS.

Upper and lower molars with both anterior and posterior enamel plate always present. Upper incisors with plain, slightly rounded anterior surface, a minute groove near inner edge of each. In some species, notably *T. bulbivorus*, *T. leucodon*, and *T. umbrinus*, the groove is very obscure and can be detected only with a lens; in others, especially the *monticola* group, it is relatively deep, well defined, and readily seen with the naked eye. In species where the inner groove is obscure there is often a trace of a median line of depression along the front of the incisor, but it is a mere trace, difficult to detect and not sufficiently constant to serve as a diagnostic character. Fore feet relatively much slenderer and claws lighter than in other genera of the family, but claws long and well adapted to burrowing.

GROUP RELATIONSHIPS.

In the present paper the species are arranged so far as possible in accordance with their relationships. There are no superspecific divisions of sufficient value to be accorded subgeneric rank, but related species have characters in common which distinguish them as a group from other groups.

The lower outline of the rostrum is the strongest division character, and this, though slight, seems clearly to separate two great groups. In one group the rostrum is deep and heavy in side view, and its lower outline slopes rather evenly from the anterior base of the upper molars to near the base of the incisors. This group includes *T. bulbivorus*, *T. townsendi*, *T. bottæ*, *T. alpinus*, *T. perpallidus*, *T. fulvus*, *T. umbrinus*, and related species. In the other group the rostrum is relatively slender in side view and its lower outline is abruptly arched in front of the upper molars. This group includes *T. talpoides*, *T. fossor*, *T. douglasi*, *T. monticola*, *T. fuscus*, and related species. In the text this division falls on page 96, the slender-rostrum group beginning with *T. talpoides* and continuing to the end. The species of these two groups seem not to intergrade.

HEAVY ROSTRUM GROUPS.

In the heavy rostrum groups are seven divisions, not all of equal distinctness.

Thomomys bulbivorus stands by itself because of its concave pterygoids, small claws, and peculiar fur; but it is not very distant from the *bottæ* group with which it agrees in arrangement of mammæ in 4 pairs.

The *townsendi* group also stands close to the *bottæ* group, as shown by the number and arrangement of mammæ; projecting, obscurely grooved incisors; and short, wide skull.

The *bottæ* group is large, variable, and not sharply separated from the *perpallidus* and *fulvus* groups; all of them agree in number and arrangement of mammæ, short ears, and many other characters. All the forms except *T. magdalenæ* and *T. b. russeolus* are dark or light ochraceous, and it is doubtful whether these two pale forms may not really belong to the *perpallidus* group, with which they agree in distinctly grooved incisors.

The *alpinus* group includes long, narrow-skulled, dark-colored, rather large-eared forms from high up in separate mountain ranges. The mammæ are as in the *bottæ* group. The incisors are abruptly decurved and distinctly grooved.

The *perpallidus* group includes mainly pale desert forms with very small ears, but has no very distinctive group characters. The incisors are abruptly decurved and distinctly grooved.

The *fulvus* group includes several mountain forms of rather bright tawny shades, and paler tawny valley forms in the surrounding country. Some strongly resemble forms of the *umbrinus* group, but all have the mammæ in 4 pairs (2 of inguinal and 2 of pectoral). The incisors are slightly projecting in some species. All are distinctly grooved.

The *umbrinus* group is characterized by 3 pairs of mammæ (2 of inguinal and 1 of pectoral); by relatively short, wide skulls; by projecting, obscurely grooved incisors; and, in most species, by indented or straight anterior base of zygomata.

SLENDER ROSTRUM GROUPS.

In the slender rostrum groups are five subdivisions, none very strongly marked, but all with distinctly grooved incisors.

The *talpoides* group is best characterized by 6 pairs of mammæ (2 of inguinal, 2 of abdominal, and 2 of pectoral), by medium-sized ears, and by general gray coloration.

The *fossor* group is distinguished by 5 pairs of mammæ (2 pairs of inguinal and 3 of pectoral) and by generally brownish coloration. In the three mountain forms the ears are rather large, but in the two valley forms (*T. quadratus* and *T. fisheri*) the ears are very small.

The *douglasi* group and the two following are distinguished by 4 pairs of mammæ (2 of inguinal and 2 of pectoral).

The *monticola* group is very similar to the *douglasi* group, but has slightly larger and more pointed ears and generally more slender skulls.

The *fuscus* group is distinguished by very small, pointed ears and light brown color.

List of Species and Subspecies, with Type Localities.

- Thomomys bulbivorus* group (pp. 40-42):
Thomomys bulbivorus (Richardson)..... Portland, Oreg.
- Thomomys townsendi* group (pp. 42-45):
Thomomys townsendi townsendi (Bachman)..... Nampa, Idaho (?).
townsendi nevadensis Merriam..... Austin, Nev.
- Thomomys bottæ* group (pp. 45-63):
Thomomys bottæ bottæ (Eydxoux & Gervais)..... "Coast of California."
bottæ laticeps Baird..... Humboldt Bay, Cal.
bottæ leucodon Merriam..... Grants Pass, Oreg.
bottæ navus Merriam..... Red Bluff, Cal.
bottæ mewa Merriam..... Raymond, Cal.
bottæ minor Bailey..... Fort Bragg, Cal.
bottæ diaboli Grinnell..... Diablo Range, Cal.
bottæ angularis Merriam..... Los Banos, Cal.
bottæ pascalis Merriam..... Fresno, Cal.
bottæ pallescens Rhoads..... Grapeland, Cal.
bottæ infrapallidus Grinnell..... Carrizo Plain, Cal.
bottæ nigricans Rhoads..... Witch Creek, Cal.
bottæ puertæ Grinnell..... La Puerta, Cal.
bottæ anitæ Allen..... Santa Anita, Lower California.
bottæ alticolus Allen..... Sierra Laguna, Lower California.
bottæ russeolus Nelson & Goldman.. San Angel, Lower California.
magdalenæ Nelson & Goldman.... Magdalena Island, Lower California.
altivallis Rhoads..... San Bernardino Mountains, Cal.
- Thomomys alpinus* group (pp. 63-68):
Thomomys alpinus alpinus Merriam..... Mount Whitney, Cal.
alpinus awahnee Merriam..... Yosemite Valley, Cal.
neglectus Bailey..... San Gabriel Mountains, Cal.
jacinteus Grinnell & Swarth..... Round Valley, San Jacinto Mountains, Cal.
martirensis Allen..... San Pedro Martir Mountains, Lower California.
- Thomomys perpallidus* group (pp. 68-80):
Thomomys perpallidus perpallidus Merriam..... Palm Springs, Cal.
perpallidus albatus Grinnell..... Near Pilot Knob, Cal.
perpallidus chrysonotus Grinnell.... Ehrenburg, Ariz.
perpallidus perpes Merriam..... Lone Pine, Cal.
perpallidus canus Bailey..... Deep Hole, Nev.
perpallidus aureus Allen..... Bluff, Utah.
perpallidus apache Bailey..... Lake La Jara, N. Mex.
cabezonæ Merriam..... Cabezon, Cal.
operarius Merriam..... Keeler, Cal.
latirostris Merriam..... Tanners Crossing of Little Colorado River, Ariz.
cervinus Allen..... Phoenix, Ariz.
sinaloæ Merriam..... Altata, Sinaloa, Mexico.

Thomomys fulvus group (pp. 80-89):

<i>Thomomys fulvus fulvus</i> (Woodhouse).....	San Francisco Mountains, Ariz.
<i>fulvus pervagus</i> Merriam.....	Espanola, N. Mex.
<i>fulvus desertorum</i> Merriam.....	Mud Spring, Detrital Valley, Ariz.
<i>fulvus intermedius</i> Mearns.....	Huachuca Mountains, Ariz.
<i>fulvus texensis</i> Bailey.....	Davis Mountains, Tex.
<i>fulvus toltecus</i> Allen.....	Colonia Juarez, Chihuahua, Mexico.
<i>mearnsi</i> Bailey.....	Animas Valley, N. Mex.
<i>baileyi</i> Merriam.....	Sierra Blanca, Tex.
<i>lachugilla</i> Bailey.....	El Paso, Tex.

Thomomys umbrinus group (pp. 89-96):

<i>Thomomys umbrinus umbrinus</i> (Richardson).....	Boca del Monte, Vera Cruz, Mexico (?).
<i>umbrinus orizabæ</i> Merriam.....	Mount Orizaba, Puebla, Mexico.
<i>umbrinus peregrinus</i> Merriam.....	Salazar, Mexico, Mexico.
<i>nelsoni</i> Merriam.....	Parral, Chihuahua, Mexico.
<i>sheldoni nobis</i>	Santa Teresa, Tepic, Mexico.
<i>goldmani</i> Merriam.....	Mapimi, Durango, Mexico.
<i>perditus</i> Merriam.....	Lampazos, Nuevo Leon, Mexico.
<i>atrovarius</i> Allen.....	Tatemales, Sinaloa, Mexico.

Thomomys talpoides group (pp. 96-110):

<i>Thomomys talpoides talpoides</i> (Richardson).....	Fort Carlton, Saskatchewan, Canada.
<i>talpoides rufescens</i> Wied.....	Fort Clark, N. Dak.
<i>talpoides clusius</i> Coues.....	Bridgers Pass, Wyo.
<i>talpoides bullatus</i> Bailey.....	Powderville, Mont.
<i>talpoides nebulosus</i> Bailey.....	Sand Creek (Black Hills), Wyo.
<i>talpoides caryi</i> Bailey.....	Big Horn Mountains, Wyo.
<i>talpoides pryori</i> Bailey.....	Pryor Mountains, Mont.
<i>talpoides agrestis</i> Merriam.....	Medano Ranch, San Luis Valley, Colo.
<i>columbianus</i> Bailey.....	Touchet, Wash.
<i>ocius</i> Merriam.....	Fort Bridger, Wyo.
<i>idahoensis</i> Merriam.....	Birch Creek, Idaho.
<i>pygmaeus</i> Merriam.....	Montpelier Creek, Idaho.

Thomomys fossor group (pp. 111-116):

<i>Thomomys fossor</i> Allen.....	Florida, Colo.
<i>bridgeri</i> Merriam.....	Fort Bridger, Wyo.
<i>winta</i> Merriam.....	Uinta Mountains, Utah.
<i>quadratus quadratus</i> Merriam.....	The Dalles, Oreg.
<i>quadratus fisheri</i> Merriam.....	Beckwith, Cal.

Thomomys douglasi group (pp. 116-121):

<i>Thomomys douglasi douglasi</i> (Richardson).....	Fort Vancouver, Wash.
<i>douglasi oregonus</i> Merriam.....	Oregon City, Oreg.
<i>douglasi yelmensis</i> Merriam.....	Tenino, Wash.
<i>douglasi melanops</i> Merriam.....	Olympic Mountains, Wash.
<i>limosus</i> Merriam.....	White Salmon, Wash.
<i>niger</i> Merriam.....	Seaton, Oreg.

Thomomys monticola group (pp. 121-126):

<i>Thomomys monticola monticola</i> Allen..	Mount Tallac, Cal.
<i>monticola mazama</i> Merriam.....	Anna Creek, near Crater Lake, Oreg.
<i>monticola pinetorum</i> Merriam.....	Sisson, Cal.
<i>monticola nasicus</i> Merriam.....	Farewell Bend, Deschutes River, Oreg.
<i>monticola helleri</i> Elliot.....	Goldbeach, Oreg.

Thomomys fuscus group (pp. 126-131):

<i>Thomomys fuscus fuscus</i> Merriam.....	Head of Big Lost River, Idaho.
<i>fuscus saturatus</i> Bailey.....	Silver (near Saltese), Mont.
<i>fuscus loringi</i> Bailey.....	South Edmonton, Alberta, Canada.
<i>fuscus myops</i> Merriam.....	Conconully, Wash.
<i>hesperus</i> Merriam.....	Tillamook, Oreg.

Key to Groups of Related Species.

- a*¹. Rostrum deep and evenly sloping in front of upper molars.
- b*¹. Pterygoids concave on inner surface and convex on outer; mammæ in 4 pairs, **bulbivorus** group (p. 40).
- b*². Pterygoids flat and straight.
- c*¹. Mammæ in 3 pairs (inguinal, 2-2; pectoral, 1-1)..... **umbrinus** group (p. 89).
- c*². Mammæ in 4 pairs (inguinal, 2-2; pectoral, 2-2).
- d*¹. Skull short and wide; color mainly dark or light ochraceous, **botte** group (p. 45).
- d*². Skull not conspicuously short and wide.
- e*¹. Skull long and narrow; color dark..... **alpinus** group (p. 63).
- e*². Skull not conspicuously long and narrow; color mainly pale.
- f*¹. Color pale buffy yellowish, or gray and black.
- g*¹. Color buffy or yellowish (except *apache*)... **perpallidus** group (p. 68).
- g*². Color gray and black..... **townsendi** group (p. 42).
- f*². Color tawny (light or dark tawny)..... **fulvus** group (p. 80).
- a*². Rostrum slender, abruptly arched in front of upper molars.
- b*¹. Mammæ in 6 pairs or more (inguinal, 2-2; abdominal, 2-2; pectoral, 2-2), **talpoides** group (p. 96).
- b*². Mammæ in 4 or 5 pairs.
- c*¹. Mammæ in 5 pairs (inguinal, 2-2; pectoral, 3-3)..... **fossor** group (p. 111).
- c*². Mammæ in 4 pairs (inguinal, 2-2; pectoral, 2-2).
- d*¹. Ears rather large and rounded at tips..... **douglasi** group (p. 116).
- d*². Ears large or small and pointed at tips.
- e*¹. Ears relatively large and pointed..... **monticola** group (p. 121).
- e*². Ears relatively small and pointed..... **fuscus** group (p. 126).

Key to Species and Subspecies of *Thomomys*.

[Measurements in millimeters.]

- a*¹. Size large; hind foot of ♂ 38 or more.
- b*¹. Color uniformly dark sooty brown above and below; hind foot of ♂ 40 or more, **bulbivorus** (p. 40).
- b*². Color gray or black (dichromatic); hind foot of ♂ 38, of ♀ 35.
- c*¹. Color in gray phase dark buffy gray **townsendi** (p. 42).
- c*². Color in gray phase light buffy gray **nevadensis** (p. 44).
- a*². Size medium or small.
- b*¹. Size very small, hind foot of ♂ averaging 26 or less; color buffy gray or brown.
- c*¹. Color buffy gray.
- d*¹. Hind foot of ♂ averaging 26..... **ocius** (p. 107).
- d*². Hind foot of ♂ averaging 23..... **idahoensis** (p. 108).
- c*². Color light brown.
- d*¹. Hind foot of ♂ averaging 25..... **myops** (p. 130).
- d*². Hind foot of ♂ averaging 22 (smallest of the genus)..... **pygmæus** (p. 109).

- b*². Size medium, hind foot of ♂ averaging over 26 and under 36.
- c*¹. Color brown, mainly cinnamon-hazel, chestnut, or russet.
- d*¹. Color dark and rich browns.
- e*¹. No conspicuous black on nose and face; hind foot of ♂ about 30,
limosus (p. 120).
- e*². Much blackish on nose and face.
- f*¹. Size smaller, hind foot of ♂ about 27.....hesperus (p. 131).
- f*². Size larger, hind foot of ♂ about 29.
- g*¹. Skull with very small oval interparietal.....melanops (p. 119).
- g*². Skull with large triangular interparietal.....helleri (p. 126).
- d*². Color light, or bright or dull browns.
- e*¹. Ears small but pointed and well formed.
- f*¹. Color light brown; hind foot of ♂ about 27.
- g*¹. Slightly paler; molars lighter.....fuscus (p. 126).
- g*². Slightly darker; molars heavier.....loringi (p. 129).
- f*². Color duller and darker shades of brown; size larger.
- g*¹. Skull very long and narrow; hind foot of ♂ about 29. saturatus (p. 128).
- g*². Skull relatively short and wide.
- h*¹. Incisors projecting beyond tip of nasals; hind foot of ♂ 29,
pryori (p. 104).
- h*². Incisors not projecting beyond tip of nasals.
- i*¹. Nasals truncate at posterior tip; hind foot of ♂ 27,
quadratus (p. 114).
- i*². Nasals emarginate at posterior tip; hind foot of ♂ 28,
caryi (p. 104).
- e*². Ears relatively long and pointed.
- f*¹. Color dull brown.
- g*¹. Size larger, hind foot of ♂ averaging 33.....bridgeri (p. 112).
- g*². Size smaller, hind foot of ♂ under 33.
- h*¹. Bullæ large; posterior tip of nasals rounded.....fossor (p. 111).
- h*². Bullæ smaller; posterior tip of nasals emarginate.....uinta (p. 113).
- f*². Color bright, warm browns.
- g*¹. Size larger, hind foot of male averaging about 30.
- h*¹. Skull relatively short and wide; interparietal triangular,
oregonus (p. 117).
- h*². Skull long and narrow; interparietal small and oval.
- i*¹. Zygomatic arches widest anteriorly.....douglasi (p. 116).
- i*². Zygomatic arches widest posteriorly.....yelmensis (p. 118).
- g*². Size smaller, hind foot of ♂ about 28 or less.
- h*¹. Color russet; bullæ full and rounded.....mazama (p. 123).
- h*². Color hazel; bullæ relatively small and angular.
- i*¹. Color dull hazel; braincase very narrow.....monticola (p. 121).
- i*². Color more yellowish hazel; braincase wider.
- j*¹. Nasals longer and conspicuously widened anteriorly,
nasicus (p. 125).
- j*². Nasals shorter and merely cuneate.....pinetorum (p. 124).
- c*². Color not distinctly brown, but of various shades of ochraceous, tawny, buff, gray, umber, or black.
- d*¹. Color strongly ochraceous.
- e*¹. Incisors projecting conspicuously beyond tip of nasals.
- f*¹. Color dark ochraceous, clouded with dusky in winter.
- g*¹. Size large, hind foot of ♂ averaging 33.....bottæ (p. 45).
- g*². Size smaller, hind foot of ♂ not over 30.
- h*¹. Color darker than in bottæ.....minor (p. 51).
- h*². Color lighter than in bottæ.....diaboli (p. 51).

- f*². Color light, bright, or rusty ochraceous.
- g*¹. Color light or bright ochraceous.
- h*¹. Color bright ochraceous; skull heavy and angular,
angularis (p. 53).
- h*². Color pale ochraceous; skull not heavy and angular,
infrapallidus (p. 55).
- g*². Color rusty ochraceous.
- h*¹. Incisors heavy and not greatly projecting **laticeps** (p. 46).
- h*². Incisors slender and greatly projecting.
- i*¹. Hind foot of ♂ 30 to 33 **leucodon** (p. 47).
- i*². Hind foot of ♂ 27 to 30 **navus** (p. 49).
- e*². Incisors not projecting conspicuously beyond tip of nasals.
- f*¹. Color light ochraceous.
- g*¹. Size large, hind foot of ♂ averaging about 32.
- h*¹. Bullæ large; skull short and wide **pascalis** (p. 54).
- h*². Bullæ small; skull long and narrow **pallescens** (p. 55).
- g*². Size smaller, hind foot of ♂ averaging 30 or less.
- h*¹. Underparts buffy or whitish **cabezona** (p. 76).
- h*². Underparts light ochraceous **puertæ** (p. 58).
- f*². Color dark ochraceous, or ochraceous heavily clouded with black.
- g*¹. Size large, hind foot averaging 34 **altivallis** (p. 62).
- g*². Size medium or small.
- h*¹. Size small, hind foot of ♂ about 27.
- i*¹. Skull narrow **awahnee** (p. 64).
- i*². Skull wide **mewa** (p. 50).
- h*². Size medium, hind foot of ♂ averaging 30-32.
- i*¹. Dorsal outline of skull arched, rostrum decurved.
- j*¹. Interpterygoid fossa wide, not sharply V-shaped,
apache (p. 75).
- j*². Interpterygoid fossa narrow, sharply V-shaped.
- k*¹. Throat usually white, interparietal large and quadrate,
alpinus (p. 63).
- k*². Throat rarely white, interparietal small and often triangular.
- l*¹. Premaxillæ wide **alticolus** (p. 60).
- l*². Premaxillæ narrow.
- m*¹. Skull very long and narrow **martirensis** (p. 67).
- m*². Skull not very long and narrow **nigricans** (p. 56).
- l*². Dorsal outline of skull straight, rostrum not decurved.
- j*¹. Zygomatic arches widest posterior to middle; nasals emarginate,
neglectus (p. 65).
- j*². Zygomatic arches widest anterior to middle; nasals usually truncate **jacinteus** (p. 66).
- d*². Color not strongly ochraceous.
- e*¹. Color tawny, varying from dark to bright and pale tawny.
- f*¹. Size large, hind foot of ♂ averaging 31 or more.
- g*¹. Color bright tawny.
- h*¹. Tail, feet, and belly well haired **pervagus** (p. 82).
- h*². Tail, feet, and belly very thinly haired.
- i*¹. Skull short and wide **sinaloæ** (p. 80).
- i*². Skull long and relatively narrow **anitæ** (p. 59).
- g*². Color dull tawny, bordering on buffy and fawn.
- h*¹. Hind foot of ♂ averaging 34 or more **cervinus** (p. 79).
- h*². Hind foot of ♂ averaging about 31 or less.
- i*¹. Color dull tawny **toltecus** (p. 86).
- i*². Color yellowish tawny **baileyi** (p. 87).

- f*². Size smaller, hind foot averaging 30 or less.
- g*¹. Color dark tawny, clouded with black in winter pelage.
- h*¹. Hind foot of ♂ about 30.....*fulvus* (p. 80).
- h*². Hind foot of ♂ about 27.
- i*¹. Color dark, bordering on umber.....*intermedius* (p. 84).
- i*². Color brighter with less black on back.....*texensis* (p. 85).
- g*². Color bright or pale tawny.
- h*¹. Color very bright tawny.
- i*¹. Incisors not conspicuously protruding beyond nasals,
desertorum (p. 83).
- i*². Incisors conspicuously protruding beyond nasals.
- j*¹. Belly pale tawny.....*nelsoni* (p. 92).
- j*². Belly white or yellow.
- k*¹. Belly white.....*goldmani* (p. 94).
- k*². Belly yellow.....*mearnsi* (p. 87).
- h*². Color pale tawny.
- i*¹. Color brighter, more buffy tawny.....*lachuguilla* (p. 88).
- i*². Color duller, more grayish tawny.....*perditus* (p. 95).
- e*². Color not tawny.
- f*¹. Color buff or orange, varying from light buff to rich orange-buff.
- g*¹. Color bright orange-buff or buffy yellow.
- h*¹. Size large, hind foot of type (♂ ad.) 36.....*magdalenæ* (p. 61).
- h*². Size smaller, hind foot not over 33.
- i*¹. Zygomatic arches abruptly constricted posteriorly,
operarius (p. 77).
- i*². Zygomatic arches not abruptly constricted posteriorly.
- j*¹. Rostrum very broad.....*latirostris* (p. 78).
- j*². Rostrum less broad.....*aureus* (p. 74).
- g*². Color buff or grayish buff.
- h*¹. Color grayish buff.
- i*¹. Size large, hind foot of ♂ about 33.....*canus* (p. 73).
- i*². Size smaller, hind foot of ♂ about 30.....*perpes* (p. 72).
- h*². Color clear yellowish buff.
- i*¹. Size large, hind foot of ♂ averaging 34.....*albatus* (p. 70).
- i*². Size smaller, hind foot of ♂ about 30.
- j*¹. Nasals conspicuously truncate posteriorly.....*russeolus* (p. 60).
- j*². Nasals usually slightly emarginate posteriorly.
- k*¹. Skull narrow and slender.....*perpallidus* (p. 68).
- k*². Skull short and wide.....*chrysonotus* (p. 71).
- f*². Color not buff or orange.
- g*¹. Color gray, varying from light to dark brownish gray.
- h*¹. Color dark brownish gray; claws stout; ears larger.
- i*¹. Audital bullæ long but not full and rounded.
- j*¹. Skull not heavily ridged in old ♂, hind foot about 30,
talpoides (p. 96).
- j*². Skull heavily ridged in old ♂, hind foot about 31,
rufescens (p. 98).
- i*². Audital bullæ full and rounded.
- j*¹. Color lighter, bullæ larger.....*bullatus* (p. 102).
- j*². Color darker, bullæ smaller.....*nebulosus* (p. 103).
- h*². Color light brownish gray or pale gray; claws slender; ears smaller.
- i*¹. Audital bullæ large and globose.
- j*¹. Color very pale gray.....*agrestis* (p. 105).
- j*². Color not so pale gray.....*clusius* (p. 100).

Color.—*Winter pelage:* Dark sooty brown, the plumbeous basal color showing through on belly; ears and nose blackish; chin and throat and usually small anal patch white; feet usually streaked or mottled with white. *Summer pelage:* Washed with rusty brown above and below. *Young:* Like summer adults but very thinly haired, the skin showing through on belly.

Skull.—Short and wide with zygomatic arches usually widest posteriorly; rostrum, slender; nasals short, falling considerably short of premaxillæ at both ends; pterygoids convexly inflated and divided by narrow fossa; bullæ rather small and narrow but auditory meatus unusually open or dilated. *Dentition* rather light; incisors slender, greatly protruding, and usually white tipped; groove on inner edge of upper incisors very obscure.

Measurements.—Average of 5 adult males from Salem and Beaverton, Oreg.: Total length, 300; tail vertebræ, 90; hind foot, 42. Largest male: 302, 99, 43. Average of 4 adult females: 271, 81, 39. *Skull* (σ ad.):¹ Basal length, 52; greatest length over incisors, 57; nasals, 19; zygomatic breadth, 36.5; mastoid breadth, 30.5; alveolar length of upper molar series, 10.

Remarks.—This is the most aberrant form of the genus, marking either an ancestral type or more probably a highly specialized development of adaptive characters. Widely separated geographically from the *bottæ* group, with which it shows the closest affinities, it is entirely isolated in the humid, rich-soiled valley of the Willamette.

The object of the projecting incisors becomes evident when these gophers are trapped. During the dry season the soil of the Willamette Valley becomes baked and so hard that digging open gopher holes with a small shovel, knife, or sharp stick is difficult, and but for a granular cleavage would be almost impossible. The adobe earth breaks out somewhat as the segments of a pomegranate, but in coarser granules. Evidently the little irregular clay balls making up the gopher hills are pried out with the projecting incisors, which by long use have become perfect miners' picks. The upper incisors project actually beyond the tip of the gopher's nose and at a convenient angle for prying out the earth balls. The lower incisors project equally far but from farther back. The fur-lined lips close behind the incisors, so that no earth can get into the mouth. The short bristly fur surrounding the base of the incisors protects the lips, and leaves the "pick and shovel" teeth free. That the teeth are regularly used for digging is evidenced by the much-worn tips and edges. The white tips are shown by the lens to be due to the wearing away of the yellow enamel surface. The slight inner groove is usually worn entirely away before it reaches the tip of the incisor. It seems

¹No. 57322, U. S. Nat. Mus., from Salem, Oreg.

highly probable that the unusually weak front claws of this gopher result from their disuse in heavier kinds of digging.

The subgeneric characters ascribed to this species consist of little more than the convex wings of the pterygoids. While this character is unique in the genus it involves only the form of a weak and variable bone and seems too superficial for more than specific value. As there are no other divisions of subgeneric rank in the genus this one seems of doubtful value.

The large mounds of these gophers have been observed in Oregon at Albany, Cottage Grove, Harris, Lyons, and almost continuously along the roads from Salem to a little south and 12 miles east of Eugene.

Specimens examined.—Total number, 62, as follows:

Oregon: Beaverton, 12; Corvallis, 1; Eugene, 8; Gaston, 2; Grand Ronde, 3; McCoy, 6; Mulino, 6; Portland, 5; Salem, 20; Sheridan, 2.

Thomomys townsendi Group.

THOMOMYS TOWNSENDI TOWNSENDI (BACHMAN).

TOWNSEND POCKET GOPHER.

(Pl. II, fig. 2; Pl. III, fig. 2.)

Geomys townsendii Bachman (from Richardson's MS.), Journ. Acad. Nat. Sci. Philadelphia, VIII, pt. 1, 105, 1839.

Thomomys nevadensis atrogriseus Bailey, Proc. Biol. Soc. Washington, XXVII, 118, July 10, 1914. Type locality, Nampa, Idaho.

Type.—Type locality erroneously given as "Columbia River," but probably southern Idaho and very probably near Nampa, where Townsend's party camped to trade with Indians, August 22, 1834. Type specimen in Acad. Nat. Sci. Philadelphia.

Distribution.—Valley of Snake River in southern Idaho, from American Falls to Weiser (fig. 5).

Characters.—Size very large; ears small but pointed; claws medium; mammae 4 pairs, inguinal, 2-2, pectoral 2-2; color dichromatic, a dark gray phase and a black phase; skull relatively wide and angular.

Color.—In gray phase: Upperparts dark buffy gray or sooty gray; nose and face blackish; ear patch black; feet and tail soiled gray; underparts washed with rich buff; cheek pouches lined with black and white; chin white. In black phase: Dull, slaty black all over except white patch on chin and toes and usually on lower part of feet. There seems to be little seasonal variation except for a general darkening with wear as the buff tips disappear from the hairs. Two specimens from Caldwell, Idaho, collected May 30 and June 3, are clearer, richer buff than any others and much darker and richer even than any specimens of the subspecies *nevadensis*. This may be a normal but rare pelage.

Skull.—Large and wide with spreading zygomatic arches, narrow nasals and rostrum, and short, wide braincase; sagittal and occipital crests well developed in old males; audital bullæ large but depressed to level of basioccipital, rather angular; basioccipital thick and narrow; pterygoids high but short and thickened at margins. *Dentition* heavy; incisors long and slightly projecting; inner groove obscure.

Measurements.—Adult male: Total length, 305; tail vertebrae, 100; hind foot, 38. Adult female: 276, 75, 35. These are about average measurements. *Skull* (σ ad.): Basal length, 49; nasals, 18; zygomatic breadth, 35; mastoid breadth, 29; interorbital breadth, 8; alveolar length of upper molar series, 10.

Remarks.—The type of Bachman's *Geomys townsendii* which evidently was labeled, not by the collector but after it came into the possession of the Academy of Natural Sciences of Philadelphia, "Rocky Mts., J. K. Townsend," is fortunately still extant. Bachman published Richardson's manuscript description of the species in 1839, and stated that it came from the Columbia River. It was a mounted specimen with the skull inside, and its identity has caused much speculation. Through the kindness of Dr. Witmer Stone, of the Academy of Natural Sciences, the type is now before me and the skull has been removed and cleaned. The type is an immature female and much faded, but the skull serves to identify the species at once as one which I recently described under the name *atrogriseus* from southern Idaho. I take pleasure in yielding my recent name in favor of one which for 76 years has been misapplied. In 1834, J. K. Townsend made his journey to the coast of Oregon through southern Idaho, and very probably secured the type of the species named for him near the present town of Nampa, where his party camped August 22 to trade with the Indians.¹ The type locality of *Thomomys townsendii* may therefore be fixed as the vicinity of Nampa, where these large gophers still abound and from which place we have a fine series of specimens.

My *atrogriseus* was described as a subspecies of *nevadensis*, but now *nevadensis* becomes a subspecies of *townsendii* since the latter is the earlier name. The nearest relationships are with the *bottæ* and *perpallidus* groups, but there is probably no direct connection with either at the present time.

Specimens examined.—Total number, 63, as follows:

Idaho: American Falls, 10; Caldwell, 2; Nampa, 19; Payette, 14; Weiser, 4.

Oregon: Ontario, 2; Owyhee, 6; Vale, 6.

¹Townsend, J. K., Narrative of a Journey Across the Rocky Mountains to the Columbia River, 136, 1839.

THOMOMYS TOWNSENDI NEVADENSIS MERRIAM.

NEVADA POCKET GOPHER.

(Pl. III, fig. 3.)

Thomomys nevadensis Merriam, Proc. Biol. Soc. Washington, XI, 213, 1897.

Type.—Collected at Austin, Nevada (exact locality, bottom of valley about 5 miles west of the town in moist soil near Reese River) by Vernon Bailey, November 11, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Valleys of central and northern Nevada and southeastern Oregon, from Austin and Lovelocks, Nev., north to Alvord Lake, Oreg. (fig. 5).

Characters.—Size large; hind foot 35–40 mm.; skull heavily ridged and angular with projecting incisors; colors dichromatic, buffy gray, or black; in the gray phase more buffy and in the black phase more plumbeous than in *townsendi*; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—In gray phase: Light buffy gray, slightly paler on belly, feet, and tail; nose and cheeks plumbeous; throat white. In black phase: Bluish black or plumbeous all over except white throat and usually white feet. There is often a small white spot on top of head and the white throat patch extends to breast on some specimens. Intermediate specimens are bluish gray or mixed gray and plumbeous.

Skull.—Heavy and angular with long nasals and rostrum; lateral ridges joined in sagittal crest in old males; zygomatic arches wide spreading with slight median constriction; bullæ large but depressed to plane of basioccipital and with sharp anterior points; basioccipital narrowed between bullæ; pterygoids high, thin, and arched. *Dentition* heavy; incisors slightly projecting; inner groove obscure.

Measurements.—Type (♂ ad.): Total length, 275; tail vertebræ, 90; hind foot, 38. Topotype (♀ ad.): 255, 82, 35. *Skull* (of type): Basal length, 44; nasals, 15.5; zygomatic breadth, 31; mastoid breadth, 26; alveolar length of upper molar series, 9.

Remarks.—None of the type series are in the black phase, but in a series of 15 from Battle Mountain 7 are black, 5 are gray, and 3 are intermediate. Other melanistic specimens come from Halleck, Argenta, Winnemucca, and McDermitt, Nev., and Lake Alvord, Oreg. Like *townsendi*, this gopher inhabits moist fertile valley bottoms and not the surrounding dry sagebrush land. Its range therefore is along stream valleys, and while its close relationship with *townsendi* indicates only subspecific rank, its range is apparently at present not continuous with that form. On the west it is cut off from its next nearest relative—*griseus*—by the Sink of the Humboldt and its desert margins.

Specimens examined.—Total number, 93, as follows:

Nevada: Argenta, 1; Austin, 9; Battle Mountain, 15; Big Creek, 3; Halleck, 5; Independence Valley, 1; Lovelocks, 10; McDermitt, 2; Paradise, 8; Quinn River Crossing, 14; Winnemucca, 7.

Oregon: Alvord, 1; Alvord Lake, 10; Tumtum Lake, 7.

Thomomys bottæ Group.

THOMOMYS BOTTÆ BOTTÆ (EYDOUX & GERVAIS).

CALIFORNIA POCKET GOPHER.

(Pl. II, fig. 3; Pl. III, fig. 4; text fig. 2.)

Oryzomys (Saccophorus) bottæ Eydox & Gervais, Mag. de Zool., VI, 23-24, pl. 21, fig. 4, 1836.

Thomomys bottæ Baird, Proc. Acad. Nat. Sci. Philadelphia, VII, 335, 1855.

Thomomys bulbivorus Baird, Mamm. N. Am., 389, 1857. Not *Diplostoma bulbivorum* Richardson.

Type.—Collected on "coast of California," probably at Monterey or San Francisco. Type in "Collection de la Faculté des Sciences," Paris.

Distribution.—Coast region of California, from Sonoma County (Freestone) south to San Diego (fig. 6).

Characters.—Size large, males much larger than females; average of hind foot in males, 33 mm., in females, 28 mm.; ears short, a mere thickened rim; color dull, dark yellowish brown, nearly unicolor; skull well arched, heavily ridged, and angular, with slightly projecting incisors; grooves on inner edge of incisors very small; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color—*Winter pelage*: Upperparts dark ochraceous, heavily clouded with black-tipped hairs; underparts lightly washed with dull ochraceous over the plumbeous underfur, often almost as dark as upperparts; ear patch, nose, and cheeks blackish; lips and lining of pockets white; tail usually dusky or brownish gray; feet usually white. *Summer pelage*: Very similar, but slightly brighter, clearer ochraceous.

Skull.—Adult male: Heavy and angular with long, decurved rostrum; lateral ridges occasionally meeting in very old age in sagittal crest; nasals long, cuneate or slightly spatulate, narrow, and generally emarginate posteriorly; auditory meatus large and slightly inflated; bullæ rather depressed and angular; upper incisors projecting slightly beyond tip of nasals. Adult female: Much smaller, slenderer, and less ridged than in males, but with the same arched outline, slender rostrum, and projecting incisors.

Measurements.—Average of 5 adult males from near Monterey: Total length, 267; tail vertebræ, 81; hind foot, 33. Average of 5 females: 219, 69, 28. *Skull* (σ ad.):¹ Basal length, 45; nasals, 16.5; zygo-

¹No. 107856, U. S. Nat. Mus., from near Monterey, Cal.

matic breadth, 29; mastoid breadth, 24; alveolar length of upper molar series, 9. Skull of adult female (from same locality): 36, 13, 24, 19, 8.7.

Remarks.—In addition to the unusual discrepancy in size of males and females of *bottæ* there is a great range of local variation in specimens from widely separated localities. To the south this subspecies passes into *pallescens*; to the north it intergrades with *minor* and apparently with *leucodon*; to the east it grades into the larger bright-colored *angularis* of the San Joaquin Valley; and along the eastern side of the valley it runs into the paler *pascalis*. But in the coast region it is fairly typical from Bodega on the north to San Diego on the south.

Specimens examined.—Total number, 713, as follows:

California (western): Alameda, 1; Alhambra, 4; Arroyo Seco (Monterey County), 7; Banta, 7; Bear Valley (head of Carmel River), 2; Berkeley, 18; Big Pine Mountains, 2; Bodega, 11; Carmel River, 1; Carmel Valley, 5; Carpinteria, 2; Colma, 1; Cone Peak, 1; Cuyama Valley (Schoolhouse Canyon), 6; Drum Barracks (Los Angeles County), 2; Freestone, 12; Gaviota Pass, 3; Glendora, 6; Half Moon Bay, 1; Haywards, 14; Hernandez (San Benito County), 1; Hueneme, 5; Inverness, 28; Jamesburg, 13; Jolon, 10; Laguna Ranch, 6; Lagunitas, 1; La Honda, 5; Las Virgines Creek, 6; Little Pine Canyon, 1; Los Angeles, 14; Los Gatos, 1; Mansfield, 5; Matilija (Ventura County), 9; Milpitas Ranch (south base Santa Lucia Peak), 1; Mono Flats, 9; Monrovia, 1; Monterey (Pacific Grove and Point Pinos), 34; Morro, 2; Mount Tamalpais, 1; Mountain View (Santa Clara County), 1; Nicasio, 84; Oakland, 1; Olema, 1; Pacific Grove, 1; Palo Alto, 44; Palos Colorados Canyon, 2; Pasadena and vicinity, 22; Pescadero, 7; Pine Creek (Bailey's Ranch), 2; Pine Valley (Monterey County), 7; Petaluma, 6; Pleyto, 6; Point Reyes, 18; Point Sur, 6; Portolo (San Mateo County), 8; Posts, 11; Pozo, 2; Priest Valley, 9; Redwood City, 27; Salinas Valley, 4; San Diego, 8; San Francisco (Golden Gate), 9; San Jose, 2; San Lorenzo, 1; San Mateo, 2; San Simeon, 2; Santa Ana Canyon, 4; Santa Barbara, 1; Santa Clara County, 6; Santa Cruz, 6; Santa Cruz Mountains, 1; Santa Inez, 2; Santa Margarita (San Luis Obispo County), 1; Santa Monica, 3; Santa Paula, 1; Soquel (Santa Cruz County), 2; Stanford, 48; Stanford University, 7; Stony Creek (Monterey County), 1; Sur River, 1; Tassajara Spring (Contra Costa County), 2; Tomales, 18; Tracy and vicinity, 25; Twin Oaks, 13; Union Island, 1; Ventura, 5; Walnut Creek, 16.

THOMOMYS BOTTÆ LATICEPS BAIRD.

HUMBOLDT BAY POCKET GOPHER.

(Pl. III, fig. 6.)

Thomomys laticeps Baird, Proc. Acad. Nat. Sci. Philadelphia, VII, 335, Apr., 1855.

Type.—Collected at Humboldt Bay, California, by Lieut. W. P. Trowbridge, February 21, 1855. Type specimen in U. S. Nat. Mus.

Distribution.—Coast region of northwestern California, from Smith River south to Eel River (fig. 6).

Characters.—Size and general appearance of *bottæ*, but color warmer and brighter and less clouded with black-tipped hairs; skull averaging slightly wider, and nasals especially wider; mammæ in 4 pairs.

Color.—Upperparts uniform clear rusty ochraceous or almost snuff brown, brighter than in *bottæ* and with less black; underparts light buffy ochraceous, in strong contrast with upperparts; feet and distal half of tail and usually lips and chin whitish. Summer and winter pelage identical in all specimens examined.

Skull.—Similar to that of *bottæ*, but slightly wider in proportion to length; middle of malar arch more indented; auditory meatus less inflated; lateral ridges not meeting in old males; nasals wide and not sharply emarginate posteriorly. *Dentition* about the same as in *bottæ* or slightly heavier.

Measurements.—Average of 5 topotypes (σ ad.): Total length, 264; tail vertebræ, 88; hind foot, 33. Average of 5 topotypes (♀ ad.): 226, 77, 30. *Skull* (of topotype, σ ad.):¹ Basal length, 43; nasals, 16; zygomatic breadth, 30; mastoid breadth, 23; alveolar length of upper molar series, 9.

Remarks.—The subspecies *laticeps* is closely related to *bottæ*, but seems not to intergrade directly with it, as a smaller form of *bottæ* comes between. It can stand, however, as a well-marked subspecies. Specimens from the region of Humboldt Bay only are typical, while those from Crescent City are slightly paler. Two from Rio Dell may be grading toward *leucodon* and a small female from Alton Junction is doubtfully referred to *laticeps*. Specimens from Cuddeback and Hoopa are clearly intermediate between *laticeps* and *leucodon*, but are referred to the latter.

Specimens examined.—Total number, 90, as follows:

California (coast region of Humboldt and Del Norte Counties): Alton Junction, 1; Arcata (on Humboldt Bay), 49; Crescent City, 10; Eureka, 1; Requa, 6; Rio Dell, 2; Smith River, 2; Table Bluff (on Humboldt Bay), 16; Trinidad, 3.

THOMOMYS BOTTE LEUCODON MERRIAM.

WHITE-TOOTHED POCKET GOPHER.

(Pl. II, fig. 11; Pl. III, fig. 5.)

Thomomys leucodon Merriam, Proc. Biol. Soc. Washington, XI, 215, July 15, 1897.

Type.—Collected at Grants Pass, Rogue River Valley, Oregon, by Clark P. Streater, December 17, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Portions of northern California and southwestern Oregon, from Grants Pass, Oreg., south to Fairfield and Placerville, Cal. (fig. 6).

Characters.—Smaller, lighter, and brighter colored than *bottæ*; in winter pelage, very similar in color and markings to *laticeps*, much brighter in summer pelage; skull short and wide, with slender, projecting incisors, which are generally white or white tipped and with obscure inner grooves; mammæ in 4 pairs.

Color.—*Winter pelage:* Upperparts uniform dark rusty ochraceous or snuff brown; nose dusky; underparts light buffy ochraceous; feet, chin, and often cheeks and spots on belly white. *Summer pelage:* Upperparts dark cinnamon; underparts clear bright cinnamon.

Skull.—Low and wide with short, wide braincase, wide-spreading zygomatic arches, widest posteriorly, and wide, quadrate, or triangular interparietal; nasals short, deeply emarginate; bullæ small; pterygoids narrowly V-shaped. *Dentition* very light; incisors slender, mainly white or white tipped and projecting far beyond nasals and premaxillæ.

Measurements.—Type (young ♂): Total length, 221; tail vertebrae, 68; hind foot, 29. Topotype (old ♂): 246, 72, 32. Average of 4 topotypes (females): 188, 60, 28. *Skull* (of type): Basal length, 36; nasals, 13; zygomatic breadth, 26; mastoid breadth, 19; interorbital breadth, 6.5; alveolar length of upper molar series, 7. Skull of topotype (old ♂): 41, 15.8, 29, 23.5, 6, 8.

Remarks.—Typical *leucodon* differs widely from typical *bottæ*, but as the gap is largely bridged by the somewhat divergent characters of *navus*, and the chain of intergradation between the two extremes is complete, there is ample ground for grouping not only *leucodon* but *navus* and *mewa* as subspecies under *bottæ*. Only specimens from the Rogue River Valley can be considered typical of *leucodon*, but in spite of much variation specimens occurring over a wide range of rough mountain, valley, and foothill country south to Fairfield, Cal., can better be referred to *leucodon* than to any other form. Skins of Fairfield specimens are indistinguishable from topotypes of *leucodon*, but the skulls are close to *navus*. The principal variation over this range is in a reversion toward the cranial characters of *bottæ* to the southward and a brightening of color in the less humid interior. These brighter-colored specimens are externally very similar to typical *fulvus* of the San Francisco Mountain plateau region of Arizona, but comparison of skulls shows that the resemblance is only superficial. Specimens from Hoopa Valley and Cuddeback are clearly intermediate between *leucodon* and *laticeps* but are listed under *leucodon*. Those from Cuddeback also strongly suggest *bottæ* but are rather small and in this approach *minor*.

Specimens examined.—Total number, 313, as follows:

California: Baird, 3; Battle Creek, 2; Big Valley Mountains, 12; Bartlett Mountain, 5; Berger Creek (Mendocino County), 1; Blue Canyon, 1; Briceland, 6; Burney, 5; Cahto, 1; Calistoga, 2; Cassel, 1; Cuddeback, 9; Dana, 4; Downieville, 1; Dutch Flat, 2; Edgewood (Shasta Valley), 2; Eel River (head of, near South Yolla Bolly Mountain), 1; Fairfield, 6; Fair Oaks, 13; Fall River Mills, 2; Fort Jones, 1; Fyffe, 5; Gazelle, 6; Genesee, 3; Glen Ellen, 2; Gold Run, 6; Goosenest Mountain (Shasta Valley), 1; Greenville, 1; Hayden Hill, 1; Helena, 26; Hoopa Valley, 7; Hornbrook, 10; Indian Valley (Lassen County), 2; Lakeport, 1; Laytonville, 1; Lower Lake, 12; Mad River, near Kunz (Trinity County), 6; Mountain House (Butte County), 8; Mount George, 1; Mount

St. Helena, 3; Mount Sanhedrin (3 miles west of summit), 8; Mount Veeder, 2; Novato, 6; Old Fort Crook, 20; Petaluma, 3; Picard, 9; Placerville, 2; Post Creek, 2; Prattville, 1; Quincy, 6; Rumsey, 6; Slippery Ford, 4; Snow Mountain (Colusa County), 3; Susanville, 3; Tower House, 5; Ukiah, 7; Vacaville (8 miles west), 7.

Oregon: Ashland, 2; Ferren, 3; Grants Pass, 27; Grizzly Peak (west slope), 5.

THOMOMYS BOTTÆ NAVUS MERRIAM.

RED POCKET GOPHER.

(PL. IV, fig. 3.)

Thomomys leucodon navus Merriam, Proc. Biol. Soc. Washington, XIV, 112, July 19, 1901.

Type.—Collected at Red Bluff, California, by Clark P. Streater, December 26, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Sacramento Valley, Cal., from Battle Creek, Tehama County, south to Tracy Lake, San Joaquin Valley (fig. 6).

Characters.—Size much smaller than *bottæ*; color lighter; skull relatively shorter and wider, with more projecting incisors, intermediate to some extent between *bottæ* and *leucodon*; mammæ in 4 pairs.

Color.—*Winter pelage:* Upperparts light rusty ochraceous, darker on back, face, and nose; ears blackish; underparts pale buffy or ochraceous; feet whitish. *Summer pelage* (as shown in one July specimen from Marysville Buttes): Slightly brighter and more fulvous above and below than in winter.

Skull.—Short and wide with zygomatic arches widest posteriorly; nasals short, cuneate, emarginate posteriorly; bullæ not large but smoothly rounded. From the skull of *leucodon* it differs in smaller size, narrower interorbital constriction, orange coloration and relatively heavier incisors. *Dentition* light; incisors slender, protruding, and bright orange except the white tips.

Measurements.—Average of 4 topotypes (σ ad.): Total length, 203; tail vertebræ, 67; hind foot, 27.5. Average of 4 topotypes (♀ ad.): 189, 61, 26.5. *Skull* (of type, σ ad.): Basal length, 35; nasals, 13; zygomatic breadth posteriorly, 25; mastoid breadth, 20; alveolar length of upper molar series, 7.

Remarks.—By treating *leucodon* as a subspecies of *bottæ*, it becomes necessary to place *navus* under *bottæ*, with which it connects at one angle as it does with *leucodon* at another. While typical Sacramento Valley specimens of *navus* are strongly marked, others would go with one form as well as with another. Fairfield specimens may with equal propriety be placed with *bottæ*, *navus*, or *leucodon*. Again, on the east side of the Sacramento Valley, the gradation northward is toward *leucodon*, and southward toward *mewa*. Wheatland and Jackson specimens, though having typical *navus* skulls, are dark and rich in color, approaching *leucodon*.

Specimens examined.—Total number, 178, as follows:

California (Sacramento Valley): Carbondale, 23; Chico, 19; Colusa, 3; Davis, 1; Grafton (Knights Landing), 7; Jackson, 4; Leesville (5 miles west), 2; Marysville Buttes, 38; Mokelumne Hill, 2; Nelson, 1; Oroville (6 miles east), 2; Payne, 1; Red Bluff, 42; Sacramento, 1; St. John, 1; Sites, 8; Tehama, 6; Tracy Lake (San Joaquin Valley), 9; Wheatland, 4; Willows, 1; Winslow, 3.

THOMOMYS BOTTÆ MEWA MERRIAM.

DIGGER PINE POCKET GOPHER.

(Pl. V, fig. 10.)

Thomomys mewa Merriam, Proc. Biol. Soc. Washington, XXI, 146, June 9, 1908.

Type.—Collected at Raymond, Madero County, California, by N. Hollister, June 28, 1904. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Foothill country on east side of San Joaquin Valley, Cal., from Kernville north to Chinese (fig. 6).

Characters.—Smaller than *bottæ*, blacker in winter pelage, more intensely ochraceous-tawny in summer; skull relatively shorter and wider with more rounded bullæ; mammæ in 4 pairs.

Color.—*Winter pelage:* Whole upperparts dull ochraceous-tawny, heavily clouded with glossy black; underparts bright ochraceous; feet whitish; tip of tail whitish or gray. *Summer pelage:* Upperparts rich ochraceous-tawny, darkening to blackish on forehead and around nose and ears; underparts lighter and brighter; nose rufous; feet and tip of tail whitish.

Skull.—Smaller than in *bottæ* and relatively shorter and wider, with fuller, shorter, more rounded bullæ. Size of *navus*, but with less protruding incisors and with zygomatic arches not so conspicuously widened posteriorly; incisors with well-defined inner groove.

Measurements.—Type (♂ ad.): Total length, 225; tail vertebræ, 60; hind foot, 27. Topotype (♀ ad.): 196, 53, 25. *Skull* (of type): Basal length, 37.4; nasals, 13; zygomatic breadth, 24.7; mastoid breadth, 20; alveolar length of upper molar series, 7.

Remarks.—This little, richly colored gopher occupies the Upper Sonoran foothill country from Kernville north to Chinese but farther north grades into *navus*, as shown by Wheatland and Jackson specimens. Others from Merced approach *pascalis* in color but have more nearly the cranial characters of *mewa*. Four females from Kernville are peculiar in abruptly decurved incisors and very rich color. A series of 13 December specimens from Salt Springs are in the fresh black winter pelage with an iridescent purple gloss.

Specimens examined.—Total number, 117, as follows:

California (east side of San Joaquin Valley): Bower Cave (near Mariposa), 3; Camp Badger (Fresno County), 1; Chinese, 2; Coarse Gold, 6; Coulterville, 2; Fresno Flat, 5; Kernville, 4; Merced, 6; Merced Falls, 8; Porterville (8 miles east), 3; Raymond, 58; Salt Springs, 13; Three Rivers, 3; Wawona, 3.

THOMOMYS BOTTÆ MINOR BAILEY.

MENDOCINO POCKET GOPHER.

(Pl. IV, fig. 2.)

Thomomys bottæ minor Bailey, Proc. Biol. Soc., Washington, XXVII, 116, July 10, 1914.

Type.—Collected at Fort Bragg, Mendocino County, California, by James H. Gaut, November 30, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Coast region of California, from Cape Mendocino south to Cazadero (fig. 6).

Characters.—Size smaller than *bottæ*; color slightly darker; skull narrower and slenderer, with especially slender rostrum, and deeply emarginate posterior tip of nasals; mammæ in 4 pairs.

Color.—In November pelage, upperparts dark, rich ochraceous or cinnamon-brown, heavily obscured with black, and in most specimens becoming almost black on nose, face, and around ears; feet white; tail grayish; underparts ochraceous-buff; lips and lining of cheek pouches usually white. Summer pelage but little lighter or brighter.

Skull.—Very slender and rather narrow, with very narrow and deeply emarginate nasals, slender zygomata, rather large and quadrate interparietal, very small and short audital bullæ. *Dentition*: Incisors slender, light colored, and projecting about as in *bottæ*.

Measurements.—Type (σ ad.): Total length, 226; tail vertebræ, 73; hind foot, 29. Average of 3 adult males: 219, 73, 29. Topotype (♀ young ad.): 187, 58, 24. *Skull* (of type): Basal length, 35; nasals, 13.4; zygomatic breadth, 23; mastoid breadth, 19; interorbital breadth, 4.7; alveolar length of upper molar series, 7.5.

Remarks.—This little, dark, narrow-skulled gopher of the rugged coast strip south of Humboldt Bay can not be included with *bottæ* or *leucodon*, and it is still more distinct from the big, wide-skulled *laticeps*. It closely resembles *nigricans*, but can be distinguished at a glance by its slender, protruding incisors.

Specimens examined.—Total number, 56, as follows:

California: Cape Mendocino, 2; Cazadero (7 miles west), 3; Ferndale, 11; Fort Bragg, 4; Gualala, 9; Gurneyville (1 mile west), 1; Mendocino City, 12; Petrolia, 4; Punta Arena, 7; Rockport, 2; Westport, 1.

THOMOMYS BOTTÆ DIABOLI GRINNELL.

DIABLO POCKET GOPHER.

Thomomys diaboli Grinnell, Univ. of Cal., Publ. Zool. XII, 313, Nov. 21, 1914.

Type.—Collected in Diablo Range, Merced County, California, at Sweeney's ranch, 22 miles south of Los Banos, by C. H. Richardson and H. A. Carr, April 2, 1911. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Inner ridge of the Coast Ranges along west side of the San Joaquin Valley, Cal. (fig. 6).

Characters.—Size small, about as in *navus*; color bright yellowish brown, much as in *angularis*, brighter than summer pelage of *bottæ*; skull a miniature of the *bottæ* skull, with short, wide braincase and projecting incisors.

Color.—*Summer pelage.* (March and October specimens): Upperparts bright sayal brown, with but slight darkening of black-tipped hairs; ears and ear patches black; nose dusky; underparts clear, bright ochraceous-tawny; lips and lining of cheek pouches white; tail buffy; feet whitish. *Winter pelage* (as shown in a few not fully typical October specimens from Pacheco Pass and Pacheco Peak): Much darker than in summer, but apparently not so black as in *bottæ*.

Skull.—Similar to that of *bottæ* but smaller and slenderer, with especially slender rostrum and zygomatic arches. *Dentition:* Teeth very light, incisors slender and projecting well beyond tip of nasals, pale yellow or whitish.

Measurements.—Type (♀ young ad.): Total length, 180; tail vertebræ, 60; hind foot, 25. Female topotype: 193, 65, 26.¹ Average adult male from Pacheco: 218, 65, 30; female: 201, 57, 28. *Skull* (of type, ♀ ad.): Basal length, 31; nasals, 10.3; zygomatic breadth, 22; mastoid breadth, 17.9; interorbital breadth, 7; alveolar length of upper molar series, 7.2. Skull of topotype (♂ ad.): 34, 12, 24, 19.3, 6, 7.2. Skull of old male from Pacheco Pass:² 37, 12, 25, 20.7, 5.5, 7.5. Skull of old female: 32, 10, 22, 19, 5.5, 7.

Remarks.—This depauperate form of *bottæ* seems to be a product of the hot and arid Upper Sonoran inner ridge of the Coast Ranges along the west side of the San Joaquin Valley, in what Dr. Grinnell calls the "hillside juniper association." It needs no comparison with the robust and massive-skulled *angularis* of the valley along its eastern border, but could easily be confused with intermediates between *leucodon* and *navus* from similar arid ridges north of San Francisco Bay. The skull, however, is more nearly of the true *bottæ* type.

Specimens examined.—Total number, 19, as follows:

California: McKittrick, divide west of (Kern County, 3,000 feet altitude), 1; Pacheco Pass (Santa Clara County), 6; Pacheco Peak (Santa Clara County), 6; Sweeney's Ranch (Diablo Range, Merced County), 6.

¹ Foot measured dry.

² No. 150799, Biological Survey collection.

THOMOMYS BOTTÆ ANGULARIS MERRIAM.

LOS BANOS POCKET GOPHER

(Pl. III, fig. 7.)

Thomomys angularis Merriam, Proc. Biol. Soc. Washington, XI, 214, July 15, 1897.

Type.—Collected at Los Banos, Merced County, California, by J. Ellis McLellan, January 1, 1894. Type specimen in U. S. Nat. Mus.. Biological Survey collection.

Distribution.—West side of San Joaquin Valley, Cal., from Tracy south to Santiago Spring; also Santa Clara, San Juan, and Salinas Valleys (fig. 6).

Characters.—Size large, hind foot in males averaging 33; ears short and thick; color lighter and brighter than in *bottæ*; skull short, wide, angular, and heavily ridged; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Summer pelage*: Rich ochraceous-buff, slightly darkened above with black-tipped hairs; ear patch black; nose and cheeks dusky or brownish; lining of pockets, lips, and sometimes chin, white; feet white; tip of tail nearly or quite naked. *Winter pelage*: Considerably darkened above by excess of black-tipped hairs; slightly paler below—not quite so black as *bottæ*.

Skull.—Males: Relatively shorter, wider, more angular, and more heavily ridged than in *bottæ*, with high sagittal crest in adults; nasals short and widely spatulate; incisors projecting about as in *bottæ*. Females: Much smaller, not ridged or angular; short and wide with arched outline.

Measurements.—Average of 6 topotypes (σ ad.): Total length, 258; tail vertebræ, 80; hind foot, 33. Average of 4 topotypes (φ ad.): 209, 66, 28.5. *Skull* (of type, small σ ad.): Basal length, 43; nasals, 15.7; zygomatic breadth, 28; mastoid breadth, 24; alveolar length of upper molar series, 8.5. *Skull* (of topotype, larger σ ad.):¹ 45, 15, 31, 25, 9.

Remarks.—Specimens from the type locality of *angularis* show strongly marked characters, and considered alone these would indicate that this is a distinct species not closely related to *bottæ*; others, however, from the Santa Clara, San Juan, and Salinas Valleys, while nearest to *angularis*, show a tendency toward *bottæ* in both external and cranial characters, and suggest the probability of intergradation along the sides of these valleys with the smaller, darker, slenderer-skulled *bottæ*.

Specimens examined.—Total number, 101, as follows:

California: Bitterwater, 17; Coalinga, 2; Del Monte (7 miles southeast, in Salinas Valley), 5; Kings City, 1; Los Banos, 54; Palo Alto, 2; Paraiso Spring, 1; Paso Robles, 4; Salinas, 2; San Benito, 3; San Miguelito, 1; Santiago Spring, 2; Tracy (8 miles south), 7.

THOMOMYS BOTTÆ PASCALIS MERRIAM.

FRESNO POCKET GOPHER.

(Pl. IV, fig. 1.)

Thomomys angularis pascalis Merriam, Proc. Biol. Soc. Washington, XIV, 111, July 19, 1901.

Type.—Collected at Fresno, San Joaquin Valley, California, by Clark P. Streater, March 4, 1892. Type specimen in U. S. Nat. Mus.. Biological Survey collection.

Distribution.—East side of San Joaquin Valley, Cal., from Stockton south to San Emigdio Canyon and Cuyama Valley (fig. 6).

Characters.—Size approximately as in *bottæ*; hind foot averaging 32 mm. in adult males and 28 mm. in females; ear short; color dull ochraceous; skull with broad base and swollen bullæ; mammæ in 4 pairs; inguinal 2-2, pectoral 2-2.

Color.—*Winter pelage*: Upperparts dull ochraceous, slightly darkened on nose and face; ear patch inconspicuous; underparts paler ochraceous; feet white; irregular white spots in many specimens on legs, throat, and belly. *Summer pelage*: Brighter, more fulvous above and below than in winter pelage. The summer pelage is slightly paler than in *angularis* and the winter pelage instead of being darker than the summer, as in *angularis* and *bottæ*, is still paler.

Skull.—Shorter and wider, with larger bullæ and more swollen auditory meatus than in *bottæ*; smaller than in *angularis*, less ridged, with much larger, more rounded bullæ and with narrower angular process of lower jaw, and rarely with sagittal crest, even in old males.

Measurements.—Average of 3 topotypes (σ ad.): Total length, 219; tail vertebræ, 73; hind foot, 32. Average of 4 females from type locality: 195, 63, 28. *Skull* (of type, σ ad.): Basal length, 41; nasals, 16; zygomatic breadth, 28; mastoid breadth, 23; alveolar length of upper molar series, 8.6.

Remarks.—Specimens from Tehachapi, Old Fort Tejon, and San Emigdio Canyon and Mount Pinos, at the south end of the San Joaquin Valley, vary from typical *pascalis* in smaller bullæ and larger auditory meatus, showing probable intergradation with *bottæ* of the adjoining chaparral-covered ranges. Specimens from Cuyama Valley about equally approach *pascalis*, *bottæ*, and *pallescens*. On the north, three specimens from Stockton might almost as well be referred to *angularis*.

Specimens examined.—Total number, 169, as follows:

California (San Joaquin Valley): Alila, 5; Bakersfield, 2; Bakersfield (8 miles northeast), 2; Bodfish, 11; Bodfish (12 miles below), 2; Buena Vista Lake, 6; Buena Vista Slough, 1; Buttonwillow, 12; Cuddy Canyon (near Frazer Mountain), 1; Cuyama Valley, 4; Delano, 1; Earlmart, 2; Fresno, 16; Lane Bridge, 29; Lemoore, 7; Modesto, 5; Mount Pinos (5,500-8,500 feet altitude), 6; Oakdale, 4; Old Fort Tejon, 10; San Emigdio Canyon, 7; Stockton, 3; Tehachapi, 10; Tejon Pass (8 miles west), 3; Tipton, 9; Tulare, 1; Walker Basin, 10.

THOMOMYS BOTTÆ PALLESCENS RHODS.

GRAPELAND POCKET GOPHER.

(Pl. III, fig. 8.)

Thomomys bottæ pallescens Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, 36, Feb. 21, 1895.

Type.—Collected at Grapeland, San Bernardino Valley, California, by R. B. Herron, March 22, 1894. Type specimen in Acad. Nat. Sci. Philadelphia.

Distribution.—San Bernardino Valley, Cal., north to San Fernando (fig. 6):

Characters.—Size of *bottæ*, but paler, and with buffy or whitish belly and less ridged skull; mammæ in four pairs.

Color.—*Summer pelage*: Upperparts dull ochraceous, darker along line of back and around nose; ear patch blackish; underparts pale buffy or soiled whitish. *Winter pelage*: Upperparts heavily clouded with blackish; underparts clear pale buff in sharp contrast.

Skull.—Long and narrow, with narrower braincase and less spreading zygomatic arches than in *bottæ*; lateral ridges parallel, never meeting in old males; incisors decurved more nearly at right angles to axis of skull.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 268; tail vertebræ, 84; hind foot, 32.3. Average of 5 females from type locality: 207, 64, 28. *Skull* (of topotype, ♂ ad.):¹ Basal length, 43; nasals, 16; zygomatic breadth, 27; mastoid breadth, 22; alveolar length of upper molar series, 9.5.

Remarks.—The subspecies *pallescens* is a large pale form of the *bottæ* group, differing from both *pascalis* and *altivallis* in cranial and external characters, but combining some of the characteristics of both with those of *bottæ*. The only typical specimens examined are from the great dry San Bernardino Valley. Those from San Fernando are darker colored and almost as near to *bottæ*, while Santa Paula, Mono Flats, and Little Pine Valley specimens might with almost equal propriety be referred to *pallescens* or *bottæ*.

Specimens examined.—Total number, 68, as follows (fig. 6):

California: Beaumont, 1; Cajon Pass (west slope), 1; Cajon Wash (near San Bernardino), 10; Cold Water Canyon, 1; El Casco, 4; Glendora, 4; Grapeland, 18; Jumpa Mountains, 2; Lytle Creek, 3; Rêche Canyon (4 miles southeast of San Bernardino), 3; San Bernardino, 17; San Fernando, 3; West Riverside, 2.

THOMOMYS BOTTÆ INFRAPALLIDUS GRINNELL.

CARRIZO PLAIN POCKET GOPHER.

Thomomys infrapallidus Grinnell, Univ. of Cal. Publ. Zool.; XII, 314, Nov. 21, 1914.

Type.—Collected on Carrizo Plain (Pimento Ranch, 7 miles south of Simmler) San Luis Obispo County, California, by H. S. Swarth, May 25, 1911. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Carrizo Plain, Cal. (fig. 6).

Characters.—Size large, about as in *bottæ*; color pale, belly buff or whitish; skull similar to that of *bottæ*, but with smaller molars.

Color.—*Summer pelage* (May specimens): Upperparts dull ochraceous-buff, paler than in *angularis* or *pascalis*; nose brownish; ears blackish; underparts pale buffy or whitish (one specimen with almost pure white belly); feet and tail white.

Skull.—Very similar to that of *bottæ* but with conspicuously smaller molar crowns and smaller bullæ. The narrow skull and projecting incisors readily separate this race from *angularis* or *pascalis*, while the projecting incisors and shorter braincase distinguish it from *pallescens*.

Measurements.—Type (♂ ad.): Total length, 248; tail vertebræ, 76; hind foot, 34. Female topotype: 205, 70, 29. *Skull* (of type): Basal length, 40; nasals, 15; zygomatic breadth, 29; mastoid breadth, 23; interorbital breadth, 6.7; alveolar length of upper molar series, 8.

Remarks.—This is evidently a rather local form of the *bottæ* group occupying the hot, arid, alkaline desert valley known as Carrizo Plain. It is paler and more strongly differentiated than is the Cuyama Valley form, in which some of the same characters are less emphasized. These specimens it seems better to identify with *pascalis*. Dr. Grinnell says of the Carrizo Plain, "Faunally and zonally it may be considered very arid, high Lower Sonoran. A sparse prairie vegetation grows on ground that is more or less strongly alkaline over most of the area."¹

Specimens examined.—Total number, 9, as follows:

California (Carrizo Plain): Painted Rock (5 miles north), 3; Simmler (7 miles south), 6.

THOMOMYS BOTTE NIGRICANS RHOADS.

STEPHENS POCKET GOPHER.

(Pl. V, fig. 16.)

Thomomys fulvus nigricans Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, 36, Apr. 12, 1895.

Thomomys aphantus Elliot, Field Columb. Mus., zool. ser., III, 219, June, 1903.

Type from Santo Tomas, Lower California, 18 miles south of Ensenada at 50-100 feet altitude. *Type* collected by E. Heller; *type specimen* in Field Mus. Nat. Hist.

Type.—Collected at Witch Creek, 2,753 feet altitude (7 miles west of Julian), San Diego County, California, by F. Stephens, December 22, 1893. *Type specimen* in Acad. Nat. Sci. Philadelphia.

Distribution.—Southwestern California and northern Lower California, from the San Jacinto Mountains, Cal., south to Ubar, Lower California (fig. 7).

¹ Univ. of Cal., Publ. Zool., XII, 314, 1914.

Characters.—Size smaller than *bottæ*, with the same small ears and very similar colors in both winter and summer pelage; skull slenderer, with shorter bullæ and less projecting incisors; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Winter pelage:* Upperparts dark ochraceous-tawny, darkened above by black-tipped hairs; nose, cheeks, and ear patches blackish; underparts lightly washed with rich ochraceous; tip of tail, hind feet, and lining of cheek pouches usually whitish. *Summer pelage:* Lighter and suffused with tawny above and below. *Young,* paler, more buffy above and whitish below.

Skull.—Relatively narrower, slenderer, and less arched than that of *bottæ*; bullæ shorter, more rounded; interparietal more quadrate; external auditory meatus with less expanded rim. *Dentition* lighter; incisors less projecting and more distinctly grooved. It differs from *fulvus*, with which it was originally compared, in less spreading zygomatic arches, slenderer rostrum, and relatively narrower braincase.

Measurements.—Topotype (σ ad.):¹ Total length, 231; tail, 74; hind foot, 30. Average of 5 typical males from San Jacinto Mountains: 232, 77, 30.2. Average of 5 females: 199, 65, 27.4. *Skull* (of topotype, σ ad.):² Basal length, 34.5; nasals, 13.5; zygomatic breadth, 23; mastoid breadth, 18; interorbital breadth, 6.5; alveolar length of upper molar series, 7.5.

Remarks.—From *bottæ*, *nigricans* differs in lighter, slenderer skull; more abruptly decurved and more distinctly grooved incisors; lighter dentition; and numerous details of cranial and external characters; but scarcely if at all in color. It is much smaller and darker than *pallescens* with which it intergrades at Elsinore and Wildomar, while Twin Oak specimens are clearly intermediate between *nigricans* and *bottæ*.

In a series of 18 specimens from Santo Tomas, Lower California, I find no characters by which to recognize *Thomomys aphrastus* as even subspecifically different from *nigricans*. A series of 32 specimens of *alticolus* from the Victoria Mountains, farther south on the peninsula, are scarcely distinguishable from *nigricans* in external characters, but in cranial characters tend toward *anitæ*.

Specimens examined.—Total number, 401, as follows:

California (southern): Ballena, 1; Campo (San Diego County, at 2,500 feet altitude), 8; Cuyamaca Mountains, 16; Dulzura, 14; Escondido, 3; Foster, 5; Fullers Mill, 1; Grapevine Spring, 1; Hemet Valley, 5; Jacumba, 11; Jamul Creek, 3; Julian, 15; Kenworthy, 2; La Puerta, 24; Mountain Spring, 1; Pine Mountains, 1; Poway, 1; Rose Canyon, 1; San Jacinto Mountains (south end at 5,000 to 8,000 feet), 21; Santa Rosa Peak, 1; Santa Ysabel, 15; Schains Ranch, 4; Strawberry Valley (in central part of San Jacinto range at 6,000 feet), 24; Thomas Mountain, 1; Tia Juana, 2; Tia Juana River (mouth), 1; Warners Pass, 7; Witch Creek (San Diego County at 2,750 feet), 53.

¹No. 148685, U. S. Nat. Mus.

²No. 148688, U. S. Nat. Mus.

Lower California: Aguaji de las Fresas, 2; Ensenada, 6; Ensenada (canyon 20 miles east), 1; Fresno, 1; Hanson Laguna, 11; La Grulla (at 7,000 feet altitude), 13; La Huerta (Hanson Laguna Mountains), 1; Mattomi, 1; Milquatay Valley, 2; Nachoguero Valley, 4; Parral, 5; Pinon (west slope San Pedro Martir Mountains), 3; Rancho la Progres, 5; Rancho Santo Tomas (12 miles south of La Grulla), 3; Rancho Viejo (15 miles south of Alamos), 5; Rosarito, 2; San Antonio, 3; San Francisquito, 2; San Pedro Martir Mountains, 11; San Quintin, 14; San Telmo, 18; San Ysidro Ranch, 4; Santa Eulalia, 7; Santa Rosa, 1; Santo Tomas, 18; Socorro, 2; Tecate Valley, 2; Trinidad Valley (northwest base San Pedro Martir Mountains), 2; Vallecitos, 6; Yubay, 4 (not typical).

THOMOMYS BOTTÆ PUERTÆ GRINNELL.

LA PUERTA POCKET GOPHER.

Thomomys nigricans puertæ Grinnell, Univ. of Cal., Publ. Zool., XII, 315, Nov. 21, 1914.

Type.—Collected at La Puerta (Mason's Ranch, 5 miles west of Vallecitos, at the lower end of La Puerta Valley), San Diego County, California, by F. Stephens, May 31, 1909. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—La Puerta and San Felipe Valleys, Cal. (fig. 6).

Characters.—In size, proportions, and cranial characters, very similar to *nigricans*, but much paler in both summer and winter pelage; considerably brighter than *cabezonæ*.

Color.—*Summer pelage:* Upperparts pale ochraceous-tawny, becoming darker along median line of back; ears and postauricular spot black; nose and face brownish or dusky; underparts pale or bright cinnamon; feet and tail buffy or soiled whitish. *Winter pelage:* Duller and more grayish, fading to pinkish- or vinaceous-salmon in bright-colored individuals.

Skull.—Not readily distinguishable from that of *nigricans* from the surrounding chaparral slopes.

Measurements.—Type (σ young ad.): Total length, 203; tail vertebrae, 80; hind foot, 28. *Skull* (of type): Basal length, 32; nasals, 12; zygomatic breadth, 21.2; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—The series of 43 specimens in the Museum of Vertebrate Zoology labeled La Puerta were collected by F. Stephens, and Grinnell says, "According to his field notebook, the majority were caught in cultivated land on Mason's Ranch, which is located at the lower end of La Puerta Valley. Others, however, were taken on surrounding hillsides."¹ The 43 specimens divide readily into 21 of the present pale form and 22 of the typical dark-colored *nigricans*. These I assume represent a pale desert form from the valley bottom where creosote bush, mesquite, and cactus indicate extreme arid Lower Sonoran conditions; and typical *nigricans* from the Upper Sonoran chaparral-

¹ Univ. of Cal. Pub. Zool., XII, 315, Nov. 21, 1914.

covered slopes along the sides of the valley. In a valley so narrow the two forms undoubtedly intermingle to some extent along the boundaries of their respective habitats, but most of the specimens show no intermediate characters.

Specimens examined.—Total number, 23, as follows:

California: La Puerta, 21; San Felipe Valley, 2.

THOMOMYS BOTTÆ ANITÆ ALLEN.

CAPE SAN LUCAS POCKET GOPHER.

(Pl. V, fig. 11.)

Thomomys fulvus anitæ Allen, Bul. Am. Mus. Nat. Hist., X, 146-147, 1898.

Type.—Collected at Santa Anita, Lower California, by Dane Coolidge, May 28, 1896. Type specimen in British Museum.

Distribution.—Southern part of Lower California from Santana south to Cape San Lucas (fig. 7).

Characters.—Slightly smaller than *bottæ*; larger than *nigricans*; thin haired, bright tawny all over at all seasons, but little darker above than below; skull heavy, with abruptly decurved incisors; mammæ in 4 pairs.

Color.—For most of the year bright tawny, nearly concolor; underparts slightly lighter because thinly haired; feet and tail half naked. In new autumn pelage, apparently from September to December, slightly duller, more grayish. *Young*, slightly paler, with whitish belly.

Skull.—Relatively heavier than in *bottæ* or *nigricans*, with short, heavy rostrum, abruptly decurved incisors, short thick pterygoids, and full rounded bullæ.

Measurements.—Average of 5 topotypes (σ ad.): Total length, 243; tail vertebræ, 78; hind foot, 32.8. Average of 5 topotypes (φ ad.): 208, 67, 30. *Skull* (of topotype, σ ad.):¹ Basal length, 40; nasals, 14; zygomatic breadth, 25.5; mastoid breadth, 21; inter-orbital breadth, 6.5; alveolar length of upper molar series, 8.8.

Remarks.—Evidently intergradation is complete through local forms up the peninsula through *nigricans* to *bottæ*. The subspecies *anitæ* strikingly resembles *fulvus*, however, and but for its direct connection with *bottæ* I should not change Dr. Allen's original arrangement, making it a subspecies of *fulvus*. The *bottæ* and *fulvus* groups are widely separated geographically. Externally *anitæ* is not easily distinguishable from *sinaloæ*, just across the gulf, but the skulls are different.

Specimens examined.—Total number, 99, as follows:

Lower California: Cape San Lucas, 11; La Paz, 12; Las Palmas, 1; Matancita, 6; Miraflores, 5; Rosarito, 20; San Jorge, 5; San Jose del Cabo, 10; Santana, 8; Santa Anita, 16; Tres Pachitas, 1; Triunfo, 4.

¹ No. 146831, U. S. Nat. Mus.

THOMOMYS BOTTÆ ALTICOLUS ALLEN.

SIERRA LAGUNA POCKET GOPHER.

(Pl. IV, fig. 8.)

Thomomys fulvus alticolus Allen, Bul. Am. Mus. Nat. Hist., XII, 13, Apr. 4, 1899.

Type.—Collected at Sierra Laguna, Lower California, Mexico (altitude 7,000 feet), by Dane Coolidge, July 10, 1896. Type specimen in British Museum.

Distribution.—Victoria Mountains, southern Lower California (fig. 7).

Characters.—Size and proportions of *anitæ* or slightly smaller; well furred and dark colored; skull slightly slenderer than in *anitæ*, but very similar; mammæ in 4 pairs.

Color.—*Winter pelage*: Upperparts dark ochraceous or snuff brown, heavily clouded with dusky, usually darkest along median line of back; nose, ear patch, and cheeks blackish; underparts washed with bright ochraceous-tawny; lining of cheek pouches, feet, and tip of tail usually whitish. *Summer pelage*: Clear ochraceous, scarcely darker above than below, or varying to almost black in specimens with a strong tendency toward dichromatism.

Skull.—Slightly slenderer than that of *anitæ*, less slender than in typical *nigricans*, and with larger bullæ, wider occiput, and wide premaxillæ.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 225; tail vertebræ, 72; hind foot, 30. Average of 5 topotypes (♀ ad.): 203, 67, 28. *Skull* (of topotype, ♂ ad.): Basal length, 38; nasals, 13.5; zygomatic breadth, 24; mastoid breadth, 20; interorbital breadth, 6.5; alveolar length of upper molar series, 8.5.

Remarks.—This is a dark, mountain form of *anitæ* from the higher zone of nut pines and oaks. The two forms are so closely related that the skulls are practically indistinguishable, but the skins greatly differ in color. Compared with *nigricans*, the skins are scarcely distinguishable, but the skulls are strikingly different.

Specimens examined.—Total number, 52, as follows:

Lower California (southern): La Laguna, 20; Victoria Mountains, 32.

THOMOMYS BOTTÆ RUSSEOLUS NELSON & GOLDMAN.

SAN ANGEL POCKET GOPHER.

(Pl. IV, fig. 9.)

Thomomys bottæ russeolus Nelson & Goldman, Proc. Biol. Soc. Washington, XXII, 25, Mar. 10, 1909.

Type.—Collected at San Angel, Lower California, at 100 feet above sea level, by E. W. Nelson and E. A. Goldman, October 15, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 7).

Characters.—Smaller than *anitæ* or *nigricans*, with tiny ears, slender skull, thin hair, and pale buffy coloration.

Color.—About as in *perpallidus*, or slightly brighter. October specimens: Upperparts varying from pale to bright buffy; nose grayish; small ear patch dusky; underparts pale buffy, becoming whitish on throat; feet and tail thinly clothed with whitish hairs.

Skull.—Light and slender, with narrow braincase, short narrow posteriorly truncate nasals, wide premaxillæ, slender pterygoids, full rounded bullæ, and narrowly constricted shaft of basioccipital.

Dentition: Incisors abruptly decurved at right angles to axis of skull.

Measurements.—Type (σ young ad.): Total length, 208; tail vertebræ, 73; hind foot (dry), 30. Topotype (σ young ad.): 225, 82, 27 (dry). Topotype (φ im.): 88, 60, 27 (dry). *Skull* (of type): Basal length, 35.5; nasals, 12.7; zygomatic breadth, approximately 24; mastoid breadth, 19; interorbital breadth, 6; alveolar length of upper molar series, 7.5.

Remarks.—While in color practically identical with *magdalænæ* and very similar to *perpallidus*, this desert form differs in cranial characters from *magdalænæ* and *anitæ* in light slender skull, slender pterygoids, large rounded bullæ, and narrow basioccipital; and from *perpallidus* in narrow braincase, wider premaxillæ, and uniformly truncate nasals. The characters strongly suggest a little slender-skulled form of *perpallidus*. The type specimens are from an oasis in a sandy desert where they were apparently isolated, but specimens from Rosarito on the north and San Jorge on the south apparently intergrade with *anitæ*.

One specimen from San Jorge and two from Rosarito might be thrown with *russeolus* (though the majority from the same places are nearer *anitæ*), and on this account this form was made a subspecies of *bottæ* rather than of *perpallidus*.

Specimens examined.—Four, from type locality.

THOMOMYS MAGDALENÆ NELSON & GOLDMAN.

MAGDALENA POCKET GOPHER.

(Pl. V, fig. 12.)

Thomomys magdalænæ Nelson & Goldman, Proc. Biol. Soc. Washington, XXII, 24, Mar. 10, 1909.

Type.—Collected at Magdalena Island, near west coast of Lower California, by E. W. Nelson and E. A. Goldman, December 3, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Magdalena Island, Lower California (fig. 7).

Characters.—Larger than *anitæ*, with heavy, angular skull; color paler; hair thin.

Color.—Type (collected December 3): Upperparts bright buffy orange; underparts, feet, and tail pale buffy or whitish; a scarcely perceptible dusky ear spot.

Skull.—Old male: Very heavy and angular, with narrow braincase, short heavy rostrum, abruptly decurved incisors, angular and anteriorly spreading zygomatic arches, deep lateral pits of palate, prominent and revolutely margined pterygoids.

Measurements.—Type: Total length, 255; tail vertebræ, 87; hind foot, 36. *Skull*: Basal length, 41.5; nasals, 15; zygomatic breadth, 29; mastoid breadth, 23; interorbital breadth, 6; alveolar length of upper molar series, 9.

Remarks.—The type and only specimen of *magdalenæ* is a fine old male from this barren, sandy island off the coast of Lower California. While having strongly marked affinities with *anitæ* of the mainland, the single specimen is so different as to indicate a well-marked insular species. The general characters are those of *anitæ* greatly accentuated. It evidently belongs in the *bottæ* group and is not more different from that species than is *angularis*, just over the ridge from the type region of *bottæ*.

Specimen examined.—One, the type.

THOMOMYS ALTIVALLIS RHODS.

SAN BERNARDINO MOUNTAIN POCKET GOPHER.

(Pl. III, fig. 9.)

Thomomys altivallis Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1895, 34, Feb. 21, 1895.

Type.—Collected on San Bernardino Mountains, California, (altitude 5,000 feet), by R. B. Herron, August 10, 1894. Type specimen in Acad. Nat. Sci. Philadelphia.

Distribution.—San Bernardino Mountains, Cal. (fig. 6).

Characters.—Size large, hind foot in males averaging 34, in females 30; ears short; color dull and dark; skull long, well ridged, with heavy dentition and sloping posterior base of zygoma; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2 (one individual with 2 pairs of abdominal also).

Color.—Paler than in *bottæ*, slightly duller and darker than in *pallescens*; upperparts dull ochraceous with trace of darker dorsal stripe; ear patch, nose, and cheeks blackish; underparts, feet, and most of tail buffy or soiled whitish. Pelage apparently brighter ochraceous in summer than in winter, but only traces of much-worn winter pelage are shown in the specimens examined.

Skull.—Longer and less spreading than in *bottæ*, less sharply ridged, with less inflated auditory meatus, and heavier rostrum; larger than in *pallescens*, with heavier rostrum and less sharply constricted posterior base of zygomatic arch.

Measurements.—Average of 5 topotypes (σ ad.): Total length, 269; tail vertebrae, 78; hind foot, 34. Average of 5 topotypes (φ ad.): 224, 64, 30. *Skull* (of topotype, old σ):¹ Basal length, 46; nasals, 17; zygomatic breadth, 30; mastoid breadth, 24; alveolar length of upper molar series, 10.

Remarks.—*Thomomys altivallis* apparently has its nearest relative in *pallescens*, which stands intermediate in characters and geographic position between it and *bottæ*. It is probably a robust, mountain form of the *bottæ* group occupying the higher levels of the San Bernardino Mountains. The exact type locality is unknown other than as 5,000 feet altitude in the San Bernardino Mountains. Herron, who collected it, is no longer living, and S. N. Rhoads, who described the species, has no further information as to its location. The type specimen, however, is of the large, high-mountain form, agreeing with the large series from Bluff Lake and vicinity.

Specimens examined.—Total number, 155, as follows:

California (at various altitudes from 2,700 to 9,200 feet in the San Bernardino Mountains): Bear Lake, Bear Valley, Bluff Lake, Doble, Dry Lake, Fish Creek, Santa Ana River, Seven Oaks, Sugarloaf, Waterman Canyon, and Fawnskin Park.

Thomomys alpinus Group.

THOMOMYS ALPINUS ALPINUS MERRIAM.

MOUNT WHITNEY POCKET GOPHER.

(Pl. V, fig. 13.)

Thomomys alpinus Merriam, Proc. Biol. Soc. Washington, XI, 216, 1897.

Type.—Collected on Big Cottonwood Meadows (8 miles southeast of Mount Whitney), at 10,000 feet altitude in the Sierra Nevada, California, by B. H. Dutcher, August 6, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Southern part of the Sierra Nevada, Cal., at altitudes between 6,000 and 11,000 feet, from Mount Whitney south to Siretta Meadows (fig. 6).

Characters.—Size large; hind foot about 30 mm. in both males and females; sexes very similar; ears large and conspicuous; colors dull and dark; skull not ridged or angular; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Summer pelage:* Dull dark ochraceous (much as in *bottæ*), becoming blackish along middle of back, paler on belly; nose blackish; throat white; feet and distal two-thirds of tail whitish. One immature specimen is paler, more ochraceous above and buffy below. *Winter pelage* (long and faded on rump and sides in July specimens): Dull dark clay color.

¹ No. 89968, U. S. Nat. Mus.

Skull.—Compared with that of *bottæ* the skull is light and slender, without conspicuous ridges or angles in old age; the incisors are decurved; interorbital region wide and flat; interparietal quadrate; auditory meatus smaller; zygomatic arches less spreading; and nasals conspicuously widened anteriorly. From that of *fulvus* the skull differs less in size and proportions, but has relatively heavier dentition; smaller bullæ; narrower basioccipital; larger, more quadrate interparietal; and narrower posterior part of nasals.

Measurements.—Average of 5 topotypes (σ ad.): Total length, 222; tail vertebræ, 61; hind foot, 30.3. Average of 5 topotypes (φ ad.): 222, 63, 30. *Skull* (of type, σ ad.): Basal length, 36; nasals, 14; zygomatic breadth, 25; mastoid breadth, 19; interorbital breadth, 6.6; alveolar length of upper molar series, 8.

Remarks.—Typical *alpinus* seems not readily to fall into any of the larger groups of species. From *fulvus* it differs more than from *bottæ*, and from the little slender-skulled *monticola* still more widely, except in the large ears. From the *perpallidus* group it differs in long, narrow skull, large molars, and in so many other details as to indicate no close connection. From *nigricans* it differs less in either color or cranial characters than from *bottæ* but shows larger molars, more spreading nasals, greatest width of zygomata posterior instead of anterior to middle, and other distinctions. For the present it may well be retained as the center of a group to which *awahnee* and *neglectus* belong, and possibly also *jacinteus* and *martirensis*.

Specimens examined.—Total number, 158, as follows:

California (southern High Sierra): Big Cottonwood Meadows (10,000 feet altitude), 30; Cottonwood Creek (9,500 feet), 2; Cottonwood Lakes (11,000 feet), 25; Jackass Meadows (7,000 feet), 12; Jordan Hot Springs (6,700 feet), 8; Menache Meadows (8,000 feet), 17; Olanche Peak (9,000–9,750 feet), 6; Ramshaw Meadows, 3; Red Rock Meadows (9,000 feet), 2; Siretta Meadows (9,000 feet), 1; Trout Creek (6,000 feet), 19; Whitney Meadows (9,000 feet), 33.

THOMOMYS ALPINUS AWAHNEE MERRIAM.

YOSEMITE POCKET GOPHER.

(Pl. V, fig. 9.)

Thomomys alpinus awahnee Merriam, Proc. Biol. Soc. Washington, XXI, 146, June 9, 1908.

Type.—Collected in Yosemite Valley, Mariposa County, California, (at 4,000 feet altitude in bottom of valley, near the Sentinel Hotel), by N. Hollister, June 14, 1904. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Western slopes of the Sierra Nevada, Cal., from Sequoia, Tuolumne County, south to Tehachapi Peak (fig. 6).

Characters.—Size small; colors dull and dark; skull slender and narrow, with short rostrum and abruptly decurved incisors; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts dull dark ochraceous; underparts varying from pale buffy to ochraceous; belly irregularly marked and spotted with white in all Yosemite specimens; feet and distal half of tail whitish. *Winter pelage:* Darker, more dusky ochraceous.

Skull.—But little arched; not ridged or angular; rostrum short and incisors abruptly decurved; interorbital region wide and flat; interparietal usually short and wide; bullæ small and well rounded.

Measurements.—Topotype (σ ad.): Total length, 220; tail vertebrae, 75; hind foot, 27. Type (♀ ad.): 194, 54, 26. *Skull* (of type): Basal length, 32; nasals, 12; zygomatic breadth, 21; mastoid breadth, 17; alveolar length of upper molar series, 7. Skull of male from Merced River: 34, 12.4, 22, 18.5, 7.5.

Remarks.—This form is not represented by a good series of adult male specimens from any one locality, but specimens from scattered localities throughout the Transition Zone, from Crockers (north of the Yosemite Valley) south to the vicinity of Mineral King, show the same general characters. Those from near Mineral King are somewhat darker than specimens from the Yosemite Valley and suggest an approach to *alpinus*, while those in the Yosemite are paler and have irregular white markings. Others from Kern River Lakes and Piute Mountain and one from Tehachapi Peak are also referred to it, but they show considerable variation.

Specimens examined.—Total number, 116, as follows:

California (southern and western slopes of the Sierra Nevada): Alta Meadows (Giant National Forest), 2; Connell Meadow (Tulare County, 7,500 feet altitude), 11; Halstead Meadows (in Sequoia National Park, 7,000 feet), 5; Horse Corral Meadows (in Sequoia National Park, 8,000 feet), 2; Huckleberry (near Giant National Forest), 1; Kaweah River (east fork, 5,600 and 8,900 feet), 2; Kern River Lakes, 2; Mineral King, 8; Piute Mountain (5,000 feet?), 31; Sequoia (Crockers), 6; South Fork Merced River (4,000 feet), 1; Taylor Meadow (Tulare County, 7,000 feet), 25; Tehachapi Peak, 1; Wawona, 2; Yosemite Valley, 17.

THOMOMYS NEGLECTUS BAILEY.

SAN GABRIEL POCKET GOPHER.

(Pl. V, fig. 15.)

Thomomys neglectus Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected on San Antonio Peak (Bear Flat Meadows at 6,400 feet altitude) in the San Gabriel Mountains, California, by James H. Gaut, July 23, 1905. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 6).

Characters.—Size medium; colors grizzled with a dark mixture of ochraceous and black; skull long and narrow, with almost straight dorsal outline; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—July pelage, in which 3 molts are shown: Upperparts dark gray produced by a heavy mixture of black-tipped hairs over dull ochraceous; nose, face, and ear patch blackish; tail gray; feet whitish; underparts dull buffy.

Skull.—Adult males: Long and narrow, with narrow braincase; nasals and rostrum long and straight; zygomatic arches slender; bullæ small and especially short and rounded; interparietal small and triangular.

Measurements.—Type (♂ ad.): Total length, 229; tail vertebræ, 77; hind foot, 32 (measured dry). Topotype (♂ ad.): 206, 64, 31. Female topotype: 211, 65, 31. *Skull* (of type): Basal length, 37; nasals, 14.5; zygomatic breadth, 24; mastoid breadth, 19.5; interorbital breadth, 6; alveolar length of upper molar series, 7.5.

Remarks.—Externally this species differs very little from *altivallis* of the San Bernardino Mountains, but the skulls show such striking differences that the two forms can not be considered closely related. Neither does the present form show any characters of *pallescens* on the south or of *perpes* on the north slopes of its range, but appears to approach *alpinus* and *awahnee* of the southern Sierra Nevada. Its actual range and real relationship present an interesting problem still to be worked out.

Specimens examined.—Three, from type locality.

THOMOMYS JACINTEUS GRINNELL & SWARTH.

SAN JACINTO POCKET GOPHER.

(Pl. V, fig. 14.)

Thomomys jacinteus Grinnell & Swarth, Proc. Cal. Acad. Sci., 4th ser., IV, 153-160, Dec. 30, 1914.

Type.—Collected on San Jacinto Mountains (Round Valley, at 9,000 feet altitude), California, by H. S. Swarth, September 15, 1914. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Upper slopes of San Jacinto Mountains, Cal. (fig. 6):

Characters.—Size medium, slightly larger than *nigricans*, much smaller than *altivallis*, and about the size of *martirensis* and *neglectus*; colors dark: skull long and narrow with relatively straight dorsal outline; mammæ in 4 pairs.

Color.—*Summer pelage*: Upperparts dark rich ochraceous, darkened with black-tipped hairs, darkest along median line of back; nose dusky; ears and ear patches black; underparts brighter ochraceous without black-tipped hairs; lining of cheek pouches and usually lips white; base of tail brownish; tip of tail and feet whitish. *Winter pelage*: More clouded by black above.

Skull.—Long, low, and narrow, with especially long narrow braincase; zygomatic arches widest at anterior angle and narrowed posteriorly with the narrowing of the braincase; nasals truncate posteriorly, generally long and narrowly cuneate, but in the type rather

wide and spatulate; interparietal rather small, quadrate, narrowing with age; pterygoids long and low and nearly parallel; interpterygoid fossa not narrowly V-shaped. *Dentition* relatively heavy; incisors curved abruptly downward and not extending much beyond tip of nasals and premaxillæ.

Measurements.—Type (σ ad.): Total length, 240; tail vertebræ, 82; hind foot, 32. Topotype (σ ad.): 234, 80, 31.5. Topotype (♀ ad.): 232, 76, 29. *Skull* (of type): Basal length, 40; nasals, 14.5; zygomatic breadth, 24.7; mastoid breadth, 20; interorbital breadth, 6; alveolar length of upper molar series, 8.8.

Remarks.—At first I was reluctant to separate this high-mountain form from *nigricans* by skull characters alone, as the skins are indistinguishable, but the series of specimens recently collected in Round Valley in the San Jacinto Mountains (at 9,000 feet altitude) by H. S. Swarth show that the skull characters are well marked and constant. The series of 8 males and 5 females from the type locality, now before me, have the long, low, narrow, straight skulls of *cabezonæ* with the same peculiar pterygoids. They differ from *cabezonæ* in larger size, heavier dentition, and much darker color, but show a decided relationship with that species. The resemblance to *nigricans* may be entirely superficial just as it is with *fulvus*, the three forms being very similar in coloration while evidently quite distinct. A close relationship with *neglectus* is indicated by the general type of skull, but that form is much more extreme in its characters. From *martirensis* the present form differs in a rather straight instead of well-arched outline of skull. The two other high-mountain species with which comparison is suggested are *altivallis* and *alpinus* from similar altitudes in the San Bernardino Mountains and the Sierra Nevada. Of these, *altivallis* is at once eliminated on account of its larger size and its broad, well-arched, and massive skull, protruding incisors, and narrowly contracted pterygoids. *Thomomys alpinus*, while so similar in general size and appearance as strongly to suggest relationship, has a very different type of skull; shorter, wider, and more arched zygomata (widest posteriorly); and too many detailed differences to admit of close relationship with the present form.

Specimens examined.—Total number, 25, as follows:

California (higher levels of San Jacinto Mountains): Round Valley (9,000 feet altitude) 8; San Jacinto Peak (10,200 feet), 1; Tahquitz Valley (8,000 feet), 13; Tamarack Valley (9,400 feet), 2; uncertain locality along the trail (8,500 feet), 1.

THOMOMYS MARTIRENSIS ALLEN.

SAN PEDRO MARTIR POCKET GOPHER.

Thomomys fulvus martirensis Allen, Bul. Am. Mus. Nat. Hist., X, 147. 1898.

Type.—Collected on San Pedro Martir Mountains (at 8,200 feet altitude), Lower California, by A. W. Anthony and E. C. Thurber, in May, 1893. Type specimen in Am. Mus. Nat. Hist.

Distribution.—San Pedro Martir Mountains, Lower California (fig. 7).

Characters.—Size considerably larger than *nigricans*; skull longer; colors grayer in both winter and summer pelage.

Color.—*Winter pelage*: Very long and dark gray, not so black as in *nigricans*; underparts buffy gray; tail and feet grayish; lining of cheek pouches white; no white on chin and throat. *Summer pelage*: Dull fulvous, not so intense as in *nigricans* or *fulvus*.

Skull.—Adult males: Very long and narrow, with especially narrow zygomatic arches and long, narrow braincase, in these characters apparently exceeding *neglectus* and *jacinteus*; dorsal outline arched, and rostrum depressed about as in *nigricans*.

Measurements.—Type (σ ad.): Total length, 248; tail vertebræ, 67; hind foot (measured dry), 31. The tail measurement of type is short; other specimens have longer tails, 8 females averaging 70. *Skull*: Basal length, 41.6; nasals, 15; zygomatic breadth, 25; mastoid breadth, 21; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is evidently a very local form occupying some high valley or the crest of the range, since other series from not far distant in the same range and only a little lower down, as at Vallecitos at 8,000 feet altitude, La Grulla at 7,000 feet, and Santo Tomas at 6,000 feet, are typical of *nigricans*. In December, 1914, A. W. Anthony wrote me that the type series of specimens was collected at La Grulla Meadows at 8,200 feet altitude in the San Pedro Martir Mountains, but the series of specimens collected by Nelson and Goldman at La Grulla (7,000 feet) are *nigricans*.

As the mountains rise to 10,200 feet, this may be a mountain-top form of considerable range. The true relationship of these high-mountain forms from *alpinus* to *martirensis* is not very clear and will not be until definite field study shows whether they merge into lower forms or are distinct and isolated.

Specimens examined.—Fourteen, from type locality.

Thomomys perpallidus Group.

THOMOMYS PERPALLIDUS PERPALLIDUS MERRIAM.

PALM SPRINGS POCKET GOPHER.

(Pl. V, fig. 2.)

Thomomys talpoides perpallidus Merriam, Science, VIII, 588, Dec. 24, 1886.

Type.—Collected at Palm Springs (Agua Caliente) Riverside County, California (at sea level on the edge of the Colorado Desert, 6 miles south of Palm Springs Station), by F. Stephens, March or April, 1886.¹ Type specimens in U. S. Nat. Mus., Merriam collection.

¹ In the original description no type was designated by number, but Dr. Merriam refers to several skins collected by F. Stephens in March and April on the Colorado Desert. In the Merriam collection are 4 skins and skulls labeled in accord with this statement, Nos. 2222♂, 2223♂, 2224♂, and 2225♀. Of these No. 2222♂ is the only fully adult male and should have been made the type.

Distribution.—Colorado Desert, southern California, from Whitewater south to Salton Sea (fig. 6).

Characters.—Size medium, hind foot 31 mm. in adult male topotype; tail long; ears small; color pale buffy gray or whitish; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Summer pelage:* Upperparts buffy or cream color; ear patches dusky; nose and cheeks grayish brown; underparts, feet, and tail whitish, thinly haired. *Winter pelage:* Paler than in summer, upperparts creamy or whitish. *Young,* buffy gray.

Skull.—Rather light and slender, without conspicuous ridges or angles; zygomatic arches slender and parallel; nasals rather short, cuneate, truncate, or slightly emarginate at posterior tips; interparietal small and irregularly triangular, oval, or quadrate; bullæ short but full and rounded. *Dentition* rather light; incisors abruptly decurved.

Measurements.—Average of 5 topotypes (σ ad.): Total length, 241; tail vertebræ, 84; hind foot, 31.5. Average of 4 topotypes (\varnothing ad.): 215, 78, 30. *Skull* (of topotype, σ ad.): Basal length, 37; nasals, 15; zygomatic breadth, 26; mastoid breadth, 21; interorbital breadth, 6.4; alveolar length of upper molar series, 7.7.

Remarks.—This very pale, desert species occupies the scattered moist oases in the hottest and driest of our deserts. Apparently its range is not continuous, as no gopher hills are to be found over wide areas of bare hot desert. The numerous colonies are to some extent isolated, and differences too slight for even subspecific recognition mark the specimens from almost every locality, but the main characters hold true over a wide area. Specimens from Carrizo Creek grade toward the more robust form *albatus* of the Colorado River bottoms on the California side, west of Yuma. A small series from Salt Creek, north of the Salton Sea, seem to go better with *perpallidus* than with any of the other three forms to which they might almost as well be referred. Direct intergradation is shown with *perpes* and through it with *griseus* and *aureus*.

The *aureus* group as heretofore considered now becomes the *perpallidus* group and includes *perpallidus*, *albatus*, *chrysonotus*, *perpes*, *canus*, *aureus*, *apache*, *cabezonæ*, *operarius*, and probably also *latirostris*, *cervinus*, and *sinaloæ*.

Specimens examined.—Total number, 68, as follows:

California: Agua Dulce, 1; Baregas Spring (8 miles east), 5; Colorado Desert (no specific locality), 5; Fish Spring, 2; Mission Creek, 1; Palm Springs, 35; Salt Creek (Riverside County), 8; Salton Sea (west side), 1; Whitewater, 10.

THOMOMYS PERPALLIDUS ALBATUS GRINNELL.

WHITE POCKET GOPHER.

(PL. V, fig. 1.)

*Thomomys albatu*s Grinnell, Univ. of Cal., Publ. Zool., X, 172, 1912.

Type.—Collected on west side of Colorado River at old Hanlon Ranch near Pilot Knob, Imperial County, California, by J. Dixon, May 7, 1910. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Southeastern California and northeastern Lower California from Carrizo Creek south to Gardner's Lagoon, Salton River (fig. 6).

Characters.—Size considerably larger than *perpallidus*; color lighter; ears small; tail long; feet stout; mammæ in 4 pairs.

Color.—*Summer pelage* (May and June): Upperparts pale buff or cream color; nose and ears grayish brown; underparts white or creamy with little or no plumbeous base to fur; feet and tail almost naked but with scattered short white hairs. *Winter pelage*: Practically as in summer, but with more evident plumbeous base to fur on belly. *Young*: Less buffy, more grayish white.

Skull.—In old males rather heavy, ridged, and angular, widest at anterior angle of zygomata; rostrum short and heavy; incisors not so abruptly decurved as in *perpallidus*; bullæ full and rounded; occiput rather sloping, not so abruptly truncate as in *aureus* and *perpes*.

Measurements.—Type (♂ ad.): Total length, 272; tail vertebræ, 100; hind foot, 35. Topotype (♂ ad.): 264, 91, 34. Topotype (♀ ad.): 229, 79, 34. *Skull* (of type): Basal length, 41.5; nasals, 15; zygomatic breadth, 28; mastoid breadth, 22; interorbital breadth, 6.8, alveolar length of upper molar series, 8.5. Skull of old female: 38, 13.5, 25, 21, 6.5, 7.7.

Remarks.—This is a robust gopher very close to *perpallidus* in color, but in size and skull characters close to *aureus*. It occupies the moist, white, river sand of the flats where there is an abundant food supply. Specimens from Carrizo Creek are not typical but nearer *albatu*s than *perpallidus*. Others from Baregas Spring and west of the Salton Sea are nearer *perpallidus*.

Specimens examined.—Total number, 72, as follows:

California: Carrizo Creek, 18; Colorado River bottoms opposite Yuma, 37; Salt Creek (Imperial County), 11; Salton Sea (Imperial County), 6.

Lower California: Salton River (Gardners Lagoon), 1.

THOMOMYS PERPALLIDUS CHRYSONOTUS GRINNELL.

YELLOW-BACKED POCKET GOPHER.

Thomomys chrysonotus Grinnell, Univ. of Cal., Publ. Zool., X, 174, 1912.

Type.—Collected at Ehrenburg, Arizona, (on dry mesa back from river bottoms), by F. Stephens, March 27, 1910. Type specimen in Mus. Vert. Zool., Univ. of California.

Distribution.—Southwestern Arizona and northwestern Sonora, from Ehrenberg south to near mouth of Colorado River, and east to Quitobaquito (figs. 7 and 8).

Characters.—Size smaller than *perpallidus*; ears minute; skull shorter, and bullæ more globose; color about the same; mammæ in 4 pairs.

Color.—*Summer pelage*: Upperparts bright to pale buff; ears brown or dusky at tips; postauricular patch generally inconspicuous; nose brownish; underparts and well up on sides whitish with pale plumbeous base of hair; feet and tail thinly clothed with short white hairs. *Winter pelage*: More grayish, fading to very pale buff in early spring.

Skull.—Short and wide; rostrum relatively shorter and wider than in *perpallidus*; bullæ fuller and more rounded; upper incisors more abruptly decurved; premaxillæ in type ending approximately even with posterior tip of nasals, but in the majority of specimens extending well back of nasals; interparietal small and nearly triangular; pterygoids short, thick, low, and wide apart.

Measurements.—Type (σ ad.): Total length, 217; tail vertebrae, 73; hind foot, 30. Adult female from Yuma, Ariz.: 203, 65, 27. *Skull* (of type): Basal length, 33.5; nasals, 13.5; zygomatic breadth, 23; mastoid breadth, 19; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—This seems to be a dry-mesa form more nearly agreeing with typical *perpallidus* than with the more robust *albatrus* of the moist bottoms just across the Colorado River. Originally I identified the type for Dr. Grinnell as *perpallidus*, but since that time he has collected a fine series of topotypes of *perpallidus* at Palm Springs, which show better diagnostic characters than do the series in the National Museum collection, and fully warrant the separation of the form ranging in the dry hot desert east of the Colorado River in southwestern Arizona and northwestern Sonora.

Specimens examined.—Total number, 25, as follows:

Arizona: Ehrenburg, 1; Monument No. 204, east side of Colorado River, 1; Quitobaquito, 2; Tacna, 1; Tule Wells (in Tule Mountains near Sonora line), 5; Yuma, 12.

Sonora: Cienega Well, 2; Mesa on east side of Colorado River, 20 miles below the Arizona line, 1.

THOMOMYS PERPALLIDUS PERPES MERRIAM.

LONE PINE POCKET GOPHER.

(Pl. V, fig. 3.)

Thomomys aureus perpes Merriam, Proc. Biol. Soc. Washington, XIV, 111, July 19, 1901.

Thomomys scapterus Elliot, Field Columb. Mus., zool. ser. III, 248, 1903. Type collected by E. Heller, in Hanopee Canyon, Panamint Mountains, California. Type specimen in Field Mus. Nat. Hist.

Type.—Collected at Lone Pine, Owens Valley, Inyo County, California, by E. W. Nelson, December 23, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Upper Sonoran desert valleys and mountain slopes of eastern California, from near head of Owens Valley south to Hesperia and Morongo Valley, into the valley of Kern River, and east to the Providence Mountains, Cal., and the Grapevine Mountains, Nev. (fig. 6).

Characters.—About the size of *perpallidus* or slightly smaller, with shorter tail, larger ears, slenderer skull, and brighter, stronger color; smaller and grayer than *aureus*; mammæ in 4 pairs.

Color.—*Summer pelage*: Upperparts bright buffy ochraceous; nose grayish brown; ear patch dusky; underparts buffy or creamy white; throat often pure white; feet and tail thinly covered with short silvery hairs. *Winter pelage*: Upperparts duller, darker, and more grayish buff. *Young*, very similar to adults.

Skull.—Slender and light with rarely a trace of lateral ridges; well arched; narrower and slenderer than in *perpallidus*, with especially slenderer rostrum; palate slightly more arched than in *perpallidus*, much less arched than in *aureus*; interparietal generally quadrate; bullæ full and rounded; nasals slightly emarginate or occasionally truncate. *Dentition* rather light; upper incisors decurved at right angles to axis of skull.

Measurements.—Average of 5 topotypes (♂ ad.): Total length, 215; tail vertebræ, 66; hind foot, 28.7. Average of 5 topotypes (♀ ad.): 210, 67, 28.5. *Skull* (of type): Basal length, 33; nasals, 12.3; zygomatic breadth, 22; mastoid breadth, 18.6; interorbital breadth, 6.5; alveolar length of upper molar series, 7.5.

Remarks.—This small gray form of the *perpallidus* group occupies Upper Sonoran desert valleys and slopes of eastern California. In parts of the Mohave Desert where it extends down into Lower Sonoran valleys it becomes slightly larger and paler than normal and might almost as well be placed with *aureus*; while in the foothills of the Sierra Nevada, San Gabriel, and San Bernardino Mountains it becomes slightly darker than the typical form and may grade into *awahnee*. It does not occur in Death Valley or Panamint Valley,

and gives place to *operarius* in the bottom of Owens Valley, and to *aureus* in Ash Meadows and the Amargosa Valley. Its connection with *perpallidus* on the south has been fully established by recent collections, so that both *perpes* and *aureus* must stand as subspecies of this earliest-described form of the desert group. *Thomomys scap-terus* of Elliot proves to be typical of *perpes*.

Specimens examined.—Total number, 344, as follows:

California: Ash Creek (west of Owens Lake), 1; Barstow, 16; Benton Station, 4; Bishop, 1; Cactus Flat, 1; Carroll Creek, 1; Copper City, 1; Coso, 19; Cushenbury Spring, 2; Daggett, 2; Fairmont, 1; Granite Spring, 1; Grapevine Ranch, 3; Haway Meadows (south of Owens Lake), 2; Hesperia, 1; Independence, 13; Independence Creek, 2; Inyo Mountains, 1; Isabelle, 6; Kern River (South Fork, near Onyx), 17; Lone Pine, 64; Lone Willow Spring, 7; Ludlow, 2; Maturango Spring, 1; Mohave River, 4; Morongo Pass, 1; Mount Waterman (north slope in San Gabriel Mountains), 1; New York Mountain (in Providence Range), 1; Orogrande, 16; Panamint Mountains (Johnson Canyon, Perognathus Flat, Coal Kilns, Hanopee Canyon, head of Willow Creek, and Cottonwood Creek), 23; Resting Spring, 24; Tuttle Creek, 5; Twelve Mile Spring, 1; Victorville, 26; Walker Pass, 28; Warrens Ranch (in Morongo Valley), 1; Warrens Well (east of Morongo Valley), 2; Weldon, 37; White Mountains (pass between Deep Spring and Owens Valley), 1.

Nevada: Grapevine Mountains, 3; Thorps Mill, 1.

THOMOMYS PERPALLIDUS CANUS BAILEY.

GRAY POCKET GOPHER.

(Pl. V, fig. 6.)

Thomomys canus Bailey, Proc. Biol. Soc. Washington, XXIII, 79, May 4, 1910.

Type.—Collected at Deep Hole, at north end of Smoke Creek Desert, Nevada, by Clark P. Streater, May 14, 1896. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Valleys of western and central Nevada, from Flowing Springs, western Humboldt County, south to Cloverdale and Monitor Valley, west to Honey Lake, Cal. (fig. 5).

Characters.—Considerably larger than *perpallidus*, with larger ears and shorter tail; size of *aureus* or a little larger; hind foot 30–33 mm.; colors buffy gray; skull wide, palate flat, not arched between molar series; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts pale buffy gray with dusky ear patch and brownish nose; underparts, feet, and tail whitish. The remnant of a more yellowish pelage on the rump of a toptype collected May 16 would indicate a darker winter pelage, while an old female collected at Amadee July 24 is coming into a still more ashen gray pelage.

Skull.—Much heavier and wider than that of *perpallidus*; like that of *aureus* but lower and wider with flat instead of arched palate; interparietal larger and more quadrate; bullæ slightly larger; anterior points of frontals less acute; lateral pits of palate deeper.

Measurements.—Type (σ ad.): Total length, 242; tail vertebræ, 64; hind foot, 33. Average of 3 topotypes (♀ ad.): 216, 66, 30.3. *Skull* (of type): Basal length, 41; nasals, 15; zygomatic breadth, 28; mastoid breadth, 23; alveolar length of upper molar series, 9.

Remarks.—In color *canus* closely resembles the gray phase of its near neighbor *nevadensis*, but shows no relationship with it in cranial characters, while it does agree closely with the *perpallidus* group. It inhabits moist fertile soil of alkaline valleys, with many interruptions in range and some variation in characters. Specimens from Cloverdale, Peavine, and Monitor Valley, Nev., could almost as well be referred to *aureus*.

Specimens examined.—Total number, 43, as follows:

California: Amedee (Lassen County), 1; Fort Sage, 1.

Nevada: Carson River (Ragtown), 2; Carson Sink, 2; Cloverdale, 7; Deep Hole, 5; Fallon, 3; Flowing Spring, 1; Granite Creek, 2; Monitor Valley, 1; Peavine, 4; Pyramid Lake (south end), 9; Smoke Creek, 4; Wadsworth, 1.

THOMOMYS PERPALLIDUS AUREUS ALLEN.

YELLOW POCKET GOPHER.

(Pl. II, fig. 4; Pl. V, fig. 5.)

Thomomys aureus Allen, Bul. Am. Mus. Nat. Hist., V. 49, Apr. 28, 1893.

Type.—Collected at Bluff, San Juan County, Utah, by Charles P. Rowley, May 12, 1892. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Desert region of southern Nevada, southern Utah, western Colorado, central and northwestern New Mexico, and northern and western Arizona (fig. 8).

Characters.—Size rather large; hind foot 29–32 mm.; ear relatively small; color golden buff; skull heavy, long, high, and narrow, with palate greatly arched between the molar series; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Winter pelage:* Upperparts beautiful orange-buff, varying to paler and darker shades and sometimes with a wash of dusky along the back; ear patch and nose blackish in the darker and slightly dusky in the lighter individuals; underparts, feet, and tail creamy white. *Summer pelage:* Slightly darker. *Young,* more grayish.

Skull.—Long and narrow, with light lateral ridges parallel or sometimes nearly meeting in a sagittal crest in extreme old age; outline of palate strongly arched; bullæ full and rounded; interpterygoid fossa normally U-shaped with a central point or spicule extending from median ridge of palate; nasals cuneate and usually truncate posteriorly. *Dentition* heavy; upper incisors abruptly decurved at right angles to skull.

Measurements.—Average of 5 old male topotypes: Total length, 240; tail vertebræ, 73; hind foot, 31. Average of 5 old females: 224, 78, 30. *Skull* (of topotype, σ ad.):¹ Basal length, 42; nasals,

¹No. 57162, U. S. Nat. Mus.

17; zygomatic breadth, 27; mastoid breadth, 22; interorbital breadth, 7; alveolar length of upper molar series, 9.

Remarks.—The subspecies *aureus* is an Upper and Lower Sonoran desert form occupying the bottoms of open sandy valleys, many of which are separated by mountainous or rough country in which the subspecies does not occur. In almost every valley slight variations of characters can be detected, but in none do they become so marked as to require recognition by name. In eastern California this form grades into the smaller *perpes*, which is mainly Upper Sonoran in range, while *aureus* occupies the Lower Sonoran valleys. On the south it evidently grades into *albatius* along the Colorado River bottoms, and thence into *perpallidus* of the Colorado Desert. Two specimens from Wickenburg, Ariz., are referred with some hesitation to *aureus*. Series of specimens from Manti and the Pine Valley Mountains, Utah, are by no means typical but may be called *aureus* rather than *perpes*. In New Mexico the subspecies reappears in the Rio Grande Valley from Bernalillo to San Marcial, and while growing darker to the southward is perfectly typical of *aureus* at Albuquerque.

Specimens examined.—Total number, 306, as follows:

Arizona: Chin Lee, 2; Jacobs Pool, 4; Keams Canyon, 6; Parker, 16; Wickenburg, 2.

California: Amargosa River (near Nevada line), 3.

Colorado: Ashbaugh Ranch, 1; Coventry, 8; Grand Junction, 1; Los Pinos, 1; Mesa Verde, 1.

Nevada: Ash Meadows, 51; Charleston Mountains (east base), 4; Colorado River (head of Black Canyon), 1; Oasis Valley, 3; Pahranagat Valley, 1; Pahrum Valley, 23; St. Thomas, 5; Vegas Valley, 10.

New Mexico: Acoma, 2; Albuquerque, 4; Bear Spring Mountains, 6; Belen, 6; Bernalillo, 4; Chusca Mountains (west slope), 1; El Vado (Chama River Valley), 1; Fruitland, 4; Gallina (Chama River Valley), 1; Gallup, 2; Juan Tofoya, 2; Laguna, 4; Riley, 4; San Augustine Plain (12 miles northwest of Monica Spring), 6; San Marcial, 5; Shiprock, 2; Socorro, 13; Wingate, 1.

Utah: Bluff (San Juan County), 48; Hanksville, 6; Hebron, 1; Henry Mountains, 3; Kanab, 4; Manti, 13; Mountain Meadows, 2; Pine Valley, 4; Pine Valley Mountains, 7; St. George, 5; Santa Clara, 2.

THOMOMYS PERPALLIDUS APACHE BAILEY.

JICARILLA POCKET GOPHER.

(Pl. IV, fig. 6.)

Thomomys apache Bailey, Proc. Biol. Soc. Washington, XXIII, 79, May 4, 1910.

Type.—Collected at Lake La Jara (7,500 feet altitude) on the Jicarilla Apache Indian Reservation, N. Mex., by James H. Gaut, September 19, 1904. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Transition Zone in northeastern Arizona, northwestern New Mexico, and southwestern Colorado (fig. 7).

Characters.—Size large, hind foot 33–34 mm.; color dark; hind feet and tip of tail conspicuously white; mammæ in 4 pairs.

Color.—Upper and under parts nearly uniform dull sooty gray slightly washed with dull ochraceous; back with an ill-defined stripe of blackish from tip of nose to base of tail; basal half to three-quarters of tail brownish or blackish, the rest abruptly white; hind feet white; lips usually and chin rarely white. *Young*: One half-grown individual is lighter, more buffy, with white belly.

Skull.—Similar in form and general characters to that of *aureus*; bullæ full and rounded; pterygoids U-shaped, with spicule point of palatal ridge; nasals normally slightly emarginate with doubly rounded posterior tips, instead of normally truncate as in *aureus*, or widely emarginate as in *fulvus*. *Dentition*: Upper incisors white-tipped and decurved at nearly right angles to axis of skull.

Measurements.—Type (♂ ad.): Total length, 229; tail vertebræ, 74; hind foot, 34. Topotype (♀ ad.): 229, 74, 33. *Skull* (of type): Basal length, 41; nasals, 14; zygomatic breadth, 28; mastoid breadth, 23; alveolar length of upper molar series, 8.5.

Remarks.—This is a large, dark form of the *perpallidus* group with conspicuous markings, but with cranial characters close to those of *aureus*. It seems to be a dark local Transition Zone form of the yellow *aureus* of the surrounding valleys.

Specimens examined.—Total number, 36, as follows:

Arizona: Canyon de Chelly (7 miles above mouth), 1; Fort Defiance (sawmill 12 miles northwest), 2.

Colorado: Arboles, 1; Bayfield, 1.

New Mexico: Boulder Lake, 4; ¹ Chama River (near Gallina), 1 (not typical); Chusca Mountains (around lakes at top of range, 8,000–9,000 feet altitude), 13; Lake La Jara, 2; ¹ Stinking Lakes, 11.¹

THOMOMYS CABEZONÆ MERRIAM.

CABEZON POCKET GOPHER.

(Pl. V, fig. 8.)

Thomomys cabezonæ Merriam, Proc. Biol. Soc. Washington, XIV, 110, July 19, 1901.

Type.—Collected at Cabezon, San Gorgonio Pass, California, by Clark P. Streater, June 3, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—San Gorgonio Pass, southern California, south to Cabezon (fig. 6).

Characters.—Size medium, hind foot 30 mm.; ears rather large; color dull ochraceous; skull long and narrow.

Color.—*Summer pelage*: Upperparts dull ochraceous, varying from buffy ochraceous to dull brownish; ear patch black; nose and lips dusky or plumbeous; underparts creamy white to buffy or salmon. In 8 of 10 topotypes collected in June, a paler, more buffy gray pelage (probably winter) is disappearing on the rump.

¹ On the Jicarilla Apache Indian Reservation in northern New Mexico.

Skull.—Long, narrow, and slender, with nearly parallel lateral ridges; zygomatica parallel or slightly wider anteriorly; nasals long and narrow; interparietal rectangular or oval, wider than long in immature skulls; pterygoids long, low, and thin, with rounded symphysis.

Measurements.—Average of 7 male topotypes: Total length, 221; tail vertebræ, 79; hind foot, 30. Average of 3 female topotypes: 208, 71, 28.7. *Skull* (of type): Basal length, 35; nasals, 14.5; zygomatic breadth, 23; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—*Thomomys cabezonæ* seems to be a local form not closely connected with surrounding species. From *perpallidus*, its nearest neighbor on the east, and *palleescens* on the west, it is sharply differentiated. In general appearance it most nearly resembles *perpes*, from which it differs strikingly in large ears and in many cranial characters. Two specimens from Whitewater show an overlapping of range with *perpallidus*, but Gaut reports *cabezonæ* in irrigated fields, and *perpallidus* in the sagebrush. A single specimen of *nigrescens* from 2,500 feet altitude near Banning, and 7 specimens of *cabezonæ*, show a meeting or overlapping of ranges along the edge of the valley. The narrow braincase suggests relationship with *jacinteus*, and with *neglectus* of which it may be a pale valley form.

Specimens examined.—Total number, 55, as follows:

California (southern): Banning, 12; Cabezon, 27; Schains Ranch (4,500 feet altitude), 4; Snow Creek (near Whitewater), 2; Whitewater, 10.

THOMOMYS OPERARIUS MERRIAM.

OWENS LAKE POCKET GOPHER.

(Pl. V, fig. 4.)

Thomomys operarius Merriam, Proc. Biol. Soc. Washington, XI, 215, July 15, 1897.

Type.—Collected at Keeler, California, on east side of Owens Lake, at 3,600 feet altitude, by E. W. Nelson, November 29, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 6).

Characters.—Size medium, hind foot 30 mm.; color rich buff; skull short and wide; mammæ in 4 pairs.

Color.—Upperparts rich buff or pale ochraceous; ear patch gray or plumbeous; underparts, feet, and tail creamy white. *Young*, more grayish.

Skull.—Short and wide with short, heavy rostrum; zygomatica abruptly spreading; upper incisors sharply decurved or slightly incurved; maxillaries short and heavy.

Measurements.—Average of 5 topotypes (σ ad.): Total length, 223; tail vertebræ, 69; hind foot, 30.6. Average of 5 females: 217, 66, 29.6. *Skull* (of type): Basal length, 38; nasals, 13.5; zygomatic

breadth, 26.7; mastoid breadth, 21.5; interorbital breadth, 7; alveolar length of upper molar series, 8.5.

Remarks.—*Thomomys operarius* seems to be a very local form, quite distinct from *perpes*, by which its range is closely surrounded, but more nearly resembling *albatus* in short rostrum and heavy skull, and *aureus* in color. While clearly of the *perpallidus* group, it seems not to have direct connection with any of the forms and may well stand as described, a full species. It is confined to the sandy alkaline soil along the east side of Owens Lake.

Specimens examined.—Seventy-nine, from type locality.

THOMOMYS LATIROSTRIS MERRIAM.

PAINTED DESERT POCKET GOPHER.

(Pl. V, fig. 7.)

Thomomys latirostris Merriam, Proc. Biol. Soc. Washington, XIV, 107, July 19, 1901.

Type.—Collected at Little Colorado River, Painted Desert, Arizona (at Tanners Crossing, northeast of San Francisco Mountain), by C. Hart Merriam and Vernon Bailey, September 22, 1899. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Painted Desert, Ariz. (fig. 8).

Characters.—Size medium, hind foot 33 mm.; skull flattened; rostrum short and broad; ears very small; color orange-buff, much as in *aureus*.

Color.—Upperparts bright buffy yellow or pale orange-buff, without trace of black-tipped hairs; ears dusky; nose grayish brown; underparts, feet, and tail white, with a tinge of sulphur yellow stain on belly of type. *Young*, slightly less yellow, more buffy.

Skull.—Narrow and flat, with wide, flat rostrum; nasals narrow in the middle, spreading anteriorly; premaxillæ unusually wide at base of rostrum; incisors abruptly decurved at right angles to axis of skull; interparietal broadly pentagonal; bullæ small, about as in *fulvus*; basioccipital wide, flat, and keeled.

Measurements.—Type (♂ ad.): Total length, 232; tail vertebræ, 79; hind foot, 33. *Skull* (of type): Basal length, 39; nasals, 14; zygomatic breadth, 26; mastoid breadth, 21; alveolar length of upper molar series, 8.

Remarks.—While unique in characters, *latirostris* can best be placed in the group with *aureus* (*perpallidus*), with which it agrees in abruptly decurved incisors and U-shaped pterygoids. It is evidently an isolated form of restricted range. The type specimen was caught in the sand dunes in the Painted Desert along the Little Colorado River at Tanners Crossing, between Black Tank and Moencopie. It is a very old male in thin summer pelage, a worn and faded portion of which is disappearing over the posterior half of the body,

while a new, bright coat is replacing it over the anterior half. An immature female taken at Tuba, August 16, 1909, by Clarence Birds-eye, is the only other known specimen. The distinguishing characters of the species are maintained in this young specimen, which disproves the idea that the type was abnormal. Two skulls of immature females without skins, from Winslow, do not possess characters sufficiently well marked for satisfactory determination, but are provisionally referred to *latirostris*. Apparently this is a Painted Desert form somewhat related to *aureus*.

Specimens examined.—Total number, 4, as follows:

Arizona: Painted Desert, 1; Tuba, 1; Winslow, 2.

THOMOMYS CERVINUS ALLEN.

PHOENIX POCKET GOPHER; FAWN-COLORED POCKET GOPHER.

(Pl. VI, fig. 2.)

Thomomys cervinus Allen, Bul. Am. Mus. Nat. Hist., VII, 203, June 29, 1895.

Type.—Collected at Phoenix, Arizona, by J. Diefenbach, October 20, 1894. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Upper Gila Valley, Ariz. (figs. 7 and 8).

Characters.—Size large, hind foot 33–36 mm.; color pale fawn; skull heavy, ridged, and angular; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage*: Upperparts pale fawn, with conspicuously blackish ear patch; nose and cheeks brown or blackish; underparts, feet, and tail a still paler shade of fawn; lining of cheek pouches white. *Young*, with whitish bellies.

Skull.—Long and narrow, as in *aureus*; palate only slightly arched; bullæ large and truncate instead of smoothly rounded anteriorly; pterygoids variable, narrowly constricted or wide apart, with thickened margins, and often inclosing a postpalatal spicule.

Measurements.—Average of 3 topotypes (♂ ad.): Total length, 253; tail vertebræ, 84; hind foot, 34.6. Average of 5 topotypes (♀ ad.): 245, 77, 34. *Skull* (of topotype, ♂ ad.):¹ Basal length, 42; nasals, 15.5; zygomatic breadth, 28; mastoid breadth, 20.5; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is evidently a large form of the *perpallidus* group, occupying the Gila Valley. From *albatus* of the Colorado River valley it differs in darker color and longer, slenderer skull and rostrum. It also suggests relationship with the *fulvus* group through *toltecus* of the valleys farther east.

Specimens examined.—Total number, 19, as follows:

Arizona: Phoenix, 16; Sacaton, 1; Tempe, 2.

THOMOMYS SINALOÆ MERRIAM.

SINALOA POCKET GOPHER.

(Pl. IV, fig. 7.)

Thomomys sinaloæ Merriam, Proc. Biol. Soc. Washington, XIV, 108, July 19, 1901.

Type.—Collected at Altata, Sinaloa, Mexico (altitude 10 feet above sea level), by E. A. Goldman, March 28, 1899. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Western Sonora and Sinaloa, from Hermosillo south to Albata (fig. 7).

Characters.—Size rather large, hind foot 30–32 mm.; tail long; pelage thin; color bright tawny; skull heavy, wide, and angular; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts bright tawny or dull chestnut with a trace of dusky along back; underparts plain light tawny; nose grayish brown; feet and tail half-naked, half-covered with buffy hairs. *Young*, paler, more buffy. Summer and winter colors not very different.

Skull.—Heavy, wide, and angular; rostrum wide; nasals short and normally truncate posteriorly; zygomata abruptly spreading; bullæ full and rounded; basioccipital narrow between bullæ. *Dentition* heavy; incisors abruptly decurved.

Measurements.—Type (♂ ad.): Total length, 233; tail vertebræ, 73; hind foot, 31. Average of 3 topotypes (♂ ad.): 228, 75, 31.5. Average of 3 adult females: 214, 73, 31.3. *Skull* (of type): Basal length, 39.5; nasals, 14.5; zygomatic breadth, 28.3; mastoid breadth, 22; interorbital breadth, 6.2; alveolar length of upper molar series, 8.2.

Remarks.—Despite fulvous coloration the closest affinities of this form appear to be with the *perpallidus* group. From its nearest relative, *cervinus*, it differs in thin pelage, darker coloration, and short wide skull. Two small females from Magdalena, Sonora, are not typical and can only provisionally be referred to this species.

Specimens examined.—Total number, 22; as follows:

Sinaloa: Altata, 6.

Sonora: Camoæ, 11; Hermosillo, 2; Magdalena, 2; Ortiz, 1.

Thomomys fulvus Group.

THOMOMYS FULVUS FULVUS (WOODHOUSE).

FULVOUS POCKET GOPHER.

(Pl. VI, fig. 1.)

Geomys fulvus Woodhouse, Proc. Acad. Nat. Sci., Philadelphia, VI, 201, 1852.

Thomomys fulvus Baird, Mamm. N. Am., 402, 1857.

Type.—Collected on San Francisco Mountain, Arizona, by Dr. S. W. Woodhouse, October, 1851. Type specimen in U. S. Nat. Mus.

Distribution.—Transition Zone in northern and central Arizona from the Trumbull Mountains to the White Mountains; east in New

Mexico to Sierra Grande, and the White and Guadalupe Mountains; north to Fisher Peak, southeastern Colorado (fig. 7).

Characters.—Size medium; hind foot 28–30 mm.; color dark tawny or dull chestnut; ears and claws medium; mammae in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Summer pelage:* Upperparts clear dark tawny or light chestnut, often dusky or blackish along back; ear patch, nose, and cheeks dusky or blackish; underparts lighter; chin, lining of cheek pouches, and feet usually white or whitish; tail tawny or dusky above, grayish below. *Winter pelage:* Duller darker tawny, more uniformly dusky above. *Young* very similar to adults.

Skull.—Heavier and relatively wider than in the *fuscus* or *fossor* groups; lighter and slenderer than in *perpallidus* or *aureus*. Lateral ridges slightly developed and approximately parallel at all ages; nasals broadly emarginate posteriorly; bullae medium; basioccipital broadly triangular; pterygoid fossa normally V-shaped. *Dentition:* Incisors not projecting beyond tip of nasals; distinctly grooved.

Measurements.—Old male topotype: Total length, 231; tail vertebrae, 74; hind foot, 30. Average of 5 male topotypes: 219, 70, 30. Average of 5 female topotypes: 209, 66, 29.2. *Skull* (of topotype, ♂ ad.):¹ Basal length, 36; nasals, 15; zygomatic breadth, 24; mastoid breadth, 19; interorbital breadth, 6; alveolar length of upper molar series, 8.

Remarks.—The typical subspecies of *Thomomys fulvus* seems to occur only in the Transition Zone, above which it rarely extends and below which it extends mainly in modified forms, several of which have been separated. The name *fulvus* stands not only for a species with its six subspecies, but for the center of a widely distributed group, including *mearnsi*, *baileyi*, and *lachuguilla*. Its relationship with the *bottæ* group of the west coast is genetically close but geographically the two are widely separated. If connected with the *perpallidus* group it is through *toltecus* and *cervinus*, but this connection seems doubtful and by no means close.

Specimens examined.—Total number, 305, as follows:

Arizona: Aubrey (10 miles south of Pine Spring, 6,000 feet altitude), 2; Beaver Creek (near Fort Verde), 1; Bill Williams Mountain, 2; Blue (Greenlee County, 6,000 feet), 2; Bradshaw City, 17; Flagstaff, 2; Fort Verde, 5; Fort Whipple, 2; Fossil Creek, 3; Grand Canyon (Canyon Spring), 1; Little Spring (18 miles northwest of Flagstaff), 1; Pine Spring (5 miles north, 7,000 feet), 1; Prescott, 7; Prieto Plateau (south end Blue Range, Greenlee County, 7,500–9,000 feet), 6; San Francisco Mountain, 20; Springerville (7,000 feet), 29; Trumbull Mountains, 3; White Mountains, 3.

Colorado: Fisher Peak, 1.

New Mexico: Burro Mountains, 2; Capitan Mountains, 36; Chloride (10 miles east), 1; Cliff, 1; Cloudcroft, 7; Cloudcroft (10 miles north), 1; Coppermines, 1; Copperton, 6; Corona, 6; Carasal (Bernalillo County), 3; Datil Mountains, 7; Fairview, 1; Folsom, 2; Fort Wingate, 2; Gallina Mountains, 1; Gila, 5; Glenwood, 1; Guadalupe Mountains, 6; Halls Peak, 7; Head of Mimbres, 2; Hoskins Ranch (Colfax County), 2; Jicarilla Mountains, 5; Kingston (about 4 miles west, 9,500 feet altitude), 2; Long Canyon (3 miles north of Catskill), 1; Luna, 3; Luna (6 miles southwest, 7,000 feet), 5; Magdalena Mountains (Copper Canyon, 8,200 feet), 1; Magdalena Mountains (Water Canyon, 6,500 feet), 1; Manzano Mountains, 12; Mimbres River, 1; Mogollon Mountains, 7; Mora (10 miles south), 4; Mount Capitan (east base), 1; Pecos, 2; Pleasanton, 3; Quemado (10 miles southwest), 2; Raton Range (near Folsom), 3; Rio Alamosa (15 miles north of Ojo Caliente, 6,900 feet), 1; Ruidosa, 7; San Andres Mountains, 6; San Mateo Mountains (Monica Canyon, 8,000 feet), 2; San Pedro, 2; Sierra Grande, 4; Silver City, 12; Fort Stanton, 3; Fort Union, 1; Zuni Mountains, 5; Zuni River, 1.

THOMOMYS FULVUS PERVAGUS MERRIAM.

ESPAÑOLA POCKET GOPHER.

(Pl. IV, fig. 5.)

Thomomys aureus pervagus Merriam, Proc. Biol. Soc. Washington, XIV, 110, 1901.

Type.—Collected at Espanola, New Mexico, by J. Alden Loring, January 4, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Upper Rio Grande and San Luis Valleys in northern New Mexico and southern Colorado (fig. 8).

Characters.—Size large, hind foot 31–33 mm.; color lighter than in *fulvus*; skull longer and heavier; mammæ in 4 pairs.

Color.—*Summer pelage*: Upperparts plain bright tawny; nose, cheeks, and ear patch blackish; underparts paler tawny; feet whitish; tail dusky above, usually to tip. *Winter pelage*: Slightly duller above and below.

Skull.—As in *fulvus*, but longer, narrower, and with less-spreading zygomatic arches, and slightly larger audital bullæ; differing from *aureus* in less arched palate, emarginate nasals, and V-shaped pterygoids.

Measurements.—Type (♂ ad.): Total length, 244; tail vertebræ, 76; hind foot, 31. Average of 4 topotypes (♂ ad.): 239, 73, 32.3. Average of 5 females: 224, 68, 31.4. *Skull* (of type): Basal length, 42; nasals, 15.5; zygomatic breadth, 27; mastoid breadth, 21; alveolar length of upper molar series, 8.

Remarks.—In characters *pervagus* stands so nearly between *fulvus* and *aureus* as to suggest that it forms a connecting link between the two groups, but in a large number of specimens, collected since the species was described, the affinities are uniformly with *fulvus* instead of *aureus*. It is evidently a paler, more robust, Upper Sonoran valley form of *fulvus* inhabiting the upper Rio Grande and San Luis Valleys.

Specimens examined.—Total number, 50, as follows:

Colorado: Antonito, 8; Conejos River (6 miles west of Antonito), 2; Gardiner, 2; Salida, 9.

New Mexico: Abiquiu, 1; Arroyo Hondo, 4; Chama River Canyon (above Abiquiu), 1; Espanola, 8; Fort Burgwyn, 5; Questa, 4; Rinconada, 2; Santa Clara Canyon, 2; Santa Fe, 1;¹ Santa Fe (10 miles north), 1.

THOMOMYS FULVUS DESERTORUM MERRIAM.

DESERT POCKET GOPHER.

(Pl. VI, fig. 6.)

Thomomys desertorum Merriam, Proc. Biol. Soc. Washington, XIV, 114, July 19, 1901.

Type.—Collected at Mud Spring (10 miles southwest of Mineral Park, southern end of Detrital Valley), Arizona, at about 3,400 feet altitude in Lower Sonoran Zone, by Vernon Bailey, February 21, 1889. Type specimen in U. S. Nat. Mus., Merriam collection.

Distribution.—Detrital and Big Sandy Valleys, northwestern Arizona; east in the Grand Canyon to Prospect Valley (figs. 7 and 8).

Characters.—Size small, hind foot 26 mm.; color bright tawny; skull small, light, and smooth, with abruptly decurved incisors; sexes very similar; mammae in 4 pairs.

Color.—*Summer pelage:* Upperparts rich orange-tawny, or orange-cinnamon, lighter and brighter than in *fulvus*; ear patch, nose, and cheeks dusky; underparts creamy white to light cinnamon; feet and tail soiled whitish or buffy. *Winter pelage:* Duller and more yellowish; upperparts bright cinnamon; underparts whitish to buffy ochraceous.

Skull.—Small and light, smoothly rounded, not ridged or angular; bullæ small, but full and rounded, not flattened and angular as in *fulvus*, nor large and prominent, as in *aureus*; basioccipital, as in *fulvus*, wide with sharp keel. *Dentition:* Incisors bent downward at right angles to axis of skull.

Measurements.—Type (σ ad.): Total length, 200; tail vertebræ, 68; hind foot, 26. Average of 5 male topotypes: 195, 63, 26. Average of 4 female topotypes: 190, 60, 25.5 *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 22; mastoid breadth, 17.5; alveolar length of upper molar series, 6.5.

Remarks.—The color of this little gopher in summer pelage suggests relationship to *fulvus*, but its cranial characters are so strongly marked that it was originally described as a species. It may, however, probably be considered a depauperate Lower Sonoran desert

¹ In the mammal collection of the Academy of Natural Sciences of Philadelphia is a mounted skin without skull (No. 145) of a typical *Thomomys pervagus*. It is labeled "Columbia River," but the label has been copied from the catalogue where originally no locality was indicated, and the locality of the preceding specimen has been given to it. This is evidently the specimen referred to (Proc. Acad. Nat. Sci. Phila., VI, 1852, p. 53, Pl. LXIV) as *Geomys rufescens*, donated by Col. Geo. A. McCall. McCall's specimens apparently were not labeled, but this collection of 70 mammals and bird skins was said to be from California and Oregon. As *pervagus* is neither a California nor an Oregon form, the specimen in question probably came from Santa Fe, N. Mex., where McCall was previously stationed.

form of the *fulvus* group, with a range corresponding to that of the creosote bush in the Detrital and Big Sandy Valleys, and extending well up into the Grand Canyon.

Specimens examined.—Total number, 34, as follows:

Arizona: Big Sandy Creek (at 2,000 feet altitude), 7; Dolans Spring, 7;¹ Grand Canyon (at 4,500 feet in lower end of Prospect Valley on Hualpai Indian Reservation), 4; Little Meadows (in Sacramento Valley), 2; Mineral Park, 3;¹ Mud Spring, 8;¹ Willow Spring, 3.¹

THOMOMYS FULVUS INTERMEDIUS MEARN'S.

MOUNTAIN-TOP POCKET GOPHER.

(PL. VI, fig. 5.)

Thomomys fulvus intermedius Mearns, Proc. U. S. Nat. Mus., XIX, 1897, 719, July 30, 1897.

Type.—Collected on summit of Huachuca Mountains (9,000 feet altitude) southern Arizona, by F. X. Holzner, September 6, 1893. Type specimen in U. S. Nat. Mus.

Distribution.—Upper slopes of mountains in southeastern Arizona and extreme southwestern New Mexico (fig. 8).

Characters.—Smaller than *fulvus*, with conspicuous black back and bright brown sides; skull small and slender; ears and claws medium; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—Upperparts dark tawny shading into black along the back from nose to tail, in some specimens forming a broad and clear black band and in others indistinct and brownish black; underparts pale tawny; tail brown, with whitish tip; feet soiled whitish. May, August, and September specimens show practically the same coloration.

Skull.—Small and slender; zygomata very slender and strictly parallel; nasals narrow, deeply emarginate; bullæ small and flattened; basioccipital triangular; pterygoids thickened at base and with narrow fossa; interparietal small and generally triangular. *Dentition* light.

Measurements.—Type (♂ ad.): Total length, 200; tail vertebræ, 66; hind foot, 26. Adult male from Fort Huachuca: 200, 59, 27. Adult female from Fort Huachuca: 198, 62, 25. *Skull* (of type): Basal length, 34; nasals, 13; zygomatic breadth, 22; mastoid breadth, 18; interorbital breadth, 7; alveolar length of upper molar series, 6.5.

Remarks.—This small, black-backed form of the *fulvus* group has a wide and scattered range with considerable variation on the different mountains. On top of the Chiricahua Mountains it is a little larger than typical; on the crest of Animas Peak, a little smaller; on the

¹In Detrital Valley.

Santa Catalina Mountains, slightly larger and darker. Variation in size corresponds somewhat with the extent of high mountain areas which the animals inhabit, the smallest specimens being from the very restricted summit of the Animas Mountains. The difference between those from the tops of the Animas and the Huachuca Mountains is slight, however, compared with that between specimens of *intermedius* from the summit and *toltecus* from the base of either range.

Specimens examined.—Total number, 63, as follows:

Arizona: Chiricahua Mountains, 22; Fly Park (at 9,000 feet altitude), 1; Graham Mountains (8,500 to 9,200 feet), 8; head of Rucker Canyon, 2; Huachuca Mountains (up to 9,000 feet), 19; Mount Graham, 3; Santa Catalina Mountains (8,000 feet), 6.

New Mexico: Animas Mountains (7,000 feet), 2.

THOMOMYS FULVUS TEXENSIS BAILEY.

DAVIS MOUNTAIN POCKET GOPHER.

(Pl. IV, fig. 4.)

Thomomys fulvus texensis Bailey, Proc. Biol. Soc. Washington, XV, 119, 1902.

Type.—Collected on Davis Mountains, Texas (head of Limpia Creek, at 5,500 feet altitude, in edge of Transition Zone), by Vernon Bailey, January 7, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 7).

Characters.—Similar to *fulvus*, but smaller; hind foot 24–27 mm.; skull relatively narrower; color slightly lighter; mammæ in 4 pairs.

Color.—*Summer pelage:* Upperparts tawny-gray; underparts brighter clearer tawny; ear patch, nose, and cheeks blackish; feet and lips gray; lining of pouches white. *Winter pelage:* Slightly duller and darker than in summer.

Skull.—Light and slender, distinguished from that of *fulvus* by high narrow braincase, shallower lateral pits of palate, and shorter pterygoids.

Measurements.—Type (σ ad.): Total length, 204; tail vertebræ, 63; hind foot, 26. Average of 5 topotypes (σ ad.): 203, 65, 26.6. Average of 5 females: 187, 61, 25.8. *Skull* (of type): Basal length, 34.5; nasals, 13; zygomatic breadth, 22; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—This is evidently a small local race of *fulvus*, as shown by similarity of skull characters and also by color and general characters. It is evidently isolated in the Transition Zone area of the Davis Mountains, but not widely separated from more nearly typical *fulvus* of the Guadalupe Mountains.

Specimens examined.—Twenty, from type locality.

THOMOMYS FULVUS TOLTECUS ALLEN.

TOLTEC POCKET GOPHER.

(Pl. VI, fig. 3.)

Thomomys toltecus Allen, Bul. Am. Mus. Nat. Hist., V, 52, Apr. 28, 1893.

Type.—Collected at Colonia Juarez, Mexico (on the Casas Grandes River at about 4,500 feet altitude in northwestern Chihuahua), by F. Robinette,¹ 1890. Labeled "Juarez, N. Sonora." Type specimen in Am. Mus. Nat. Hist.

Distribution.—Lower Sonoran valleys and deserts of southeastern Arizona, southwestern New Mexico, and adjacent parts of Chihuahua and Sonora, south to Colonia Juarez, Chihuahua (fig. 7).

Characters.—Size about as in *fulvus* or slightly larger; colors paler and grayer; ears and claws medium; mammæ in 4 pairs.

Color.—*Summer pelage* (June specimens from Casas Grandes): Upperparts dull ochraceous-tawny; nose brownish; ear patch black; underparts lighter ochraceous-tawny; tail buffy gray; feet whitish. *Winter pelage*: Upperparts dark gray with a tawny suffusion over sides, and usually an indistinct dusky median line along back; nose and ear patch dusky; underparts light fawn or pinkish buff.

Skull.—Very like that of *fulvus* but more angular, less arched, with wider nasals, larger bullæ, and about the same dentition.

Measurements.—Adult male from Casas Grandes: Total length, 221; tail vertebrae, 72; hind foot, 31.5. Adult female from same locality: 205, 66, 29. *Skull* (of male): Basal length, 37; nasals, 13; zygomatic breadth, 25; mastoid breadth, 20.5; interorbital breadth, 7; alveolar length of upper molar series, 7.8. *Skull* (of type): 41, 14, 26, 21, 7, 8.

Remarks.—This is a light-colored valley form of the *fulvus* group occupying the upper edge of Lower Sonoran deserts of southern New Mexico and Arizona and northern Chihuahua. It is readily distinguishable from the smaller and grayer *lachugvilla* of the Rio Grande Valley, which occurs also at Casas Grandes and seems to be distinct. In Arizona it may grade into *cervinus* of the Gila Valley and in Sonora possibly into *sinaloæ*.

Specimens examined.—Total number, 175, as follows:

Arizona: Calabasas, 5; Chiricahua Mountains, 4; Dos Cabezas, 1; Fairbank, 24; Fort Bowie, 6; Fort Grant, 4; Fort Huachuca, 5; Fort Lowell, 12; Graham Mountains (Ash Creek, at 6,100 feet altitude), 3; Huachuca Mountains, 9; La Osa, 11; Mammoth, 1; Oracle, 2; Safford, 9; San Bernardino Ranch (Mexican boundary), 33; San Xavier, 1; Tucson, 2; Wilcox, 2.

Chihuahua: Casas Grandes, 2; Colonia Diaz, 3; Colonia Juarez, 6; Espia, 1.

New Mexico: Adobe Ranch (north base Animas Mountains), 1; Cuchillo, 1; Deming, 3; Garfield, 2; Hachita, 3; Lake Valley, 2; Las Palomas, 2; Mimbres River, 1; Monument No. 40, Mexican boundary, (upper corner, 100 miles west of El Paso), 3; Red Rock, 3.

Sonora: Santa Cruz River, 8.

¹The original label bears the name F. Robinette, but in the original description A. D. Meed was given as the collector.

THOMOMYS MEARNSI BAILEY.

MEARNS POCKET GOPHER.

(Pl. VI, fig. 4.)

Thomomys mearnsi Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected at Gray's Ranch in Animas Valley, southwest corner of New Mexico (about 20 miles north of the Mexican line), by E. A. Goldman, August 10, 1908. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 7).

Characters.—Slightly smaller than *fulvus*; less dusky in color; skull short and wide with very slender, projecting incisors; ears medium; mammae in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Summer pelage*: Upperparts dull cinnamon or light tawny, with blackish nose and ear patches; underparts pale cinnamon; tail buffy gray; feet whitish. *Winter pelage*: Evidently more grayish as indicated by some worn patches of old long fur.

Skull.—Short and wide, with arched zygomata, short braincase, short rostrum, and protruding upper incisors; bullæ very short and round; pterygoids V-shaped; nasals short and truncate or slightly emarginate; anterior base of zygoma convex against frontal and premaxillæ. *Dentition*: Incisors very slender, pale, and protruding far beyond nasals; distinctly grooved.

Measurements.—Type: Total length, 220; tail vertebrae, 67; hind foot, 31. Topotype (♀ ad.): 201, 65, 29. *Skull* (of type): Basal length, 37; nasals, 12.4; zygomatic breadth, 26; mastoid breadth, 21.5; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—This seems to be a local form in the bottom of the Animas Valley, somewhat resembling *nelsoni* but not of the *umbrinus* group. The four pairs of mammae place it in the *fulvus* group, but it seems to be distinct from the surrounding *toltecus*. Specimens were taken around the moist edges of a large marsh on the Gray Ranch and the moist, alkaline soil may be the environmental factor that has produced a local form in the midst of wide deserts. It is quite probable that the form occupies similar situations all along the Animas and San Simon Valleys.

Specimens examined.—Four, from type locality.

THOMOMYS BAILEYI MERRIAM.

SIERRA BLANCA POCKET GOPHER.

(Pl. VI, fig. 7.)

Thomomys baileyi Merriam, Proc. Biol. Soc. Washington, XIV, 109, July 19, 1901.

Type.—Collected at Sierra Blanca, El Paso County, Texas, by Vernon Bailey, December 28, 1889. The type and topotypes were caught all around the railway station where the Texas Pacific joins the Southern Pacific. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Sierra Blanca, western Texas, north to Tularosa, N. Mex. (fig. 7).

Characters.—Size medium, hind foot 29–32 mm.; color, dull ochraceous-tawny; skull short and wide with projecting incisors; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—*Fresh winter pelage:* Upperparts dull ochraceous-tawny or buffy fulvous, with dusky ear patch and nose; underparts pale salmon or creamy white; tail buffy to the tip; feet soiled whitish. *Summer pelage:* Not represented.

Skull.—Short and wide, with greatly protruding incisors; basioccipital wide between the narrow bullæ; premaxillæ extending but slightly back of nasals; interparietal quadrate; anterior base of zygoma convex; coronoid process of mandible curved, and post-coronoid notch widely circular.

Measurements.—Topotype (σ ad.): Total length, 215; tail vertebræ, 64; hind foot, 31. Average of five females: 212, 69, 29. *Skull* (of type): Basal length, 37; nasals, 17.7; zygomatic breadth, 26.5; mastoid breadth, 19; alveolar length of upper molar series, 7.5.

Remarks.—In wide skull and projecting incisors *baileyi* suggests the *umbrinus* group, but as no other detailed characters of the group appear the resemblance is evidently accidental. Nine specimens from Tularosa, N. Mex., average larger and darker colored than those of the type series, but show the prominent cranial characters. There is nothing to indicate that the species has a continuous range between these localities, but it is not improbable that it follows along the west base of the Sacramento Mountains in the Upper Sonoran or the upper edge of the Lower Sonoran Zone. The Tularosa specimens suggest a distant connection with the *fulvus* group.

Specimens examined.—Total number, 15, as follows:

New Mexico: Tularosa, 9.

Texas: Sierra Blanca, 6.

THOMOMYS LACHUGUILLA BAILEY.

LACHUGUILLA POCKET GOPHER.

(Pl. VI, fig. 8.)

Thomomys aureus lachuguilla Bailey, Proc. Biol. Soc. Washington, XV, 120, June 2, 1902.

Type.—Collected at El Paso, Texas (in a dry wash in the mountains a mile northeast of the town), by Vernon Bailey, September 24, 1901. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Arid Lower Sonoran mesas in extreme western Texas and southern New Mexico, south to Casas Grandes, Chihuahua (fig. 7).

Characters.—Size small, hind foot 27–29 mm.; color, dull ochraceous-tawny; skull narrow with abruptly decurved incisors; mammæ in 4 pairs, inguinal 2–2, pectoral 2–2.

Color.—Upperparts dull ochraceous-tawny or grayish buff; nose and ear patch dusky; underparts pale cinnamon to soiled whitish; feet whitish.

Skull.—Resembling that of *aureus* in general form, with full rounded bullæ, narrow basioccipital, and slightly arched palate, but differing in its smaller size, slenderer form, and less-ridged surface; interparietal normally quadrate; slender points of premaxillæ extending far back of truncate or slightly emarginate tip of nasals.

Measurements.—Type (σ ad.): Total length, 215; tail vertebrae, 65; hind foot, 29. Average of five topotypes (σ ad.): 202, 61, 27. Average of three females: 195, 62, 26. *Skull* (of type): Basal length, 35; nasals, 14; zygomatic breadth, 22; mastoid breadth, 19; alveolar length of upper molar series, 7.

Remarks.—This form needs no comparison with *baileyi* on the east or *perditus* on the south. It was originally, but probably erroneously, considered a small, dull-colored desert form of *aureus*. It occupies the arid Lower Sonoran mesas, but apparently does not occur in moist and fertile bottom lands as do the more robust *aureus* and *toltecus*. Specimens from Presidio County and the Great Bend region are not typical, but they vary so much with each locality that to avoid making more subspecies I have referred them to this, the nearest form. It seems probable that the great variation in the gophers of this region is due to the scarcity of individuals and the isolation of colonies.

Specimens examined.—Total number, 33, as follows:

Chihuahua: Casas Grandes, 2.

New Mexico: Organ, 2; Organ Mountains, 2.

Texas: Alpine, 1; Boquillas, 2; El Paso, 12; Franklin Mountain (10 miles north of El Paso, 4; and 15 miles north, 2), 6; Marathon (15 miles south), 1; Paisano, 1; Presidio County (35 miles south of Marfa), 4.

Thomomys umbrinus Group.

THOMOMYS UMBRINUS UMBRINUS (RICHARDSON).

SOUTHERN POCKET GOPHER.

(Pl. II, fig. 13; Pl. VI, fig. 13; text fig. 2.)

Geomys umbrinus Richardson, Fauna Boreali-Americana, I, 202, 1829.

Thomomys umbrinus Bailey, Proc. Biol. Soc. Washington, XIX, 3, Jan. 29, 1906.

Type.—In British Museum, said to have come from "Cadadaguiois, a town in southwestern Louisiana," but no such town has ever been located, except the Kadhoadacho Indian settlements on the Red River, in western Louisiana, where *Thomomys* does not occur. The type locality is now restricted to Boca del Monte, Vera Cruz. Type identified with specimens from Vera Cruz.¹

¹ Proc. Biol. Soc. Washington, XIX, 3, Jan. 29, 1906.

Distribution.—Known only from Boca del Monte and Xuchil, Vera Cruz (fig. 9).

Characters.—Size medium, hind foot 27–28 mm.; color dichromatic, dull umber, brown, or black; skull short and wide with emarginate anterior base of zygoma and strongly projecting incisors; groove on inner margin of incisors very obscure; ears small; claws very slender; mammæ in 3 pairs, inguinal 2–2, pectoral 1–1.

Color.—Upperparts in brown phase varying from dull burnt umber, or Prout's brown, to nearly black; underparts lightly washed with pale buff or whitish; chin, feet, and tip of tail white. In black phase, slaty black all over except white chin, feet, and tip of tail.

Skull.—Light and smooth, not ridged or angular, short and wide, with very short rostrum and greatly projecting incisors; anterior base of zygoma emarginate or concave in outline where it joins the frontal; lachrymal long and attached for all or most of its length to zygoma; premaxillæ widening posteriorly and terminating approximately even with nasals; palate flat, not arched between molar series; lateral pits deep; base of pterygoids constricted. *Dentition* light; incisors slender, projecting, pale or whitish, with indistinct or obsolete inner groove; anterior lower incisor with anterior enamel plate minute or often entirely wanting.

Measurements.—Average of 4 topotypes (♂ ad.): Total length, 193; tail vertebræ, 58; hind foot, 27.2. Average of 3 adult females: 195, 57, 27. *Skull* (♂ ad.):¹ Basal length, 33.7; nasals, 12.4; zygomatic breadth, 24; mastoid breadth, 17.6; alveolar length of upper molar series, 7.3.

Remarks.—It would be useless to list the various species of *Thomomys* to which authors have applied the name *umbrinus*. For over half a century the name was shifted about to one and another species, and proved a stumbling block to every naturalist working on the genus. Fortunately the type is still extant and has been identified with a sufficiently restricted species to give it a definite location. The species thus becomes the type of a well-defined group, including *umbrinus*, *orizabæ*, *peregrinus*, *nelsoni*, *sheldoni*, *goldmani*, *perditus*, and *atrovarius*.

Specimens examined.—Total number, 15, as follows:

Vera Cruz: Boca del Monte, 8; Xuchil, 7.

THOMOMYS UMBRINUS ORIZABÆ MERRIAM.

ORIZABA POCKET GOPHER.

(Pl. VI, fig. 15.)

Thomomys orizabæ Merriam, Proc. Biol. Soc. Washington, VIII, 145, Dec. 29, 1893.

Type.—Collected on Mount Orizaba (9,500 feet altitude), Puebla, Mexico, by E. W. Nelson and E. A. Goldman, April 25, 1903. Type specimen in U. S. Nat. Mus., Biological Survey collection.

¹No. 66091, U. S. Nat. Mus., from Boca del Monte, Vera Cruz.

Distribution.—Known only from type locality (fig. 9).

Characters.—Considerably larger than *umbrinus* or *peregrinus*; hind foot 27–31 mm.; skull heavier; colors dichromatic, usually black, rarely bright umber; ears small; claws slender; mammæ in 3 pairs.

Color.—In 14 of 16 topotypes: Glossy iridescent black all over except white on tip of tail, toes, and usually chin and inside of pockets. Two topotypes in brown phase: Upperparts bright burnt umber in the adult, darker in the immature specimen; underparts washed with paler shade of the same or ochraceous-buff; tip of tail, toes, and inside of pockets white.

Skull.—Relatively more elongated, angular, and ridged than in *umbrinus* or *peregrinus*; base of zygoma deeply concave, or emarginate; lachrymal long and borne mainly on zygoma; premaxillæ widening posteriorly and terminating approximately even with nasals; palate flat between molars, but with deep lateral pits and constricted base of pterygoids. *Dentition* heavy; incisors less projecting than in *peregrinus*, and plain orange, rarely with white tips; anterior enamel plate of front lower incisor small.

Measurements.—Average of 4 topotypes (σ ad.): Total length, 219; tail vertebræ, 69; hind foot, 29.3. Average of 5 females: 132, 66, 29. *Skull* (of type, ♀ ad.): Basal length, 35; nasals, 13; zygomatic breadth, 25; mastoid breadth, 19; alveolar length of upper molar series, 7.7. One topotype (σ ad.):¹ 38.5, 14, 25, 19.5, 8.

Specimens examined.—Sixteen, from type locality.

THOMOMYS UMBRINUS PEREGRINUS MERRIAM.

MEXICAN POCKET GOPHER.

(Pl. VI, fig. 14.)

Thomomys peregrinus Merriam, Proc. Biol. Soc. Washington, VIII, 146, Dec. 29, 1893.

Type.—Collected at Salazar, Federal District of Mexico, Mexico, at 10,300 feet altitude, by E. W. Nelson and E. A. Goldman, October 24, 1892. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Mountain slopes in the Federal District of Mexico, east to San Martin, Puebla, and north to El Chico, Hidalgo (fig. 9).

Characters.—Size medium, slightly larger than *umbrinus*; hind foot 27–29 mm.; color dark rich umber; skull with projecting incisors and concave base of zygoma; mammæ in 3 pairs.

Color.—Upperparts dark rich burnt umber, becoming blackish along the back in many specimens; underparts washed with ochraceous-buff; feet, tip of tail, and sometimes chin, whitish. A fully melanistic specimen from Santa Rosa, Guanajuato, suggests partial dichromatism.

¹No. 53611, U. S. Nat. Mus.

Skull.—Less markedly short and wide than in *umbrinus* and with slightly less projecting incisors; base of zygoma slightly concave; palate flat between molar series, and unique in having shallow lateral pits and wide base of pterygoids. *Dentition* light; incisors bright orange with white tips; anterior enamel plate on front lower incisors small but distinct and constant.

Measurements.—Average of 3 topotypes (σ ad.): Total length, 208; tail vertebræ, 61; hind foot, 28. Average of 5 females: 189, 59, 27.3. *Skull* (of type, ♀ ad.): Basal length, 34; nasals, 12; zygomatic breadth, 23; mastoid breadth, 18; alveolar length of upper molar series, 7. *Skull* of topotype (σ ad.):¹ 34, 12.3, 24, 19, 7.

Specimens examined.—Total number, 43, as follows:

Hidalgo: El Chico (Sierra de Pachuca), 3; Real del Monte, 3; Tulancingo, 1.

Mexico: Popocatepetl, 1; Salazar, 17; Toluca Valley, 1; Volcan Toluca (north slope), 15.

Puebla: San Martin, 2.

THOMOMYS NELSONI MERRIAM.

NELSON POCKET GOPHER.

(Pl. VI, fig. 11.)

Thomomys nelsoni Merriam, Proc. Biol. Soc. Washington, XIV, 109, July 19, 1901.

Type.—Collected at Parral, Chihuahua, Mexico, at 6,000 feet altitude, by E. W. Nelson and E. A. Goldman, September 18, 1898. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Central Chihuahua, from Gallego south to Parral (fig. 9).

Characters.—Size small, hind foot 28 mm.; color bright tawny; skull short and wide, with projecting incisors.

Color.—*Winter pelage*: Upperparts light russet or bright tawny, darker along back and on face; nose and ear patch blackish; ankle and base of tail brownish, lower part of feet and terminal part of tail white; belly pale tawny. *Summer pelage*: A shade brighter above and below.

Skull.—Short and wide with abruptly spreading zygomata and strongly projecting, lightly grooved, white-tipped incisors; nasals narrow, cuneate, slightly notched, and terminating a little short of the wide posterior tips of premaxillæ; basioccipital wide and flat; frontals wide, crowding slightly into base of zygomata; lachrymal mainly adnate to zygoma.

Measurements.—Type (σ ad.):² Total length, 196; tail vertebræ, 60; hind foot, 28. Topotype (σ ad.): 207, 59, 28.5. *Skull* (of type): Basal length, 37; nasals, 13; zygomatic breadth, 24; mastoid breadth,

¹No. 50122, U. S. Nat. Mus.

²The type of *nelsoni* was marked "♀" on the original label and referred to in original description as female. It is, however, a fine old male with prominent sex marks showing in the skin and with the skull characters of the male.

21; alveolar length of upper molar series, 7. Skull of male topotype: 34, 12, 24, 19.5, 7.

Remarks.—The short, wide skull, projecting incisors, and white slippers and tip of tail reveal relationship with the *umbrinus* group, although in the specimens collected there are no females to show the arrangement of mammae. However, *nelsoni* is evidently a northern form of the group.

Specimens examined.—Total number, 3, as follows:

Chihuahua: Gallego, 1; Parral, 2.

THOMOMYS SHELDONI.¹ SP. NOV.

SHELDON POCKET GOPHER.

(Pl. VI, fig. 12.)

Type from Santa Teresa (6,800 feet altitude), Tepic, Mexico. Adult ♂, No. 90819, U. S. Nat. Mus., Biological Survey collection. Collected August 10, 1897, by E. W. Nelson and E. A. Goldman; collectors' number, 11443.

Distribution.—Transition Zone on the Sierra Madre, Mexico, from northern Chihuahua south to Guanajuato (fig. 9).

Characters.—In size slightly larger than *umbrinus* or *peregrinus*, and more brightly colored than either; ears small; claws slender; skull relatively long, with long nasals and not very protruding incisors; mammae in 3 pairs.

Color.—*Summer pelage:* Upperparts light umber, or russet-brown, darker along median line of back, on nose, and about ears; underparts lighter, more tawny; lower half of feet and tip of tail usually white; rarely any white on chin or throat in typical series; white lining of cheek pouches scarcely showing. *Young* duller and darker.

Skull.—Relatively longer than in other members of the group, with longer, narrower nasals and slender rostrum; interorbital region wide and flat; interparietal triangular; nasals slightly emarginate, usually falling short of posterior tips of premaxillæ; anterior base of zygoma nearly straight, in some slightly concave and in others slightly convex; lachrymal adnate to zygoma for over half its length. *Dentition:* Incisors moderately projecting, dark orange, with small but distinct grooves along inner margins.

Measurements.—Type (♂ ad.): Total length, 210; tail vertebrae, 64; hind foot, 29. Average of 4 topotypes (♂ ad.): 200, 62, 28.8. Average of 4 adult females: 191, 61, 28.5. *Skull* (of type): Basal length, 37; nasals, 14.5; zygomatic breadth, 25; mastoid breadth, 19; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—This is a northern form of the *umbrinus* group, occupying the Transition Zone of the main Sierra Madre of Mexico, and

¹Named for Charles Sheldon in recognition of his interest in mammals, large and small, and his many contributions of specimens and of notes on their habits.

probably separated by lower country from the range of *peregrinus*, its nearest relative. There is considerable variation in its extension northward to northern Chihuahua but no indication of its intergradation with *intermedius*, which is very similar in general appearance but which with its 4 pairs of mammæ and narrow, slender skull, belongs to the *fulvus* group.

Specimens examined.—Total number, 117, as follows:

Chihuahua: Chuichupa, 1; Colonia Garcia (6,400 feet altitude), 13; near Guadalupe y Calvo (at 7,000 feet), 6; Pacheco, 11; Sierra Madre (65 miles east of Batopilas at 7,000 feet), 5.

Durango: Chacala (3,000 feet), 1, immature; Coyotes, 3; El Salto (8,400 feet), 10; La Boca, 1; Rio Sestin, 1.

Guanajuato: Santa Rosa (8,500 feet), 9.

San Luis Potosi: La Tinaja (6,000 feet), 8; San Luis Potosi, 1.

Sinaloa: Sierra de Choix (50 miles northeast of Choix at 5,000 feet), 3.

Sonora: Alamos (1,200 feet), 5.

Tepic: Santa Teresa (6,800 feet), 10.

Zacatecas: Berriozabal (6,600 feet), 10; Plateado, 4; Sierra Madre (8,500 feet), 5; Valparaiso Mountains (8,700 feet), 10.

THOMOMYS GOLDMANI MERRIAM.

GOLDMAN POCKET GOPHER.

(PL. VI, fig. 10.)

Thomomys goldmani Merriam, Proc. Biol. Soc. Washington, XIV, 108, July 19, 1901.

Type.—Collected at Mapimi, Durango, Mexico, by E. A. Goldman, December 15, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Eastern Durango, from Mapimi south to Durango City (fig. 9).

Characters.—Size small, hind foot 27–30 mm.; color bright tawny above, white below; ears minute; skull short and wide, with projecting incisors; mammæ in 3 pairs, inguinal 2–2, pectoral 1–1.

Color.—Upperparts bright tawny, darkening on head and becoming dusky around nose and ears; underparts, tip of tail, and lower part of feet, white.

Skull.—Short and wide with very short nasals and projecting incisors; zygomatic arches slender, nearly parallel, abruptly constricted at posterior base; basioccipital wide and flat; nasals nearly truncate, falling slightly short of posterior tips of premaxillæ; frontals wide, pushing slightly into base of zygomata; lachrymal lying mainly against base of zygoma, as in *umbrinus*.

Measurements.—Type (♂ ad.): Total length, 208; tail vertebræ, 68; hind foot, 30. Female topotype: 190, 60, 27. *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 22; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—The specimens from Mapimi exhibit the extreme differentiation of the form. Those from Durango are darker, more nearly

like *peregrinus*, through which *goldmani* evidently connects with the *umbrinus* group.

Specimens examined.—Total number, 9, as follows:

Durango: Durango, 6; Mapimi, 2; San Gabriel, 1.

THOMOMYS PERDITUS MERRIAM.

LITTLE GRAY POCKET GOPHER.

(Pl. VI, fig. 9.)

Thomomys perditus Merriam, Proc. Biol. Soc. Washington, XIV, 108, July 19, 1901.

Type.—Collected at Lampazos, Nuevo Leon, Mexico, by Clark P. Streater, January 22, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Eastern Coahuila and western Nuevo Leon, north to Rock Springs and Castle Mountains, western Texas (fig. 9).

Characters.—Size small, hind foot 25 mm.; color buffy gray or pale tawny; skull short and narrow, with slightly projecting incisors; mammæ in 3 pairs, inguinal 2-2, pectoral 1-1.

Color.—Upperparts dark buffy gray or pale dull tawny, darkest along back; sides brighter; belly and feet pale buffy or creamy white; ear patch, nose, and lips dusky; inside of pouches white.

Skull.—Short, with smooth, rounded braincase and rectangular zygomatic arches; incisors projecting slightly beyond nasals; nasals sharply notched posteriorly and terminating on a plane with short premaxillæ; interparietal normally quadrate, wider than long; anterior base of zygoma strongly convex in outline, unlike most species of the *umbrinus* group.

Measurements.—Type (σ ad.): Total length, 195; tail vertebrae, 59; hind foot, 26.5. Average of 2 topotypes (σ ad.): 192, 58, 26.8. Average of 2 females: 180, 54, 24.5. *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 21; mastoid breadth, 18; alveolar length of upper molar series, 7.

Remarks.—The relationships of this species, as exhibited by the cranial characters, seem not to be very close with any of the surrounding forms, but the number and arrangement of mammæ place it in the *umbrinus* group.

Specimens examined.—Total number, 24, as follows:

Coahuila: Carneros, 5; Jaral, 1; Sierra Encarnacion, 1; Sierra Guadalupe, 4.

Nuevo Leon: Lampazos, 5; Villadama, 2.

Texas: Castle Mountains, 1; Comstock, 2; Devils River, 1; Rock Springs (35 miles east), 1; Samuels, 1.

THOMOMYS ATROVARIUS ALLEN.

BLACK-AND-BROWN POCKET GOPHER.

(Pl. VI, fig. 16.)

Thomomys atrovarius Allen, Bul. Am. Mus. Nat. Hist., X, 148, 1898.

Type.—Collected at Tatemales (near Rosario), Sinaloa, Mexico, by P. O. Simons, May 15, 1897. Type specimen in the British Museum.

Distribution.—Coastal Plain of southern Sinaloa and Tepic, from Mazatlan south to Colomo (fig. 9).

Characters.—Size medium, hind foot 30 mm.; pelage thin and harsh; color dark brown or blackish; skull short and wide, with projecting incisors; ears small; claws slender; mammæ in 3 pairs.

Color.—Dark umber, brown, or brownish black; underparts brownish or plumbeous; ears, feet, and tail nearly naked, but lower part of feet and tip of tail usually white when there is hair enough to show color.

Skull.—Slightly heavier and longer than in *umbrinus*, but of the same general characters, with short nasals and less-projecting incisors; base of zygoma slightly indented and the greater part of lachrymal adnate to it; posterior tips of premaxillæ narrowed and extending slightly back of truncate tip of nasals; pterygoids wide apart. *Dentition* slightly heavier than in *umbrinus*; incisors dark orange and very lightly grooved.

Measurements.—Average of 3 females from Rosario: Total length, 196; tail vertebræ, 68; hind foot, 29. Adult male from Mazatlan: 208, 66, 31. *Skull* (of adult male from Mazatlan): Basal length, 36; nasals, 13; zygomatic breadth, 25; mastoid breadth, 20; alveolar length of upper molar series, 8.

Remarks.—*Thomomys atrovarius* is a well-marked, thin-haired, nearly concolor, tropical species in which the skull characters show close affinities with the *umbrinus* group.

Specimens examined.—Total number, 14, as follows:

Sinaloa: Mazatlan, 2; Plomosas, 2; Rosario, 5; Tatemales, 1.

Tepic: Colomo, 1; Navarete, 2; Pedro Pablo, 1.

Thomomys talpoides Group.

THOMOMYS TALPOIDES TALPOIDES (RICHARDSON).

SASKATCHEWAN POCKET GOPHER.

Cricetus talpoides Richardson, Zool. Journ., III, 518, 1828.

Geomys talpoides Richardson, Fauna Boreali-Americana, 204, 1829.

S[accophorus] talpoides Fischer, Synopsis Mammalium, 588 ("388"), 1830. Taken from Richardson.

Geomys borealis Richardson,¹ Sixth Ann. Rept. Brit. Assn. for 1836, V, 150, 156, 1837. Renaming of *talpoides*.

¹ *Geomys borealis* of Richardson has been generally considered a nomen nudum and the name dated from Bachman, two years later, based on a different species. Richardson first used the name (loc. cit., 150) as "*Geomys borealis*, Rich. nov. sp." On page 156 he states that "*Geomys borealis* inhabits the Plains of the Saskatchewan," and on page 157 he gives good descriptive characters in comparison with several other species. He says "*borealis* and *talpoides* have a very fine groove close to the inner margin of each upper incisor," but evidently failed to detect the much finer grooves on the incisors of *bulbivorus* and *umbrinus* with which he was making the comparison. As Dr. Allen has pointed out (Bul. Am. Mus. Nat. Hist., V, 61, 1893) Richardson was evidently renaming his *talpoides*, of which he here (p. 156) very strangely changes the habitat to Florida. It therefore seems necessary to consider *borealis* a synonym of *talpoides*. Bachman's *borealis* (1839), of which the type is extant and perfectly identifiable, is the same as *clusius* of Coues (1875).

Since writing the foregoing I have received a letter (Mar. 15, 1915) from Mr. Oldfield Thomas, of the British Museum, expressing his opinion that *borealis* of Richardson is not a nomen nudum.

Ascomys borealis Wagner, Suppl. Schreber Säug., III, 391, 1843. Taken from Richardson.

Geomys unisulcatus Gray, List Mamm. Brit. Mus., 149, 1843. Nomen nudum.

Saccophorus borealis Gray, List Mamm. Brit. Mus., 149, 1843. From Richardson.

Ascomys talpoides Wagner, Suppl. Schreber Säug., III, 390, 1843. From Richardson.

Ascomys borealis Wagner, Suppl. Schreber Säug., III, 391, 1843. From Richardson.

Pseudostoma talpoides Audubon & Bachman, Quad. N. Am., III, 43-45, 1854; described and figured from type specimen in collection Zool. Soc., London.

Geomys (Thomomys) talpoides Giebel, Säug., 530, 1855. Compiled from Richardson.

Thomomys talpoides Baird, Mamm. N. Am., 403, 1857.

Type.¹—Type locality fixed at near Fort Carlton (Carlton House) on the Saskatchewan River, Saskatchewan. Type specimen in British Museum, a stuffed skin and anterior part of skull, which was removed from the skin in 1893.

Distribution.—Plains of Saskatchewan and Alberta; south in Montana to Great Falls and the Big Snowy Mountains (fig. 10).

Characters.—Size medium, between that of *rufescens* and *clusius*; ears prominent and pointed; claws slender; color dull and dark gray; skull not heavily ridged and with slight temporal ridges often converging anteriorly or in the middle; nasals emarginate posteriorly; rostrum slender; mammæ normally in 6 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2.

Color.—*Summer pelage*: Upperparts dull grayish brown with plumbeous nose and blackish ear patch; underparts buffy or soiled whitish gray; chin, and often throat and breast, pure white; feet whitish; tail white tipped or sometimes all white. *Winter pelage*: Upperparts dull dark gray, with little brownish; ear patch black; underparts washed with whitish.

Skull.—Rather short and wide, with anteriorly converging temporal ridges in all but very old individuals; nasals emarginate at posterior tips or rarely truncate; interparietal triangular; audital bullæ full and wide but low, with anterior arm of basioccipital narrow between them. *Dentition* noticeably lighter than in *rufescens*; upper incisors abruptly decurved and distinctly grooved.

Measurements.—Largest male from Borden, Saskatchewan: Total length, 214; tail vertebrae, 60; hind foot, 28. Largest female from same place: 210, 60, 29. Skull (σ ad. from Borden, Saskatchewan): Basal length, 34.5; nasals, 14; zygomatic breadth, 23; mastoid breadth, 19; interorbital breadth, 6; alveolar length of upper molar series, 7.

¹ The type of *talpoides*, a stuffed skin with part of skull, was procured from Mr. Leadbeater, a London dealer, and was recorded from "Hudson Bay." This evidently meant the country of the Hudson's Bay Co., or western Canada. There are no gophers known nearer the shores of Hudson Bay than on the Saskatchewan, where, as Dr. Allen has pointed out, Richardson refers to them in his original description. Carlton House or Fort Carlton, where Richardson remained for some time, and apparently the highest point he reached on the Saskatchewan River, is near the easternmost point at which these gophers are known to occur along the river. As other species are found farther west on the Saskatchewan, it is necessary to restrict the type locality of *talpoides* still further to the vicinity of Carlton House.

Remarks.—The name *talpoides* has long been applied to the gophers of North Dakota and Manitoba on the supposition that they were the same as those from the Saskatchewan. A series of specimens recently collected at Borden, Saskatchewan, the lowest point at which they could be found along the North Saskatchewan River, and only about 40 miles above the site of old Fort Carlton, prove to be separable from the Dakota animal, which therefore takes the name *rufescens*. The fact that Richardson did not get specimens or even see the gopher which he described is probably due to their absence from the immediate vicinity of Fort Carlton where he records them in an indefinite way. He may have seen their molelike mounds on a short trip up the river or may only have heard of them from trappers and other explorers in that region, possibly from Drummond or Douglas. It, therefore, seems safe to assume that specimens from Borden are typical of *talpoides* of Richardson.

Loring reports gopher hills 20 miles, and Preble 40 miles, north of Edmonton.

Specimens examined.—Total number, 98, as follows:

Alberta: Blindman River, 4; Buffalo Lake, 2; Calgary, 2; Didsbury, 2; Edmonton, 22; Irwin Lake, 1; Red Deer, 23; St. Albert, 2; Waghorn, 1.

Montana: Bearpaw Mountains, 1; Big Snowy Mountains, 2; Blackfoot, 12; Highwood, 3; Zortman, 1.

Saskatchewan: Borden, 16; Indian Head, 4.

THOMOMYS TALPOIDES RUFESCENS WIED.

PRAIRIE POCKET GOPHER; DAKOTA POCKET GOPHER.

(Pl. I; Pl. II, fig. 5; Pl. VII, fig. 1; text figs. 2, 3).

Thomomys rufescens Wied, Nova. Acta. Phys. Med. Acad. Cæs. Leop.-Carol, XIX, pt. 1, 378, 1839.

Type.—Collected at "The Minnetaree Village," now Old Fort Clark, Oliver County, North Dakota (about 6 miles south of Stanton), on the west side of the Missouri River, by Maximilian, Prince of Wiedin. 1833. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Greater part of North Dakota, eastern South Dakota, and southwestern Manitoba (fig. 10).

Characters.—Size large; feet large and claws stout; ears prominent and pointed, not a mere thickened rim as in some western species; color dull and dark gray; skull heavy, with parallel temporal ridges and wide basioccipital; rostrum slender; incisors abruptly decurved, distinctly grooved; mammæ in 6 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2.

Color.—*Thin summer pelage* (July and August): Upperparts dull brownish gray; ear and surrounding fur black; underparts buffy gray with more or less pure white on chin, throat, and breast; feet whitish; tail whitish or gray at base. *Early winter pelage* (October): Dark buffy gray above, almost as dark as in summer. *Full winter pelage*

(November to May): Bright buffy gray above, fading to paler buffy in spring. *Young*: Upperparts duller, more plumbeous, fading to buffy when half grown, changing to dark fall pelage in October. [See section on molt (p. 18); also five molts shown on one animal in fig. 3, No. 1.]

Skull.—Long and straight, with shallow rostrum and strongly developed and approximately parallel temporal ridges; nasals long and truncate or rounded at posterior tip; bullæ long and rather narrow (becoming very narrow in specimens from the eastern part of the range), basioccipital with wide, heavy shaft between bullæ; auditory meatus slender. *Dentition*: Molars heavy; incisors decurved at right angle to axis of skull.

Measurements.—Adult male from near Fort Clark, N. Dak.: Total length, 240; tail vertebræ, 70; hind foot, 31. Adult female from same locality: 230, 70, 31. *Skull* (of adult male from near Fort Clark): Basal length, 40; nasals, 15.5; zygomatic breadth, 25; mastoid breadth, 22; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—There is now ample material from the type locality and its general region to show the characters of *rufescens*, which proves to be the large, dark-colored gopher occupying the greater part of North Dakota, eastern South Dakota, and southwestern Manitoba. Specimens from the type region in early winter fur (November or December) are still needed to complete our knowledge of seasonal variation in pelage, but this pelage will probably be found to agree, as do most other characters, with specimens from the eastern part of the State.

The type, a mounted specimen with skull inside, much faded but otherwise in good condition, is in the American Museum of Natural History. It has been removed from the base, and the old label, once tacked on the base, is now attached to the foot. It bears the legend "*Thomomys rufescens* Wied. Machtohpka indigen" and also "Mas Missouri," not very legible. It hardly seemed necessary to remove the skull from so old and fragile a specimen, as there are good topotypes, and the general size and large claws are good characters. The hind foot measures 30 mm., dry. It is marked "♂" on the museum label, which also is attached to the foot.

Specimens examined.—Total number, 159, as follows:

Manitoba: Aweme, 4; Carberry, 11; Selkirk Settlement, 1.

North Dakota: Bismarck, 4; Bottineau, 1; Braddock, 1; Cannonball River, 6; Devils Lake, 1; Dickinson, 2; Fish Lake (in Turtle Mountains), 8; Fort Clark, 5; Fort Rice, 1; Glen Ullin, 1; Grafton, 3; Hensler, 6; Jamestown, 6; Larimore, 7; Mandan, 10; Minnewauken, 3; Minot, 1; Oakdale, 8; Pembina, 25; Portland, 1; Sherbrooke, 6; Souris River, 2; Steel 1; Streeter, 2; Stump Lake, 1; Valley City, 9; Wade, 2; Walhalla, 2; Washburn, 3.

South Dakota: Aberdeen, 2; Armour, 3; Fort Randall, 2; Fort Sisseton, 3; Highmore, 1; Pierre, 3; White Lake, 1.

THOMOMYS TALPOIDES CLUSIUS COUES.

COUES POCKET GOPHER.

(Pl. II, fig. 6; Pl. VII, fig. 5; text fig. 3.)

Geomys borealis Bachman,¹ Journ. Acad. Nat. Sci. Phila. VIII, pt. 1, 103, 1839.

Type locality said to be the "Columbia River," probably in Colorado near the southeast corner of Wyoming. (Not of Richardson.)

Pseudostoma borealis Audubon & Bachman, Quad. N. Am., III, 198, pl. 142, 1853. (Not *Geomys borealis* of Richardson.)

Thomomys clusius Coues, Proc. Acad. Nat. Sci. Philadelphia, 1875, 138, June 15, 1875.

Type.—Collected at Bridgers Pass, Carbon County, Wyoming, (18 miles southwest of Rawlins), by Dr. W. A. Hammond, July 28, 1857. Type specimen in U. S. Nat. Mus.

Distribution.—Central and southeastern Wyoming (north to Parkman, Sheridan County), and eastern Colorado south to Colorado Springs (fig. 10).

Characters.—Considerably smaller than *talpoides*, with slenderer claws; color slightly more rufescent; skull with the same shallow rostrum, but differing in having smaller size, large rounded bullæ, and lighter dentition; mammæ in 6 or 7 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2, or sometimes 3-3; embryos 5 to 7.

Color.—*Summer pelage*: Upperparts light buffy- or hazel-gray, brightest on crown, paler along sides; cheeks clear gray; ear patch blackish; underparts whitish or buffy; chin sometimes white; feet and tip of tail whitish. *Autumn pelage* (September): Upperparts duller and darker; crown and back dull hazel darkened with black-tipped hairs that apparently fade or wear off and leave a grayish or buffy brown in winter; black ear patch conspicuous. *Young* paler, more buffy gray.

Skull.—Light and slender, not angular or heavily ridged; temporal ridges parallel in fully adult specimens; audital bullæ much larger

¹ Bachman's description of *Geomys borealis*, which he credits to Richardson, was based mainly on a specimen collected by Townsend, of which he says, "Mr. Townsend's specimens were procured on the Columbia River." The very full description of *borealis*, including measurements, agrees perfectly with one (No. 146) of the three specimens brought back by Townsend and now before me through the kindness of Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia. I have had the skulls removed from these three mounted specimens, and for the first time it is possible to identify them. The old labels which were formerly tacked on the stands are now attached to these specimens, and Dr. Stone thinks they are in the handwriting of Le Conte, who published on them in 1852, 18 years after they were collected. (Le Conte also described a *Geomys bursarius* as *Geomys oregonensis* from a specimen labeled "Columbia River, J. K. Townsend.") It is probable that the specimens came into the collection without labels, and were supposed to have come from the Columbia River, but none of the three of *Thomomys* were collected anywhere near the Columbia. No. 147 is Bachman's type of *townsendi* and No. 144 is an adult specimen of *pygmaeus* which Bachman considered a young of *borealis*. Bachman's type of *borealis* proves to be identical with *clusius* of Coues. Townsend in his Narrative (p. 59) mentions a pocket gopher which he picked up near Scott's Bluff, Nebr., at a point near the southeastern corner of what is now Wyoming. As this specimen was preserved and is the only specimen mentioned in the narrative, it may well be the type of Bachman's *borealis*. As Richardson two years earlier applied the name *borealis* to another species (*talpoides*), Bachman's name has no standing in this connection. The fact that Richardson had identified this specimen as his *borealis*, and on it had drawn up a full description which was used by Bachman, does not make available the name which was already a synonym of *talpoides*.

and more rounded than in *talpoides*; anterior arm of basioccipital very narrow; nasals slenderer, especially at posterior tips, which are variously rounded, truncate, or slightly emarginate in the topotype series; interparietal small and triangular. *Dentition* conspicuously lighter than in *talpoides*.

Measurements.—Topotype (σ ad.): Total length, 205; tail vertebrae, 66; hind foot, 28.5. Average of 7 female topotypes: 204, 60, 27. *Skull* (topotype, σ ad.):¹ Basal length, 33.4; nasals, 13; zygomatic breadth, 22; mastoid breadth, 19.5; interorbital breadth, 11.5; alveolar length of upper molar series, 7.

Remarks.—In general appearance *clusius* is nearer *talpoides* than is the larger and paler *bullatus*, which separates their ranges and evidently grades into one on the north and the other on the south. It is not improbable, however, that *clusius* and *talpoides* meet in a narrow Transition Zone strip along the eastern base of the Rocky Mountains above the Upper Sonoran limits of *bullatus*. At the type locality and over most of its range *clusius* is found in Transition Zone sage-brush country.

Specimens examined.—Total number, 106, as follows:

Colorado: Avalo, 5; Boulder, 1; Canadian Creek (North Park), 6; Colorado Springs, 7; Estes Park, 1; Flagler, 7; Gold Hill, 1; Limon, 1; Pawnee Buttes, 1; Siebert (8 miles south), 1.

Wyoming: Bear Creek (3 miles southwest of Laramie Peak, at 7,500 feet altitude), 1; Beaver, 1; Bridgers Pass, 14; Casper (40 miles southwest), 4; Cheyenne, 7; Dayton, 1; Douglas, 2; Ferris Mountains (7,800 to 9,400 feet), 4; Fetterman, 1; Fort Russell, 1; Fort Steele, 3; Green Mountains (8,000 feet), 2; Islay, 2; Laramie Mountains (east of Laramie, at 8,500 and 9,000 feet), 3; Little Bear Creek (20 miles southeast of Chugwater), 1; Miners Delight, 1; Myersville, 2; Myersville (22 miles southeast), 1; Pass (now Parkman), 2; Pine Bluffs, 2; Rattlesnake Mountains (north base), 3; Rawhide Butte (5,400 feet), 1; Red Bank, 1; Rock Creek, 1; Sherman, 2; Shirley Mountains (7,600 to 8,800 feet), 4; Springhill (12 miles north of Laramie Peak), 2; Sun, 3; Wheatland (15 miles southwest, at 5,200 feet), 1; Woods, 2.

THOMOMYS TALPOIDES BULLATUS BAILEY.

SAGE POCKET GOPHER.

(Pl. VII, fig. 2.)

Thomomys talpoides bullatus Bailey, Proc. Biol. Soc. Washington, XXVII, 115, July 10, 1914.

Type.—Collected at Powderville, Custer County, Montana, by Dr. A. K. Fisher, July 21, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Plains of eastern Montana, northeastern Wyoming, and western South Dakota; north to Medicine Hat, Alberta (fig. 10).

Characters.—Size of *talpoides*, but with larger audital bullae, lighter dentition, and brighter colors; mammae usually in 6 pairs; young, 5 to 7.

Color.—*Summer pelage*: Practically the same as in *clusius*, with less gray on cheeks; upperparts light buffy- or hazel-gray, brightest on crown; ear patch blackish; underparts buffy, sometimes with white on chin; feet and tail whitish. *Winter pelage* (November specimen, from Fort Custer): Upperparts much paler, light buffy gray; underparts creamy white.

Skull.—Size and general form nearly as in *talpoides*, but less ridged and with smaller molars, much larger and more rounded bullæ, and narrower anterior shaft of basioccipital.

Measurements.—Type (σ ad.): Total length, 238; tail vertebræ, 72; hind foot, 30. Male topotype: 242, 76, 30; female topotype: 225, 78, 29. *Skull* (of type): Basal length, 37.6; nasals, 15.5; zygomatic breadth, 24; mastoid breadth, 20.3; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is a pale Upper Sonoran form, not entirely intermediate between *talpoides* and *clusius*, both of which are Transition Zone forms (one of the humid grass-prairies, the other of arid sagebrush). To some extent *bullatus* combines the characters of both, but is not quite intermediate and has a well-defined range. The beautiful series of specimens from Medicine Hat, Alberta, mainly immature females, are in the light gray, early winter coat. They are provisionally placed with this form until better characters can be observed from skulls of adult males and from summer skins.

Specimens examined.—Total number, 82, as follows:

Alberta: Medicine Hat, 10 (not typical).

Montana: Alzada, 1; Cedar Creek (15 miles north of Terry), 3; Darnalls (on south bank Missouri River south of Glasgow), 1; Fort Assiniboine, 4; Fort Custer, 6; Fort Thorne, 1; Johnson Lake, 2; Piney Buttes, 2; Powderville, 4; Red Lodge, 1; Terry, 1.

North Dakota: Buford, 4; Yellowstone River (mouth), 1.

South Dakota: Buffalo Gap, 3; Corral Draw (Pine Ridge Indian Reservation), 4; Crow Buttes (Harding County), 1; Elk Mountain, 10; Fort Meade, 1; Rapid City, 2; Smithville, 2.

Wyoming: Clearmont, 1; Devils Tower, 1; Ishawooa Creek, 4; Moorcroft, 3; Newcastle, 5; Powder River crossing, 2; Sage Creek (west of Fort Washakie), 1; Wind River (north of Washakie), 1.

THOMOMYS TALPOIDES NEBULOSUS BAILEY.

BLACK HILLS POCKET GOPHER.

(Pl. VII, fig. 3.)

Thomomys talpoides nebulosus Bailey, Proc. Biol. Soc. Washington, XXVII, 116, July 10, 1914.

Type.—Collected in Sand Creek Canyon, Black Hills, Wyoming (at Jack Boyden's ranch, 5 miles above mouth of Canyon, at 3,750 feet altitude), by Vernon Bailey, August 25, 1913. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Black Hills, S. Dak., and Bear Lodge Mountains, Wyo. (fig. 10).

Characters.—Size of *talpoides*; color more brownish gray; skull slender, lightly ridged; dentition light; bullæ well rounded; not very different externally from *fossor*, but mammæ in 6 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2.

Color.—*Summer pelage* (July and August): Upperparts dull grayish brown; nose plumbeous or dusky; ear patch blackish; underparts buffy, generally with white on chin and sometimes on breast; feet and tail whitish gray or buffy. *Winter pelage* (held over in April specimens from Redfern, S. Dak.): Dark buffy gray, darker than in similar coat of *talpoides*, not so rufescent as in *fossor*; underparts light buff. *Young* (half-grown July specimen from Custer, S. Dak.): Dull and dark, as in *talpoides*.

Skull.—Larger and more heavily ridged than in *talpoides* but less heavily ridged than in *rufescens*; temporal ridges parallel in adults, and interparietal triangular; audital bullæ full and well rounded but not so large as in *bullatus*; basioccipital slender. *Dentition* conspicuously light. Compared with *fossor*, the skull is larger, relatively wider, and more robust.

Measurements.—Type: Total length, 230; tail vertebræ, 66; hind foot, approximately 32 (27 without toenails). Average of 4 female topotypes: 226, 65, 31.5. *Skull* (of type): Basal length, 37.7; nasals, 14.3; zygomatic breadth, 24.3; mastoid breadth, 20; interorbital breadth, 6.5; alveolar length of upper molar series, 7.7.

Remarks.—This is a well-marked form of *talpoides*, occupying the higher parts of the Black Hills and Bear Lodge Mountains, and coming down in wooded canyons to the base of both ranges in the Canadian and Transition Zones. In the Bear Lodge Mountains it is less strongly differentiated from *talpoides* and shows a tendency toward *bullatus*, but can best be placed with the Black Hills form.

Specimens examined.—Total number, 27, as follows:

South Dakota: Beaver Creek, 1; Custer, 4; Redfern, 4; Spring Creek, 1; Tigerville, 2.

Wyoming: Bear Lodge Mountains (at 6,000 and 6,200 feet altitude), 6; Rattlesnake Creek (head, at 6,000 feet in the Black Hills), 2; Sand Creek Canyon, 5; Sundance (in canyon at base of Bear Lodge Mountains), 2.

THOMOMYS TALPOIDES CARYI BAILEY.

BIGHORN POCKET GOPHER.

(Pl. VII, fig. 6.)

Thomomys talpoides caryi Bailey, Proc. Biol. Soc. Washington, XXVII, p. 115, July 10, 1914.

Type.—Collected at head of Trapper Creek, at 9,500 feet altitude, in the Bighorn Mountains, Wyoming, by Merritt Cary, July 10, 1910. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Canadian Zone on Bighorn Mountains, Wyo. (fig. 10).

Characters.—Size about the same as *clusius* or slightly smaller; color darker, more rufescent, without gray cheeks and sides; skull with smaller bullæ and wider interparietal; mammæ in 6 pairs.

Color.—*Summer pelage* (September): Upperparts warm grayish brown, with plumbeous nose and black ear patch; underparts rich buffy with white on chin and sometimes on breast; feet soiled whitish; tail gray or buffy with whitish tip. *Winter pelage* (on rump of type, June 10): Dark buffy gray, underparts creamy.

Skull.—General form similar to that of *clusius* but with shorter, wider interparietal, slightly smaller bullæ, and generally wider and more emarginate nasals.

Measurements.—Type (♀ young ad.): Total length, 196; tail vertebrae, 54; hind foot, 26. Topotype (♀ more fully ad.): 203, 58, 28. *Skull* (of type): Basal length, 32.5; nasals, 12; zygomatic breadth, 20.5; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 6.2.

Remarks.—This form is poorly represented, but shows characters that exclude it from any of the neighboring forms. Externally it most closely resembles the Black Hills gopher, but in cranial characters stands nearest to *clusius*, of which it may be considered a dark-colored mountain race. A good series of specimens including adult males from the high central area of the Bighorn Mountains will doubtless show more pronounced characters. The details of the distribution of the form remain to be worked out. The specimens examined are all females and from the Canadian Zone.

Specimens examined.—Total number, 4, as follows:

Wyoming: Bighorn Mountains (9,000 and 9,500 feet altitude, in central part), 2; Bighorn Mountains (8,400 and 9,000 feet, in southern part), 2.

THOMOMYS TALPOIDES PRYORI BAILEY.

PRYOR MOUNTAIN POCKET GOPHER.

(PL. VII, fig. 7.)

Thomomys pryor Bailey, Proc. Biol. Soc. Washington, XXVII, 116, July 10, 1914.

Type.—Collected on Pryor Mountains, Montana, at head of Sage Creek (6,000 feet altitude), by Vernon Bailey, July 16, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Pryor Mountains, Mont., east to the Bighorn River, near Fort Custer (fig. 10).

Characters.—Size of *clusius*, but darker colored and with shorter nasals and more projecting incisors; mammæ in 6 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2.

Color.—*Summer pelage:* Upperparts dull walnut-brown, about as in *fossor*; nose plumbeous; cheeks dark gray; ear patch black;

underparts dark buff with no trace of white in topotype series; feet and tail soiled whitish or buffy. *Winter pelage* (as shown in long fur retained on rump of type and one topotype): More grayish brown.

Skull.—Low and wide, with very short and posteriorly pointed nasals; temporal ridges parallel; interparietal triangular; audital bullæ rather small; basioccipital wide between bullæ; interpterygoid fossa narrow and sharp. *Dentition* light; upper incisors strongly projecting; inner grooves not so distinct as in *talpoides*.

Measurements.—Type (σ ad.): Total length, 210; tail vertebræ, 60; hind foot, 29. Average of 2 female topotypes: 201, 53, 28.5. *Skull* (of type): Basal length, 34; nasals, 12.5; zygomatic breadth, 22; mastoid breadth, 18.5; interorbital breadth, 5.7; alveolar length of upper molar series, 7.

Remarks.—This seems to be a very local form of the higher slopes of the Pryor Mountains, and undoubtedly grades into some of the other forms below. It seems to be distinct from *caryi*, the gopher on the Bighorn Range, from which it is separated by the deep canyon of the Bighorn River, and also from *bullatus*, from which it is separated at Fort Custer by the river. The shallow, slender rostrum and arrangement of mammæ place it in the *talpoides* group, but the peculiar nasals and projecting incisors are not found in any of the other forms.

Specimens examined.—Total number, 7, as follows:

Montana: Bighorn River (west side, near Fort Custer), 2; Pryor Mountains (cold slopes, edge of Canadian Zone), 5.

THOMOMYS TALPOIDES AGRESTIS MERRIAM.

SAN LUIS POCKET GOPHER.

(Pl. VII, fig. 4.)

Thomomys talpoides agrestis Merriam, Proc. Biol. Soc. Washington, XXI, 144, June 9, 1908.

Type.—Collected at Medano Ranch (15 miles northeast of Mosca), San Luis Valley, Colorado, by Merritt Cary, October 29, 1907. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—San Luis Valley, Colo. (fig. 8).

Characters.—Decidedly larger and paler than typical *clusius*; skull heavier and more conspicuously ridged; more nearly resembling *bullatus*, but with relatively narrower skull, and larger, more pointed nasals.

Color.—*Summer pelage*: Upperparts buffy or brownish gray, richest along median line of back; ear patch blackish; nose gray; underparts buffy; chin white in two specimens; a white spot on breast in one; feet and tail whitish or buffy gray. *Winter pelage*: Upperparts lighter, more grayish; underparts whitish or creamy.

Skull.—Long and narrow, with uniformly arched outline; temporal ridges prominent and parallel in old age; nasals long and narrow, and pointed at posterior tip, with a slight expansion back of middle; interparietal triangular; auditory meatus slender; bullæ medium; not so full and rounded as in *bullatus*. *Dentition* medium; incisors bent at right angles to axis of skull.

Measurements.—Type (♀ ad.): Total length, 220; tail vertebræ, 57; hind foot, 30. Topotype (♂ not fully ad.): 205, 50, 30. *Skull* (of type): Basal length, 38; nasals, 15; zygomatic breadth, 23.5; mastoid breadth, 19.7; interorbital breadth, 6.5; alveolar length of upper molar series, 8.

Remarks.—This is a well-marked local form of the *talpoides* group occupying the great arid San Luis Valley, in open sage brush of the Transition Zone. At present it may be isolated from other forms of the group except *fossor*, by which it is surrounded in the timbered mountains and from which it may have been derived. More probably, however, it is a more recent derivative of *clusius* which has entered the valley through one of the passes.

Specimens examined.—Total number, 18, as follows:

Colorado: Blanco, 1; Creston, 1; Fort Garland, 2; Medano Ranch, 5; Saguache (12 miles northwest), 1; San Acacia, 8.

THOMOMYS COLUMBIANUS BAILEY.

COLUMBIA POCKET GOPHER.

(Pl. VII, fig. 12.)

Thomomys fuscus columbianus Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected at Touchet, Walla Walla County, Washington, by Clark P. Streater, September 10, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Plains of southeastern Washington and northern Oregon (fig. 5).

Characters.—Size slightly smaller than *talpoides*, slightly larger than *quadratus*, colors paler than either, about as in *fisheri*; skull heavier than in *quadratus*; claws moderately stout; mammæ in 6 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2.

Color.—*Summer pelage*: Upperparts light wood brown or buffy gray; sides and belly pale buffy gray; ear and postauricular patch black; nose slaty; tail gray with white tip; feet whitish. *Winter pelage* slightly grayer. *Young* very gray.

Skull.—Smaller than that of *talpoides*, with shorter, wider nasals; larger and longer than that of *quadratus*, rather heavy and angular; lateral ridges well developed in adults, approximately parallel; bullæ

large and rounded, widening base of skull and narrowing shaft of basioccipital; interparietal more or less triangular.

Measurements.—Type (♂ ad.): Total length, 209; tail vertebræ, 60; hind foot, 28. Topotype (♀ ad.): 208, 68, 27. *Skull* (of type): Basal length, 34; nasals, 13; zygomatic breadth, 22.7; mastoid breadth, 18.7; alveolar length of upper molar series, 8.

Remarks.—The relationships of this form are doubtful. In many respects it resembles the *talpoides* group, especially in arrangement of mammæ and in general skull characters. In small ears and rather square-built skull it seems close to *quadratus*, and there is some question whether along the borders of its range it does not interbreed with both *quadratus* and *fuscus*. Two young females from Asotin, Wash., are probably typical of *columbianus*, but are too young to afford reliable characters. An old male from Willows Junction, Oreg., is very small, but is provisionally referred to *columbianus*.

Specimens examined.—Total number, 37, as follows:

Oregon: Pendleton, 4; Umatilla, 9; Willows Junction, 1.

Washington: Asotin, 2; Baird, 9; Fort Walla Walla, 3; Prescott, 4; Touchet, 4; Wallula, 1.

THOMOMYS OCIUS MERRIAM.

GREEN RIVER POCKET GOPHER.

(Pl. II, fig. 12; Pl. VII, fig. 9.)

Thomomys clusius ocus Merriam, Proc. Biol. Soc. Washington, XIV, 114, July 19, 1901.

Type.—Collected near Old Fort Bridger, Wyoming (exact locality, dry sagebrush mesas at Harvey's Ranch, on Smiths Fork, 6 miles southwest of Fort Bridger), by Vernon Bailey, May 24, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Green River Basin of southwestern Wyoming, northwestern Colorado, and northeastern Utah (fig. 10).

Characters.—Size small; color very pale; skull slender, with very large and rounded audital bullæ and sharply incurved upper incisors; ears very small but pointed; mammæ normally in 7 pairs, inguinal 2-2, abdominal 2-2, pectoral 3-3.

Color.—*Summer pelage*: Upperparts light buffy gray, more strongly buffy or tinged with brownish on crown and back; sides clear gray; cheeks darker gray; ear patch blackish but small; underparts, feet, and tail soiled whitish or creamy. *Winter pelage*: Upperparts lighter buffy gray; nose and cheeks clearer gray; underparts whitish or creamy.

Skull.—Rather narrow, with slightly arched dorsal outline; interparietal short and wide; temporal ridges slightly converging anteriorly; posterior tips of nasals rounded; audital bullæ very large and

smoothly rounded, with anterior arm of basioccipital slender and narrow between them. *Dentition*: Upper incisors sharply incurved so that the cranium can be readily suspended by them, and lower incisors also curved very abruptly upward.

Measurements.—Type (a large old male): Total length, 204; tail vertebræ, 60; hind foot, 26. Topotype (σ ad.): 188, 51, 24. Average of 6 topotypes (φ ad.): 194, 58, 24.6. *Ear*: From crown, measured in flesh, 5. *Skull* (of type): Basal length, 33; nasals, 12; zygomatic breadth, 20; mastoid breadth, 17; interorbital breadth, 5.5; alveolar length of upper molar series, 7.

Remarks.—This is a little, pale, desert species of the Green River Basin, mainly in the Upper Sonoran Zone. It occupies the dry, sagebrush mesas, while *bridgeri* occupies the fertile valleys close by. Fort Bridger seems to be the extreme upper limit of *ocius*, and here its range meets that of the much larger *bridgeri* and almost or quite meets that of the smaller, darker-colored *pygmæus*. On the east it meets the range of *clusius*, but I find no signs of intergradation, and the skull characters are so strongly marked that it seems best to treat *ocius* as a full species. Its nearest relatives are *idahoensis* of southern Idaho, and more remotely the little *pygmæus*, along its western border in the Transition Zone. These three forms are the only members of the genus in which the crania can be readily suspended by hooking the upper incisors over a wire or string. The ears of *ocius* are very small, measuring uniformly 5 mm. from posterior base to tip in fresh specimens, while in *bridgeri* from the same locality they measure 8 mm. The females have normally 14 mammæ and contained 7 fetuses, contrasted with 10 mammæ and 5 fetuses in *bridgeri*, collected at the same time and place.

Specimens examined.—Total number, 38, as follows:

Colorado: Douglas Spring, 1; Ladore, 2; Lay, 1; Lily, 2; Rangely, 2; Snake River (20 miles west of Baggs), 2.

Utah: Uncompahgre Indian Reservation, 2.

Wyoming: Bitter Creek, 2; Eden, 1; Fontenelle, 1; Fort Bridger, 9; Green River (junction of New Fork), 3; Henrys Fork, 1; Maxon (5 miles southwest), 8; Opal, 1.

THOMOMYS IDAHOENSIS MERRIAM.

IDAHO POCKET GOPHER.

(Pl. II, fig. 7; Pl. VII, fig. 10.)

Thomomys idahoensis Merriam, Proc. Biol. Soc. Washington, XIV, 114, July 19, 1901.

Type.—Collected at Birch Creek (10 miles south of Nicholia, at about 6,400 feet altitude), Fremont County, Idaho, by Clark P. Streater, August 8, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Snake River Plains, southeastern Idaho (fig. 10).

Characters.—Size very small; color pale yellowish gray; ears small; skull light and smooth, with very large and globose bullæ and incurved upper incisors; mammæ in 6 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2.

Color.—*Summer pelage*: Upperparts pale dull olive-buff or buffy gray; ear with only a trace of dusky patch; nose yellowish; underparts pale buff or soiled whitish, occasionally with white chin; feet and tail very hairy, pale buffy or whitish. *Young*, more ashy gray. *Winter pelage* unknown. The summer pelage is decidedly paler than the corresponding pelage of *ocius*, hence the winter pelage is probably lighter colored than in any other northern species of the genus.

Skull.—Of much the same general form as in *ocius*, but conspicuously smaller and smoother with smaller, more oval interparietal; nasals minutely notched at posterior tip and ending approximately even with premaxillæ; audital bullæ very large and globose, sometimes actually meeting over narrow shaft of basioccipital. While the external ear is very small, the auditory meatus and audital bullæ are unusually developed, the bullæ being relatively the largest of any species of the genus.

Measurements.—Type (σ ad.): Total length, 179; tail vertebrae, 47; hind foot, 23. Average of 10 male topotypes: 179, 50, 22.5. Average of 9 female topotypes: 166, 49, 22.4. *Ear*, from base, measured in flesh, 4.5. *Skull* (of type): Basal length, 29.5; nasals, 11.5; zygomatic breadth, 18; mastoid breadth, 16; interorbital breadth, 4.7; alveolar length of upper molar series, 5.5.

Remarks.—The type locality is at the extreme upper edge of the Upper Sonoran Zone and the upper limit of the range of the species. This gopher is a small, pale, desert species of the Snake River Plains. There is no indication of its intergradation with any of the surrounding forms, and its nearest relative is *ocius* of the upper Green River Basin in Wyoming. The boundary of its range remains to be worked out, and winter or early spring specimens are greatly needed to show the winter pelage.

Specimens examined.—Total number, 42, as follows:

Idaho: Big Butte, 2; Big Lost River (near Sink), 3; Birch Creek (10 miles south of Nicholia, 6,400 feet altitude), 21; Blackfoot, 11; Dubois, 1; Idaho Falls, 1; Sink of Birch Creek (5,100 feet), 3.

THOMOMYS PYGMÆUS MERRIAM.

PYGMY POCKET GOPHER.

(PL. VII, fig. 11.)

Thomomys pygmæus Merriam, Proc. Biol. Soc. Washington, XIV, 115, July 19, 1901.

Type.—Collected at Montpelier Creek (exact locality about 10 miles northeast of Montpelier, at 6,600 feet altitude, in open sagebrush of

Transition Zone), Bear County, Idaho, by Vernon Bailey, July 29, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Southwestern Wyoming and southeastern Idaho (Transition Zone) (fig. 10).

Characters.—Size smallest of the genus; color rich hazel-brown; skull very slender and delicate with not very large audital bullæ; upper incisors incurved, distinctly grooved; ears small; mammæ in 6 pairs, inguinal 2-2, abdominal 2-2, pectoral 2-2.

Color.—*Summer pelage:* Upperparts rich hazel-brown, very uniformly distributed; dusky earpatches inconspicuous; nose plumbeous; underparts dull ochraceous, rarely with any white markings; tail usually entirely buffy gray; feet whitish or buffy. *Winter pelage:* Paler, more buffy brown. *Young:* Duller, more grayish and with lighter-colored belly.

Skull.—Very small, slender, and thin, the slight trace of temporal ridges converging anteriorly; interparietal wide and oval; nasals notched or emarginate at posterior tip; bullæ rather small; auditory meatus slender; interpterygoid fossa narrow and acute angled; basioccipital narrow. *Dentition* very light; upper incisors incurved to a slightly less degree than in *ocius* and *idahoensis*.

Measurements.—Type (♂ ad.): Total length, 177; tail vertebræ, 46; hind foot, 22. Topotype (♂ ad.): 165, 40, 20. Specimen from Bear River (♀ ad.): 168, 50, 23. *Skull* (of type): Basal length, 28.4; nasals, 10.4; zygomatic breadth, 16.5; mastoid breadth, 14.5; interorbital breadth, 5; alveolar length of upper molar series, 6.

Remarks.—This, the smallest of all known pocket gophers, seems not to be closely related to any of the neighboring forms nor to intergrade with them. It has some of the skull characters of *fuscus*, but seems to be more nearly related to *idahoensis* and *ocius*, from which, however, it is quite distinct. It occurs in the same localities but apparently not on the same ground with the much larger *bridgeri* and *vinta*, occupying the Transition Zone sagebrush ridges and mesas, while they are restricted to the mellow soil and more fertile bottoms of the stream valleys. A specimen in the Academy of Natural Sciences of Philadelphia (No. 144), collected by J. K. Townsend in 1834, probably came from the Bear River region, but was later labeled "Columbia River."

Specimens examined.—Total number, 23, as follows:

Idaho: Montpelier Creek (12 miles northeast of Montpelier at 6,700 feet altitude), 2.

Wyoming: Bear River and Bear River Divide (14 miles north of Evanston at 6,600-7,500 feet), 12; Big Piney (6,400 feet), 1; Big Sandy, 1; Fossil (6,600 feet), 1; Lone Tree (5 miles west, on Henry Fork, 7,400 feet), 2; Merna (on Horse Creek, 7,800-8,000 feet), 3; Surveyors Park (12 miles northeast of Pinedale, 8,000 feet), 1.

Thomomys fossor Group.

THOMOMYS FOSSOR ALLEN.

COLORADO POCKET GOPHER.

(Pl. II, fig. 8; Pl. VII, fig. 13; text fig. 4.)

Thomomys fossor Allen, Bul. Am. Mus. Nat. Hist. V, 51, April 28, 1893.

Type.—Collected at Florida, La Plata County, Colorado, altitude 7,200 feet, by Charles P. Rowley, June 25, 1892. Type specimen in Am. Mus. Nat. Hist.

Distribution.—Mountains of western Colorado, extreme southern Wyoming, northern New Mexico, eastern and southern Utah, and northwestern Arizona (fig. 8).

Characters.—Size medium, hind foot averaging about 29 mm.; color dull and dark brown; ears large; skull long, low, and narrow, with rostrum especially slender in profile, as in the *talpoides* group; mammæ in 5 pairs, inguinal 2-2, pectoral 3-3.

Color.—*Summer pelage*: Upperparts dull dark brown with sometimes a rich chestnut tone; ear and postauricular patch black; nose and face dusky; underparts buffy or ochraceous; part of feet and tip of tail usually whitish; chin usually, and spot on breast sometimes, white. *Winter pelage*: Duller, more grayish or drab. *Young*: In summer paler and more buffy than adults.

Skull.—Long and slender, with long rostrum, and anteriorly converging temporal ridges; nasals narrow, with generally rounded posterior tips; interparietal triangular; bullæ large and full, basioccipital narrowed between them. *Dentition* very light.

Measurements.—Average of 4 female topotypes: Total length, 221; tail vertebræ, 63; hind foot, 29. A large male measures 220, 68, 32.

Skull (of type, ♂ ad.): Basal length, 37; nasals, 15; zygomatic breadth, 22; mastoid breadth, 20; alveolar length of upper molar series, 7.5. Skull of adult male from Lake City, Colo.:¹ 34, 13.5, 21, 18.7, 7.

Remarks.—This is a wide-ranging boreal species with long, soft fur, which even in midsummer does not become so short and harsh as in low-country species. At high altitudes the long coat seems not to be entirely lost during the brief summer.

As might be expected there is some slight variation in specimens from different mountain ranges, some of which are entirely isolated by low country, but nowhere is there enough variation to warrant further subdivision. In such a variable group it is a great satisfaction to find an occasional species that holds its distinctive characters over a wide area.

Specimens examined.—Total number, 183, as follows:

Arizona: Bright Angel Spring (Kaibab Plateau), 3; DeMotte Park (Kaibab Plateau), 3.

¹No. 48190, U. S. Nat. Mus.

- Colorado:** Arapahoe Pass (Rabbit Ear Mountains), 5; Black Hawk, 2; Baxter Pass (Book Plateau), 2; Boulder (5 miles west, at 5,600 feet altitude), 7; Cascade, 1; Cochetope Pass (3 miles east), 5; Colorado City, 1; Colorado Springs (2½ miles north, at 6,000 feet), 1; Colorado Springs (east of Palmer Park), 1; Como, 1; Coulter, 3; Crested Butte, 4; Culebra Canyon (Costilla County), 1; Elk Head Mountains, 2; Elkhorn, 1; Estes Park, 6; Florida, 5; Golden, 2; Hahns Peak, 2; Hayden, 1; Lake City, 2; Longs Peak, 3; Meeker, 3; Montgomery, 3; Nederland, 4; Pagosa Springs, 3; Pagosa Peak, 1; Pearl, 1; Saguache (23 miles northwest), 1; Sapinero, 2; Silverton, 2; Uncompahgre Plateau, 2; Teller County Divide, 1; White River Plateau, 1.
- New Mexico:** Chusca Mountains, 3; Costilla Pass, 5; Costilla River, 3; Gallinas Mountains (Rio Arriba County), 7; Halls Peak, 1; Hondo Canyon, 1; Hopewell, 6; Horse Lake, 6; Jemez Mountains (head of Santa Clara Creek), 5; Moreno Valley, 2; Mount Taylor, 1; Pecos Baldy, 4; Red River (Taos County), 4; Taos Mountains, 4; Tres Piedras, 1; Tusas River, 1; Twining, 12; Whites Peak, 1; Willis, 4.
- Utah:** Beaver Mountains, 9; Buckskin Valley, 1; Fish Lake, 4; La Sal Mountains, 1; Panguich Lake, 1; Parawan Mountains, 4.
- Wyoming:** Bridgers Peak (8,800 feet altitude), 3; Medicine Bow Mountains (10,200 feet), 1.

THOMOMYS BRIDGERI MERRIAM.

FORT BRIDGER POCKET GOPHER.

(Pl. VII, fig. 15.)

Thomomys bridgeri Merriam, Proc. Biol. Soc. Washington, XIV, 113, July 19, 1901.

Type.—Collected at Fort Bridger, Wyoming (exact locality, Harvey's Ranch on Smiths Fork, 6 miles southwest of Old Fort Bridger), by Vernon Bailey, May 27, 1890. Type specimen in U. S. Nat. Mus., Merriam collection.

Distribution.—Southwestern Wyoming and southeastern Idaho (Transition Zone) (fig. 5).

Characters.—Size large; ears large and prominent; color dull dark brown; skull heavily ridged and angular, with deeply emarginate nasals; mammæ in 5 pairs, inguinal 2-2, pectoral 3-3.

Color.—*Summer pelage:* Upperparts rich warm brown, nearest to cinnamon-brown of Ridgway; nose and face dusky brown; large ear patch black; underparts dark buffy or dull ochraceous, occasionally with white patch on chin; feet partly gray or mottled with gray; toes whitish; tail brownish gray, paler below and occasionally with white tips. *Winter pelage:* Upperparts duller and darker, more nearly Prout's brown of Ridgway; nose plumbeous, ear patch black; underparts washed with buffy over light plumbeous, with almost a lavender effect. *Young* more grayish.

Skull.—Large, angular, and heavily ridged in adults; nasals long and deeply emarginate at posterior tips; temporal ridges parallel or slightly converging in middle; interparietal triangular; audital bullæ long, narrow, and wide apart, with wide shaft of basioccipital

between; auditory meatus moderately large. *Dentition* relatively light; incisors very long and slightly protruding.

Measurements.—Type (σ ad.): Total length, 237; tail vertebræ, 71; hind foot, 34. Topotype (φ ad.): 227, 68, 31. Average of 10 adult males: 244, 72, 33.2. Average of 10 adult females: 233, 71, 31.5. *Ear*: From crown, 8. *Skull* (of type): Basal length, 39; nasals, 16; zygomatic breadth, 24.5; mastoid breadth, 22; interorbital breadth, 7; alveolar length of upper molar series, 8.

Remarks.—This big gopher is abundant in fertile valleys in the Transition Zone, but does not inhabit the arid upland. It is a strongly marked, outlying form of the *fossor* group, and its nearest relative is *uinta*. It has a lower zonal range, however, and seems to be entirely distinct. More thorough collecting may show that it grades into *uinta* higher up the streams, but at present the two are best treated as distinct species.

At the type locality females were found normally to have 10 mammæ and 5 embryos, as contrasted with the 14 mammæ and 7 embryos in the little *ocius* of the dry sagebrush mesas close by.

Specimens examined.—Total number, 74, as follows:

Idaho: Montpelier, 18; Montpelier Creek (6,000 feet altitude), 1.

Wyoming: Bear River (14 miles north of Evanston, 6,600–6,800 feet altitude), 5; Border, 1; Cokeville (6,400 feet), 8; Fort Bridger, 24; Henry's Fork (5 miles west of Lonetree), 1; Lonetree (7,400 feet), 3; Lonetree (4 miles south), 2; Mountain View, 11.

THOMOMYS UINTA MERRIAM.

UINTA POCKET GOPHER.

(Pl. VII, fig. 14.)

Thomomys uinta Merriam, Proc. Biol. Soc. Washington, XIV, 112, July 19, 1901.

Type.—Collected in Uinta Mountains (10,000 feet altitude, north base of Gilbert Peak), Summit County, Utah, by Vernon Bailey, June 6, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Western Wyoming, southeastern Idaho, and northern Utah (fig. 5).

Characters.—About the size of *fossor* and practically indistinguishable in external characters; skull shorter and wider, with shorter rostrum and heavier dentition; mammæ in 5 pairs, inguinal 2–2, pectoral 3–3.

Color.—*Summer pelage*: Upperparts dull dark brown, with dusky nose and face and blackish ear and ear patch; underparts buffy or ochraceous, with occasionally a white patch on chin; feet and tip of tail usually whitish. *Late fall and winter pelage*: Duller and more grayish. *Young*, paler, more buffy than adults.

Skull.—Heavier and wider than in *fossor*, with heavier dentition, smaller bullæ, a more nearly five-angled interparietal, and wider nasals with deeply emarginate instead of rounded posterior tips.

Measurements.—Average of type and topotype (σ ad.): Total length, 226; tail vertebræ, 70; hind foot, 31. Topotype (φ ad.): 211, 64, 28. *Skull* (of type): Basal length, 35; nasals, 13; zygomatic breadth, 23; mastoid breadth, 21; alveolar length of upper molar series, 8.

Remarks.—While very similar to its nearest relative, *fossor*, in external characters, *uinta* has such pronounced skull characters and is so widely separated that it is best treated as a full species. It also has the same boreal, mountain habitat and practically the same environment and habits as *fossor*. Specimens from the mountains of western Wyoming show some local variation but not sufficient to be recognized as a subspecies. There seems to be no evidence of intergradation with the smaller and smaller-eared *fuscus* group, although they come close together in the region south of Jackson Hole, Wyo.

Specimens examined.—Total number 110, as follows:

Idaho: Albion, 5; Bridgefoot (hills east of town), 1; Bridge, 1; Inkom, 12; Irwin (10 miles southeast), 7; Malade, 6; Pocatello, 4; Preuss Mountains, 5; Shelley, 3; Swan Lake, 4.

Utah: Kelton (mountains 7 miles north), 3; Ogden, 6; Park City, 3; Parley Canyon, 1; Uinta Mountains (9,000–10,000 feet altitude), 6.

Wyoming: Afton, 7; Afton (10 miles southeast, in Salt River Mountains), 6; Afton (10 miles north on Salt River), 7; Black Rock Creek (head, in Shoshone Mountains), 5; Kendall (12 miles north), 6; Merna, 6; Needle Mountain (10,000 feet altitude), 4; Stanley (3 miles west), 1; Thayne, 1.

THOMOMYS QUADRATUS QUADRATUS MERRIAM.

DALLES POCKET GOPHER.

(PL. VII, fig. 8.)

Thomomys quadratus Merriam, Proc. Biol. Soc. Washington, XI, 214, July 15, 1897.

Type.—Collected at The Dalles, Oregon, by Clark P. Streater, November 2, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Plains of eastern and central Oregon, northeastern California, and northwestern Nevada (fig. 5).

Characters.—Smaller than *uinta*; rather brighter colored; ears small; skull relatively short and wide, with wide, truncate, posterior tip of nasals; mammæ in 5 pairs, inguinal 2–2, pectoral 3–3.

Color.—*Summer pelage*: Upperparts light russet; ear patch black; nose dark plumbeous; underparts washed with dark buff; tail brownish above, except at tip; feet whitish. *Winter pelage*: Duller and grayer. *Young*, dull and rather dark.

Skull.—Relatively short and rectangular, with parallel lateral ridges, and rectangular zygomatic arches; nasals short and posteriorly truncate; pterygoids V-shaped; interparietal small, rounded, triangular, or cordate; bullæ rather small.

Measurements.—Average of 3 male topotypes: Total length, 210; tail vertebræ, 64; hind foot, 27. Average of 5 female topotypes: 195, 62, 26.4. *Skull* (of type): Basal length, 36; nasals, 13.5; zygomatic breadth, 24; mastoid breadth, 19; alveolar length of upper molar series, 8.

Remarks.—This is a wide-ranging, variable form of the *fossor* group, occupying the Upper Sonoran plains of eastern and central Oregon, northeastern California, and northern Nevada, and extending higher up in some of the narrow desert ranges.

Specimens examined.—Total number, 159, as follows:

California: Bieber, 7; Brownell, 1; Dry Creek (at 4,450 feet altitude), 1; Eagle Lake, 2; Goose Lake, 1; Goose Lake Meadows (4,800 feet), 2; Lake City, 1; Lassen Creek, 7; Madeline Divide, 1; Madeline Plains, 6; Pete's Valley, 1; Secret Valley, 1; Sugar Hill (Modoc County, 5,000 feet), 1; Susanville (4 miles south), 2; Warner Mountains (head of Parker Creek, 7,300 feet), 16; Warner Mountains (Parker Creek, 5,500 feet), 13; Warner Peak (east slope, 8,700 feet), 3.

Nevada: Badger, 1.

Oregon: Adel, 4; Crooked River, 3; Fremont, 4; Harney, 2; Ironside (4,000 feet altitude), 11; Lake Alvord, 1; Lakeview, 4; Matoleus River, 2; Merrill, 2; Mount Warner, 1; Shirk, 17; Silver Lake, 6; The Dalles, 21; Tumtum Lake, 1; Wapinitia, 1.

Washington: Rockland, 12.

THOMOMYS QUADRATUS FISHERI MERRIAM.

FISHER POCKET GOPHER.

(Pl. VII, fig. 16; text fig. 3.)

Thomomys fuscus fisheri Merriam, Proc. Biol. Soc. Washington, XIV, 111, July 19, 1901.

Type.—Collected at Beckwith, Sierra Valley, Plumas County, California, by W. K. Fisher, August 3, 1900. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Northern, central, and western Nevada; west in California to Sierra Valley and Mono Lake (fig. 6).

Characters.—Slightly smaller than *quadratus*, shorter-tailed, and paler; smaller than *clusius*, about the same color but with narrower skull and smaller bullæ; much larger than *idahoensis* with relatively smaller bullæ; claws moderately stout; mammæ in 5 pairs, inguinal 2-2, pectoral 3-3.

Color.—*Summer pelage*: Upperparts buffy gray, lightly washed with dull russet over back; ear patch blackish; nose plumbeous; underparts buffy; chin white; feet whitish; tail whitish below, gray

above usually to the tip. *Winter pelage*: Slightly grayer. *Young*, more buffy.

Skull.—More like that of *quadratus* than of *fuscus* or *monticola*; lateral ridges parallel in adults; nasals truncate posteriorly; interparietal broadly triangular. *Dentition* lighter, and incisors less abruptly decurved than in *quadratus*, *fuscus*, or *monticola*.

Measurements.—Average of 3 topotypes (σ ad.): Total length, 191; tail vertebræ, 58; hind foot, 25.3. Average of 3 adult females: 194, 58, 25. *Skull* (of type, σ ad.): Basal length, 31; nasals, 11; zygomatic breadth, 20; mastoid breadth, 17.5; alveolar length of upper molar series, 6.

Remarks.—The subspecies *fisheri* is typical only along the western part of its range. In central Nevada it is darker and perhaps grades into *uinta*. In northwestern Nevada it grades imperceptibly into *quadratus*, the only form with which it seems to be closely connected. It is quite distinct from *monticola*, with which it occurs at the type locality, and from which it differs in much smaller ears and paler color.

Specimens examined.—Total number, 97, as follows:

California: Beckwith, 1; Casa Diablo, 6; Mono Lake, 8; Sierra Valley, 8.

Nevada: Arc Dome, 2; Big Creek 6; Bull Run, 2; Cottonwood Range, 14; Eureka, 3; Monitor Mountains, 2; Mount Siegel, 2; Mount Sugar, 6; Pine Forest Range, 4; Reese River Valley (50 miles south of Austin), 9; Reno, 6; Ruby Lake, 3; Ruby Mountains, 2; Silver Creek (north of Austin), 5; Summit Lake, 3; Verdi, 3; Wells, 2.

Thomomys douglasi Group.

THOMOMYS DOUGLASI DOUGLASI (RICHARDSON).

DOUGLAS POCKET GOPHER; COLUMBIA SAND RAT.

(Pl. II, fig. 10; Pl. VIII, fig. 5.)

Geomys douglasii Richardson, Fauna Boreali-Americana, I, 200, 1829.

Geomys fuliginosus Schinz, Syn. Mamm., II, 136, 1845. "Habitat ad fluvium Columbia."

Thomomys douglasii Allen, Bul. Am. Mus. Nat. Hist., V, 66, April 28, 1893.

Type.—Collected "near the mouth of the Columbia," at Fort Vancouver, Washington, by David Douglas, probably in 1825. Mr. Oldfield Thomas writes that it is not now in the British Museum collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size medium; claws stout; ears medium with rounded tips; color nearly uniform dull hazel without dark ear patch; skull long and slender and flat on top; incisors abruptly decurved and distinctly grooved; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—(*June specimens* from type locality): Upperparts uniform dull hazel, slightly paler on sides; underparts more ochraceous, with

a white spot on breast in all of the topotypes; nose gray; feet and tail soiled whitish. *Winter and young pelages* not seen.

Skull.—Long and narrow, somewhat of the *monticola* type, but with heavier rostrum, wider interorbital constriction, and with zygomatic arches conspicuously widest at anterior angle; interparietal very small and transversely oval; bullæ small and narrow; basioccipital triangular; pterygoids low and U-shaped.

Measurements.—Average of 3 topotypes (σ ad.): Total length, 215; tail vertebræ, 64; hind foot, 30. Average of 4 females: 200, 58, 28.6. *Skull* (of topotype, σ ad.):¹ Basal length, 36; nasals, 14; zygomatic breadth, 22.5; interorbital breadth, 7; mastoid breadth, 19; alveolar length of upper molar series, 7.6.

Remarks.—The well-developed ears, number and position of mammæ, general tone of coloration, and long narrow skull at first suggest *douglasi* as the type of the *monticola* group, but the heavier claws, more rounded ear tips, heavier rostrum, and wider interorbital region seem to be group characters shared only by *douglasi*, *oregonus*, *yelmensis*, *melanops*, *limosus*, and *niger*. This group of isolated forms may somewhere connect with *mazama*, which seems to be its nearest relative and neighbor, but for convenience it may be termed the *douglasi* group. With the smaller-eared, slenderer-clawed *fuscus* group, it seems less closely connected. From *quadratus* and *columbianus* it differs widely in external as well as cranial characters.

Specimens examined.—Total number, 7, as follows:

Washington: Vancouver (6 or 7 miles northeast, at Fourth Plain), 7.²

THOMOMYS DOUGLASI OREGONUS MERRIAM.

OREGON POCKET GOPHER.

(Pl. VIII, fig. 8.)

Thomomys douglasi oregonus Merriam, Proc. Biol. Soc. Washington, XIV, 115, July 19, 1901.

Type.—Collected at Ely, near Oregon City, Oregon (exact locality in Ely's orchard), by Clark P. Streator, October 24, 1893. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size about as in *douglasi*; ears smaller, but of the same rounded form; color brighter hazel; skull relatively shorter and wider, with distinctly triangular interparietal; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—October specimens in thin summer pelage: Upperparts clear bright hazel, with dusky nose and cheeks and blackish ear patch;

¹ No. 65929, U. S. Nat. Mus.

² Collected by Clark P. Streator, June 15-16, 1894.

underparts paler, more ochraceous; feet and tail soiled whitish. *Young* of the year, paler, more yellowish. A trace of long, rough fur on the rumps of several breeding females is duller and darker, more like the June pelage of *douglasi*.

Skull.—Relatively shorter and wider than in *douglasi*, with more-spreading and more nearly parallel zygomatic arches, triangular interparietal, larger bullæ, V-shaped instead of U-shaped interpterygoid fossa, and heavier molars; nasals narrow, with generally double rounded posterior tips.

Measurements.—Average of 5 topotypes (σ ad.): Total length, 216; tail vertebræ, 67; hind foot, 29.5. Type (σ ad.): 220, 70, 30. Average of 5 adult females: 210, 66, 28.2. *Skull* (of type): Basal length, 36; nasals, 14; zygomatic breadth, 23.7; interorbital breadth, 6.5; mastoid breadth, 19.4; alveolar length of upper molar series, 7.6.

Remarks.—The relationship between *douglasi* and *oregonus* is not very close and the question of continuity of range has not been worked out. The Columbia River probably separates their ranges, but they are near enough in characters to allow subspecific rank to show their relationship.

Specimens examined.—Twenty-eight, from type locality.

THOMOMYS DOUGLASI YELMENSIS MERRIAM.

YELM POCKET GOPHER.

(Pl. VIII, fig. 11.)

Thomomys douglasi yelmensis Merriam, Proc. Biol. Soc. Washington, XIII, 21, Jan. 31, 1899.

Type.—Collected at Tenino, Yelm Prairie, Thurston County, Washington, by Clark P. Streator, October 24, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Prairies around south end of Puget Sound, Wash. (fig. 5).

Characters.—Very similar to *douglasi*, but with more-pointed ears, duller and darker coloration, and conspicuous black ear patches; zygomatic arches not widest at anterior angle.

Color.—In faded October pelage: Upperparts dull hazel; nose and sides of face dusky; ears and large ear patches blackish; underparts buffy with irregular white patches; two specimens with white spots on breast and one with white spots on side; feet and tail white or soiled whitish. *Winter pelage* (just appearing on heads in October specimens) dark umber on crown.

Skull.—Long and low like that of *douglasi*; slightly concave interorbitally; zygomatic arches parallel or widest posteriorly; interpterygoid fossa more nearly V-shaped; nasals narrower and more deeply emarginate at posterior tips.

Measurements.—Type (♂ ad.): Total length, 222; tail vertebræ, 68; hind foot, 32. *Skull* (of type): Basal length, 35.5; nasals, 15; zygomatic breadth, 22.7; interorbital breadth, 6.6; mastoid breadth, 18; alveolar length of upper molar series, 7.7.

Remarks.—This is a well-marked form of the *douglasi* group probably not occurring beyond the margins of the Puget Sound prairies. The heavily timbered areas of western Washington and Oregon seem to exclude pocket gophers, but the scattered colonies of related forms strongly suggest a time when the valley prairies were more extensive in area, and the range of the gophers more or less continuous from Puget Sound to the Umpqua Valley. Isolated colonies have become more or less differentiated in characters. Even those from Roy, Spanway, and Steilacoom, Wash., differ to some extent from the type series from Tenino, but not sufficiently for separation.

Specimens examined.—Total number, 44, as follows:

Washington: Roy, 19; Spanway, 6; Steilacoom, 16; Tenino, 3.

THOMOMYS DOUGLASI MELANOPS MERRIAM.

BLACK-HEADED POCKET GOPHER.

(Pl. VIII, fig. 6.)

Thomomys melanops Merriam, Proc. Biol. Soc. Washington. XIII, 21, Jan. 31, 1899.

Type.—Collected at timberline at head of Soleduck River, Olympic Mountains, Clallam County, Washington, by C. Hart Merriam and Vernon Bailey, August 28, 1897. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Olympic Mountains, Wash. (fig. 5).

Characters.—About the size and color of *yelmensis*, but with more black on nose and head; ears small and pointed; skull long, with upper outline more arched than in *yelmensis* or *douglasi*; pterygoids small and wide apart.

Color.—August pelage: Upperparts dark russet, with dusky nose and face, and large black ear patches; underparts paler, more ochraceous, usually with white chin, wrists, and lining of cheek pouches; fore feet pure white; hind feet and tip of tail whitish.

Skull.—Long and well arched; lower outline of rostrum constricted; nasals long and deeply emarginate; premaxillæ wide; interparietal very small and oval or circular; bullæ narrow, and basioccipital wide between them; pterygoids high and wide apart.

Measurements.—Type (♀ ad.): Total length, 206; tail vertebræ, 63; hind foot, 27. Topotype (♀ ad.): 202, 58, 27. There are no adult males from the type locality and those from Happy Lake, Wash., are not correctly measured. *Skull* (of type): Basal length, 33; nasals, 13; zygomatic breadth, 20; mastoid breadth, 16; interorbital breadth,

6.4; alveolar length of upper molar series, 7.3. Skull of adult male from Happy Lake: 34.6; 14.3; 22; 17; 6.3; 7.

Remarks.—Only females and one young male of this form have been examined from the type locality, and in these the cranial characters are not perfectly shown. Specimens of adult male and female from Happy Lake, near the type locality, in the collection of the Field Museum, indicate a closer relationship with *yelmensis* and *douglasi* than was formerly supposed. The relationship of the form seems best indicated by considering it a subspecies of *douglasi*, although at present direct geographic connection is improbable.

Specimens examined.—Total number, 14, as follows:

Washington (Olympic Mountains): Happy Lake, 9; Soleduck River (head), 5.¹

THOMOMYS LIMOSUS MERRIAM.

WHITE SALMON POCKET GOPHER.

(Pl. VIII, fig. 12.)

Thomomys limosus Merriam, Proc. Biol. Soc. Washington, XIV, 116, July 19, 1901.

Type.—Collected at White Salmon, gorge of the Columbia, Klickitat County, Washington, by J. Alden Loring, June 26, 1897. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size and proportions of *douglasi*, but darker colored and with blackish ear patch; skull shorter and wider.

Color.—June pelage: Upperparts dull chestnut, with plumbeous nose and blackish ear patches; underparts slightly paler, more ochraceous; in about half the specimens a white spot on breast; feet and tail soiled whitish. *Young:* Half-grown specimens very similar to adults, but slightly paler, and belly more buffy.

Skull.—Relatively short and wide with more arched dorsal outline and wide-spreading zygomata; nasals with emarginate, spreading, posterior tips, terminating approximately even with tips of premaxillæ; bullæ low and narrow, and anterior shaft of basioccipital correspondingly wide between them; pterygoids small, with narrow fossa.

Measurements.—Type (σ ad.): Total length, 224; tail vertebræ, 68; hind foot, 30. Average of 3 topotypes (σ ad.): 224, 69, 29.3. Topotype (φ ad.): 216, 66, 27. *Skull* (of type): Basal length, 34.5; nasals, 14; zygomatic breadth, 23.5; mastoid breadth, 20; interorbital breadth, 6.2; alveolar length of upper molar series, 8.

Remarks.—While so strikingly different from *douglasi* as to require specific rank, this form is included in the *douglasi* group because of its prominent, rounded ear, heavy claws, and general skull characters

¹ Two adult and two immature females, and one immature male.

It is in all probability an isolated form but evidently of ancestral connection with *douglasi*.

Specimens examined.—Six skins and seven skulls, from type locality.¹

THOMOMYS NIGER MERRIAM.

BLACK POCKET GOPHER.

(Pl. VIII, fig. 7.)

Thomomys niger Merriam, Proc. Biol. Soc. Washington, XIV, 117, July 19, 1901.

Type.—Collected at Seaton, near mouth of Umpqua River, Douglas County, Oregon, by J. Ellis McLellan, October 6, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Coast region of west-central Oregon (fig. 5).

Characters.—About the size of *douglasi*, to which it shows nearest relationship in its heavy claws and rounded ear; skull heavier, shorter; rostrum depressed; upper incisors curved inward; color black; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—Upperparts uniform glossy black with purple and green iridescence; underparts duller and more plumbeous; feet and distal portion of tail white. *Young*, sooty black.

Skull.—Shorter, wider, and heavier than in *douglasi*, with heavier rostrum; nasals posteriorly sulcate, with the anterior half abruptly widened, and the posterior tips sharply emarginate; interparietal small; bullæ fuller and more rounded than in *douglasi*; pterygoids thick and wide apart. *Dentition* heavier.

Measurements.—Type (♂ ad.): Total length, 225; tail vertebrae, 81; hind foot, 30. Female topotype: 214, 71, 30. *Skull* (of type): Basal length, 33.5, nasals, 14; zygomatic breadth, 22.5; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 8.

Remarks.—This is probably a dichromatic species of which as yet only specimens of the black phase have been secured. The cranial characters place it with *douglasi* in a group of related but not closely connected forms.

Specimens examined.—Total number, 22, as follows:

Oregon: Mapleton, 8; Mercer, 7; Scottsburg (2 miles east), 1 (albino);² Seaton, 6.

Thomomys monticola Group.

THOMOMYS MONTICOLA MONTICOLA ALLEN

CALIFORNIA MOUNTAIN POCKET GOPHER.

(Pl. II, figs. 9, 9'; Pl. VIII, fig. 1.)

Thomomys monticolus Allen, Bul. Am. Mus. Nat. Hist., V, 48, Apr. 28, 1893.

Type.—Collected on Mount Tallac, California, at 7,500 feet altitude, by W. W. Price, August 8, 1892. Type specimen in Am. Mus. Nat. Hist.

¹ Collected June 26, 1897, by J. Alden Loring. Two are half-grown, the others adults.

² Without skull and not certainly identified.

Distribution.—Sierra Nevada of California and Nevada, from Lassen Peak south to Mammoth Pass (fig. 5).

Characters.—Size small; feet and claws very slender; ears large, thin, well formed, and pointed; skull long and slender, with anteriorly converging lateral ridges; colors dull hazel above, buffy below; mamæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Winter pelage:* Upperparts dull hazel with blackish ear patch and plumbeous nose; underparts and feet dull buffy; tail whitish throughout or dusky above at base. *Summer pelage:* Slightly clearer, brighter tawny. *Young,* somewhat paler, more yellowish than adults.

Skull.—Long, slender, and low; rostrum slender, especially in profile, abruptly arched anterior to molars; zygomata very slender; interparietal usually transversely oval, wider than long; nasals long, slender, and slightly emarginate or doubly rounded at posterior tips, reaching near tips of premaxillæ; bullæ very small; lateral pits of palate deep. *Dentition* light; upper incisors abruptly decurved at right angles to axis of skull, not protruding beyond tip of nasals, and distinctly grooved.

Measurements.—Average of 5 adult males from Emerald Bay, near type locality: Total length, 212; tail vertebræ, 70; hind foot, 27.4. Average of 5 adult females: 209, 67, 26.4. *Skull* (of type, from original description): Basilar length, 34; greatest breadth, 22; interorbital breadth, 6; nasals, 14. *Skull* (of topotype, ♂ ad.):¹ Basal length, 32; nasals, 12.5; zygomatic breadth, 20; mastoid breadth, 17; interorbital breadth, 6.2; alveolar length of upper molar series, 7.

Remarks.—While most nearly related to the *fuscus* and *fossor* groups, *monticola* and the other subspecies, *mazama*, *pinetorum*, *nasicus*, and *helleri*, form a well-defined group. The typical subspecies appears to overlap the range of *fisheri* in Sierra Valley and actually to meet the ranges of other surrounding forms. It is mainly a Canadian Zone species, but locally extends into the Hudsonian and to a lesser extent down into the Transition Zone.

Specimens examined.—Total number, 360, as follows:

California: American River (head of South Fork), 2; Aspen Meadows, 2; Big Trees, 3; Bloods, 1; Blue Canyon, 8; Blue Lake, 3; Buck's Ranch, 2; Burney (12 miles west), 1; Calaveras Big Trees, 3; Carberry Ranch, 8; Cisco (Placer County), 25; Clouds Rest (near, meadow above Little Yosemite), 2; Donner, 21; Donner Lake, 3; Echo, 16; Emerald Bay, 24; Fallen Leaf Lake, 9; Gardeners, 1; Gates Creek, 1; Greenville (8 miles west), 2; Hat Creek (head), 1; Heather Lake (Eldorado County), 1; Hermit Valley, 2; Hope Valley, 7; Independence Lake, 18; Independence Lake (pass west of), 1; Lassen Peak (north slope), 9; Lincoln Creek (Sierra County), 1; Little Yosemite, 2; Long Valley (Willow Ranch), 1; McCloud (12 miles northeast), 1; McKinneys, 13; Markleeville, 11; Milford, 4; Mill Creek (Mount Lassen), 2; Mokelumne River (head), 2; Mono Pass, 3; Mount Conness, 4; Mount Dana, 8; Mount Lyell, 1; Mount

¹No. 100274, U. S. Nat. Mus., from Camp Agassiz, on Mount Tallac.

Shasta, 26; Mount Tallac, 36; Mount Unicorn, 3; Pacific Creek, 1; Pine City (or Mammoth), 3; Pine Creek, 1; Pyramid Peak, 1; Robbins Creek (Lassen County), 1; San Joaquin River (head), 1; Sierra Valley, 9; Silver Lake, 8; Slippery Ford, 1; Sonora Pass, 4; Tallac, 1; Tenaya Lake, 2; Tuolumne Meadows, 20; Warner Creek (Mount Lassen), 1; West Walker River, 2.

Nevada: Carson, 1; Glenbrook, 7; Sugar Loaf (Douglas County), 2.

THOMOMYS MONTICOLA MAZAMA MERRIAM.

MAZAMA POCKET GOPHER.

(Pl. VIII, fig. 2.)

Thomomys mazama Merriam, Proc. Biol. Soc. Washington, XI, 214, July 15, 1897.

Type.—Collected at Anna Creek (near Crater Lake), Mount Mazama, Klamath County, Oregon, at 6,000 feet altitude, by Edward A. Preble, September 3, 1896. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Cascade and Siskiyou Mountains, Oreg., south in California to the Trinity Mountains (fig. 5).

Characters.—About the size of *monticola*, but darker and richer colored; ears nearly as large, and bullæ larger and more rounded; rostrum shorter, with less slender nasals; zygomatic arches more abruptly spreading; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Summer pelage*: Upperparts bright russet-brown; ear patch blackish; nose plumbeous; underparts rich buff or ochraceous; feet and tail whitish, tail usually gray above at base. *Winter pelage* unknown. *Young* slightly paler than adults.

Skull.—Not so long and slender as in *monticola*; nasals sharply emarginate posteriorly and more spreading anteriorly; anterior base of zygoma thin and prolonged against premaxilla. *Dentition* slightly heavier than in *monticola*.

Measurements.—Average of 4 topotypes (σ ad.): Total length, 209; tail vertebræ, 66; hind foot, 28. Average of 4 adult females: 202, 66, 28.7. *Skull* (of type, σ ad.): Basal length, 35; nasals, 13; zygomatic breadth, 21; mastoid breadth, 17; interorbital breadth, 6.5; alveolar length of upper molar series, 7.5.

Remarks.—From *monticola* and *pinetorum*, *mazama* is readily distinguished by its shorter, wider, emarginate nasals and larger bullæ; from the *douglasi* group, by smaller size, slenderer skull, lighter dentition, V-shaped instead of U-shaped pterygoids, and deeper lateral pits of palate; from *quadratus*, by larger ears, slenderer skull, and emarginate nasals. It occupies the Canadian Zone and to some extent the Transition also.

Specimens examined.—Total number, 294, as follows:

California: Bear Creek (head of, Trinity County, at 6,400 feet altitude), 62; Beswick (6 miles southwest, 6,000 feet), 1; Castle Lake (Siskiyou County, 5,400 feet), 8; Coffee Creek (north fork, Trinity County, 4,500 feet), 15; Grizzly Creek (Trinity County, 6,000 feet), 2; Jackson Lake (Siskiyou County), 13; Picard (Elgin Ranch), 1; Rush Creek (head of, Siskiyou County,

6,400 feet), 63; Salmon Creek Divide (Siskiyou County), 4; Salmon River (south fork, 5,000 feet), 5; Scott River (6 miles northwest of Callahans), 8; Siskiyou Mountains (6,000–7,000 feet on White Mountain and Craggy Peak and in Studhorse Canyon), 22; Taylor Fork of Salmon River (5,000 feet), 2; Trinity Mountains (west end, 5,700 feet), 5.

Oregon: Anna Creek (Mount Mazama), 3; Ashland Peak, 2; Crater Lake (Mount Mazama), 5; Diamond Lake, 7; Fort Klamath, 13; Grizzly Peak (near Ashland), 1; McKenzie Bridge, 19; Mount Hood (west slope, 6,000 feet), 5; Mount Hood (Summit House at southern base), 5; Prospect, 1; Siskiyou Mountains, 2; Sisters (north base), 3; Three Sisters (town), 17.

THOMOMYS MONTICOLA PINETORUM MERRIAM.

YELLOW PINE POCKET GOPHER.

(Pl. VIII, fig. 3.)

Thomomys monticola pinetorum Merriam, N. Am. Fauna No. 16, 97, Oct. 28, 1899.

Thomomys monticola premaxillaris Grinnell, Univ. of Cal., Pub. Zool., XII, 312, Nov.

21, 1914. Collected on South Yolla Bolly Mountain, at 7,500 feet altitude, by G. Ferris, Aug. 6, 1913. Type specimen in Mus. Vert. Zool., Univ. of California.

Type.—Collected at Sisson, west base of Mount Shasta, California, by R. T. Fisher, September 4, 1898. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Mountains along west side of Sacramento Valley, Cal., from Sisson south to South Yolla Bolly Mountain (fig. 5).

Characters.—Very similar to *monticola*, but upperparts brighter, more golden brown; nose and cheeks conspicuously gray.

Color.—*Summer pelage:* Upperparts yellow-hazel, such as is seen in yellow-pine bark, but never in color keys; ear patch blackish; nose and cheeks conspicuously plumbeous or grayish, often extending back to or beyond ears; underparts buffy; tail and feet gray or whitish. *Winter pelage:* Slightly duller than in summer. *Young,* paler than adults.

Skull.—Similar to that of *monticola*, but with nasals more conspicuously emarginate at posterior tips, and falling 1 to 2 mm. short of tips of premaxillæ; interparietal smaller and more rounded, and lateral ridges more nearly parallel in adults.

Measurements.—Type (♂ ad.): Total length, 210; tail vertebrae, 76; hind foot, 28. Average of 5 topotypes (♀ ad.): 200, 73, 27.6. *Skull* (of type, ♂ ad.): Basal length, 33; nasals, 13; zygomatic breadth, 20; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—In series of specimens from South Yolla Bolly Mountain¹ and from the head of Grindstone Creek, still farther south, the

¹ *Thomomys monticola premaxillaris* Grinnell differs from *pinetorum* in a slight accentuation of the same characters that separate that form from *monticola*. The premaxillæ extend 2 mm. back of the nasals in the type of *pinetorum*, 2½ mm. in the type of *premaxillaris*, while in *monticola* they are approximately even with it. The nasals in *premaxillaris* are decidedly narrower and more deeply emarginate than in *monticola* but very slightly more so than in *pinetorum*. The types of *premaxillaris* and *pinetorum* are indistinguishable in coloration. To recognize *premaxillaris* would seem to me to be splitting one rather poor subspecies in two.

characters of *pinetorum* are slightly accentuated, but not sufficiently for further subdivision. Specimens from Wagon Camp are to some extent intermediate between *pinetorum* and *monticola*, while from higher up Mount Shasta they are typical of *monticola*. Others from half a mile west of Sisson distinctly approach *mazama*. Apparently *pinetorum* is a Transition Zone form extending from Sisson south through the mountains along the west side of the Sacramento Valley.

Specimens examined.—Total number, 54, as follows:

California: Grindstone Creek (head), 5; Sisson, 9; South Yolla Bolly Mountain, 40.

THOMOMYS MONTICOLA NASICUS MERRIAM.

DESCHUTES POCKET GOPHER.

(Pl. VIII, fig. 4.)

Thomomys nasicus Merriam, Proc. Biol. Soc. Washington, XI, 216, July 16, 1897.

Type.—Collected at Farewell Bend, Deschutes River, Crook County, Oregon (west of Prineville), by Edward A. Preble, August 4, 1896. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—West-central Oregon (east of the Cascades), from Farewell Bend, Deschutes River, south to the Yamsey Mountains (fig. 5).

Characters.—Size and proportions of *monticola*; ears large and conspicuous; color slightly lighter and brighter; skull long and narrow, with long spreading nasals.

Color.—*Summer pelage*: Upperparts bright yellowish hazel with plumbeous nose and ear patches; underparts rich buff; feet, most of tail and chin usually whitish. *Winter pelage*: Duller hazel. *Young*, paler and duller colored.

Skull.—Long, with narrow braincase and long rostrum; nasals long and conspicuously widened anteriorly, almost spoon-shaped in some individuals, sharply emarginate at posterior tip; interparietal small and transversely oval; bullæ rather small.

Measurements.—Type (♂ ad.): Total length, 214; tail vertebræ, 69; hind foot, 27. *Skull* (of type): Basal length, 34.7; nasals, 15.4; zygomatic breadth, 21.5; mastoid breadth, 16.8; alveolar length of upper molar series, 7.

Remarks.—The subspecies *nasicus* seems to be a well-marked form of the *monticola* group, with skull characters placing it nearer *monticola* (from which it is widely separated geographically), than to its nearest neighbor, *mazama*, while in color it is very close to *pinetorum*, with which it also agrees in a Transition Zone range. Its relationship can best be shown by placing it as a subspecies of *monticola*.

Specimens examined.—Total number, 49, as follows:

Oregon: Bend, 12; Deschutes River (Farewell Bend), 2; Deschutes River (mouth of Davis Creek), 8; Fort Klamath, 1; Lapine, 12; Little Meadows, 1; Paulina Lake, 6; Pengra, 2; Yamsey Mountains, 9.

THOMOMYS MONTICOLA HELLERI ELLIOT.

HELLER POCKET GOPHER.

Thomomys helleri Elliot, Field Columb. Mus., zool. ser. III, 165, 1903.

Type.—Collected at Goldbeach, mouth of Rogue River, Oregon, by E. Heller, in 1901. No type designated. Type series in Field Mus. Nat. Hist.

Distribution.—Coast region of southwestern Oregon (fig. 5).

Characters.—About the size of *mazama*, but with darker richer coloration and slenderer skull.

Color.—*October pelage*: Upperparts dull chestnut or mars brown; sides and underparts becoming ochraceous; ear patches intense black; nose and face blackish, rarely a trace of white on lips; feet mottled or whitish; tip of tail usually white. *Young* of the year, duller colored.

Skull.—Similar to that of *mazama* but with narrower rostrum and nasals, smaller bullæ, and shorter pterygoids, with wider intervening fossa.

Measurements.—Average of 4 male topotypes: Total length, 203; tail vertebræ, 55; hind foot, 29. Average of 4 female typotypes: 195, 57, 27.2. *Skull* (of topotype ♂ ad.):¹ Basal length, 34; nasals, 14.3; zygomatic breadth, 22; mastoid breadth, 18.6; alveolar length of upper molar series, 7.5.

Remarks.—These gophers are abundant on the flats on both sides of the mouth of Rogue River but are not generally distributed on the coast nor back in the timbered interior. They form a partially isolated colony with their nearest relatives *mazama* on the open mountain ridges of the Coast Ranges and Cascades. Their group relationship is so clearly with *mazama* and *monticola* that it seems best to place them as a subspecies of *monticola*.

Specimens examined.—Total number, 19, as follows:

Oregon: Goldbeach, 11; Wedderburn (north side of river), 8.

Thomomys fuscus Group.

THOMOMYS FUSCUS FUSCUS MERRIAM.

BROWN POCKET GOPHER.

(Pl. VIII, figs. 13, 14; text fig. 4.)

Thomomys clusius fuscus Merriam, N. Am. Fauna No. 5, 69, July, 30, 1891.

Type.—Collected on mountains at head of Big Lost River, Idaho, at about 8,000 feet altitude, by B. H. Dutcher, September 23, 1890. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Southeastern British Columbia, greater part of northern and central Idaho and western Montana, northwestern Wyoming, and parts of eastern Washington and Oregon (fig. 5).

¹ No. 166949, U. S. Nat. Mus.

Characters.—Size rather small; feet slender; ears small and pointed; color light brown; skull slender, with large bullæ; dentition light; mammæ in 4 pairs, inguinal 2-2, pectoral 2-2.

Color.—*Summer pelage*: Upperparts light brownish or dull walnut-brown, not so dark as in *fossor* nor so bright as in *monticola* or *mazama*; ear patch black or blackish; nose plumbeous; underparts buffy; feet and tail soiled whitish or buffy; tail usually gray above at base.

Winter pelage: Slightly duller than summer. *Young*, paler than adults.

Skull.—Light and slender with short rostrum and anteriorly converging lateral ridges; interparietal wide and oval; nasals short and truncate posteriorly, reaching nearly to tips of premaxillæ; bullæ full and rounded; pterygoids long and narrowly V-shaped; skulls of males and females very similar. *Dentition* light; upper incisors abruptly decurved and distinctly grooved.

Measurements.—Average of 3 topotypes (♂ ad): Total length, 203; tail vertebræ, 70; hind foot, 27. Average of 5 adult females: 205, 70, 27. *Skull* (of type, ♀ ad.): Basal length, 33; nasals, 12.4; zygomatic breadth, 20; mastoid breadth, 17; interorbital breadth, 6; alveolar length of upper molar series, 7.

Remarks.—This form is fairly typical in central Idaho, western Montana, and in the Blue Mountain region of Oregon. In northern Idaho, eastern Washington, and southern British Columbia it becomes noticeably darker, but retains more nearly the skull characters of *fuscus*. West of the Columbia River it varies greatly with almost every locality, but these local forms can be placed under *fuscus* better than with *quadratus* or *myops*, both of which they suggest.

Specimens examined.—Total number, 373, as follows:

British Columbia: Ashcroft, 1; Cascade, 6; Ducks, 5; Glacier, 1; Kamloops, 2; Midway, 6; Monashee Ridge (Gold Range, at 4,000 feet altitude, 5; at 3,620 feet, 4), 9; Myers Creek, 1; Nelson, 9; Okanogan, 10; Pend Oreille River, 11; Salmon River, 2; Shuswap, 20; Skagit Valley, 1; Trail, 1; Wards Ferry, 1.

Idaho: Ashton, 2; Big Lost River (head), 2; Blackfoot (west of river), 1; Blue Lake, 12; Cœur d'Alene, 4; Freedom (near mouth of South Fork Salmon River), 1; Hoodoo Valley, 1; Lemhi Indian Agency, 2; Lerdo, 1; Lost River Mountains, 5; Midvale, 7; Mission, 1; Mount Carlton, 3; New Meadows, 3; Salmon River Mountains, 11; Sawtooth Lake, 3; Seven Devils Mountains, 2; South Fork Ranch, 1; Teton Canyon, 1; Van Wyck, 1.

Montana: Beartooth Mountains, 3; Benton (west of), 1; Corvallis, 2; Flathead Lake, 4; Fort Ellis, 2; Little Bitterroot Creek, 1; Lo Lo, 1; Midvale, 2; Ross Fork, 1; St. Marys Lake, 3; Stevensville, 2; Summit (west of Blackfoot Station), 6; Thompson Falls, 8; Tobacco Plains, 10.

Oregon: Antelope, 2; Anthony, 14; Bingham Prairie, 1; Blue Mountains (10 miles north of Harney), 1; Elgin, 1; Huntington, 1; Wallowa Mountains, 8.

- Washington:** Blue Creek (13 miles east of Walla Walla), 3; Chelan, 2; Cheney, 1; Colfax, 1; Columbia County (25 miles southeast of Dayton and Humpege Falls), 2; Colville, 6; Davenport, 1; Douglas, 2; Easton, 9; Fort Spokane, 1; Garfield, 1; Loon Lake, 2; Mabton, 3; Marcus, 5; Marshall, 11; Natches River, 1; North Yakima, 22; Orondo, 1; Pullman, 11; Rock Lake, 2; Spokane Bridge, 3; Spokane Falls, 15; Waterville, 1; Wenatchee, 8.
- Wyoming:** Black Mountains, 4; Moran, 4; Pahaska, 4; Pahaska Tepee, 12; Teton Mountains, 6; Teton Pass, 4; Yellowstone Lake, 1.

THOMOMYS FUSCUS SATURATUS BAILEY.

CŒUR D'ALENE POCKET GOPHER.

(Pl. VIII, fig. 16.)

Thomomys fuscus saturatus Bailey, Proc. Biol. Soc. Washington, XXVII, 117, July 10, 1914.

Type.—Collected at Silver (near Saltese) in the western corner of Missoula County, Montana, at 4,300 feet altitude, in the Cœur d'Alene Mountains, by Clark P. Streator, June 20, 1891. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Higher parts of the Cœur d'Alene Mountains in Idaho and Montana (fig. 5).

Characters.—Considerably larger than *fuscus*, with darker, richer coloration and less tendency to white markings below; skull long and high, with relatively narrower braincase and wider nasals.

Color.—*Summer pelage*: Upperparts dark rich hazel, becoming yellowish on sides, and this shading into a buffy wash on underparts; ear patches black; nose plumbeous; feet and tail buffy gray; rarely a trace of white on chin or throat. Only June and August specimens seen. The young are a shade paler than adults.

Skull.—Long and narrow with high, truncate occiput; lateral ridges prominent and nearly parallel; nasals widened anteriorly and emarginate posteriorly; premaxillæ very narrow posteriorly; bullæ wide and flattened; basioccipital relatively wide between bullæ.

Measurements.—Type (σ ad.): Total length, 225; tail vertebrae, 77; hind foot, 30. Average of 3 adult males: 216, 72, 29. Average of 5 females: 211, 75, 28.7. *Skull* (of type): Basal length, 33.2; nasals, 13.7; zygomatic breadth, 21.4; mastoid breadth, 17; alveolar length of upper molar series, 7.

Remarks.—This seems to be a well-marked but rather local form of the *fuscus* group occupying the higher hemlock-covered part of the Cœur d'Alene Mountains. Specimens from Prospect Creek, lower down on the east slope, show intermediate characters approaching *fuscus* while others from Thompson Falls, at the east base of the mountains are almost typical of *fuscus*.

Specimens examined.—Total number, 26, as follows:

Idaho: Mullan, 3.

Montana: Prospect Creek, 6; Silver, 16; Thompson Pass, 1.

THOMOMYS FUSCUS LORINGI BAILEY.

ALBERTA POCKET GOPHER.

(PL. VIII, fig. 9.)

Thomomys fuscus loringi Bailey, Proc. Biol. Soc. Washington, XXVII, 118, July 10, 1914.

Type.—Collected at South Edmonton, Alberta (exact locality not given), by J. Alden Loring, September 23, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from Edmonton and Moose Mountain, Alberta (fig. 5).

Characters.—Similar to *fuscus*, but slightly larger and duller colored, with relatively heavier dentition, and small, circular interparietal; ears small and pointed.

Color.—*Winter pelage* (September 23): Upperparts dull russet-brown, becoming rich buff on sides; nose slaty gray; small ear patch black; underparts rich buffy over plumbeous; chin and small spot on breast white; feet soiled whitish; tail pale buffy. *Summer pelage* (in two July 2 specimens from Moose Mountains): Similar but slightly brighter russet.

Skull.—Long and slender, with narrow braincase and small, nearly quadrate zygomatic arches, and almost circular interparietal; incisors less abruptly decurved than in *fuscus*; molars heavier; bullæ about the same; basioccipital somewhat triangular; nasals narrow and truncate at posterior tips.

Measurements.—Type (♂ ad.): Total length, 199; tail vertebræ, 47; hind foot, 26.5. *Skull* (of type): Basal length, 34; nasals, 12.8; zygomatic breadth, 20.5; mastoid breadth, 18; interorbital breadth, 6; alveolar length of upper molar series, 8.

Remarks.—Although represented by only one specimen from the type locality, which is well out on the plains, this is evidently a form of the mountain species *fuscus* from farther south and west. Two skins in the Victoria Memorial Museum from Moose Mountain are apparently the same, while specimens from St. Marys Lake, Glacier Park, Mont., show a slight tendency toward the characters represented by this form, but are much nearer typical *fuscus*. Specimens from Shuswap, British Columbia, much farther west, show none of the characters of this form. There are no specimens of gophers available from the mountains of western Alberta, between Moose Mountain and the Montana line, but in this strip of country no collections have been made, and probably gophers occur along the eastern slope of the mountains from the United States boundary north to the Edmonton region.

Loring collected specimens of *talpoides* about Edmonton, but these large, dark-colored, large-footed gophers are quite distinct from the

present little brown form. There were no notes to indicate whether the two species occupy the same or separate areas.

In the type specimen the upper molars are abnormally close together at the anterior base, but this is probably not characteristic of the species. Unfortunately there are no skulls for the Moose Mountain specimens, but the skins match the type in color. They are both breeding females collected July 2 by W. Spreadborough and are particularly interesting in showing fully developed sets of 12 mammæ each; inguinal 2-2, abdominal 2-2, pectoral 2-2. This is the formula for the *talpoides* and not for the *fuscus* group. The status of the form is at present very uncertain and will be until more collecting is done in the type region.

Specimens examined.—Total number, 3, as follows:

Alberta: South Edmonton, 1; Moose Mountain, 2 (skins only).

THOMOMYS FUSCUS MYOPS MERRIAM

LITTLE-HEADED POCKET GOPHER.

(Pl. VIII, fig. 15.)

Thomomys myops Merriam, Proc. Biol. Soc. Washington, XIV, 112, July 19, 1901.

Type.—Collected at Conconully, Okanogan County, Washington, by J. Alden Loring, September 11, 1897. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Known only from type locality (fig. 5).

Characters.—Size smaller than *fuscus* but with very similar coloration and the same minute ears; skull small; tips of premaxillæ even with posterior tips of nasals.

Color.—*September pelage*: Upperparts light brownish or dull walnut-brown; ear patch blackish; nose plumbeous; underparts and base of tail buffy; feet and tip of tail whitish; chin usually white. *Young*, paler, more grayish.

Skull.—Small, but of about the form and proportions of that of *fuscus*; nasals and premaxillæ terminating posteriorly on an approximately even line; interparietal transversely elongated; bullæ small; anterior shaft of basioccipital relatively wide; pterygoids wide apart, with edges flattened at base.

Measurements.—Average of 2 topotypes (♂ ad.): Total length, 182; tail vertebrae, 57; hind foot, 25. Average of 5 females: 186, 59, 24.4. *Skull* (of type, ♀ ad.): Basal length, 31.8; nasals, 12.5; zygomatic breadth, 20; mastoid breadth, 17.5; alveolar length of upper molar series, 7.5.

Remarks.—Specimens from the type locality, Conconully, on Conconully Creek, a western affluent of the Okanogan River, are very uniform in characters and so peculiar that they were originally described with full specific rank. They evidently belong to the *fuscus* group,

however, which shows great variation in that general region, and probably mark only a local valley form partly cut off from the general range of the species.

Specimens examined.—Seven, from type locality.

THOMOMYS HESPERUS MERRIAM.

WEST COAST POCKET GOPHER.

(Pl. VIII, fig. 10.)

Thomomys hesperus Merriam, Proc. Biol. Soc. Washington, XIV, 116, July 19, 1901.

Type.—Collected at Tillamook, Tillamook County, Oregon, by J. Ellis McLellan, November 9, 1894. Type specimen in U. S. Nat. Mus., Biological Survey collection.

Distribution.—Coast region of northwestern Oregon (fig. 5).

Characters.—Size very small, with the small, pointed ears of the *fuscus* group; color dark rich auburn; skull small, short, and rounded.

Color.—Upperparts bright rich auburn, brighter than in *helleri* or *melanops*, darker and richer than in *mazama*; nose and cheeks dusky; large ear patch black; underparts lighter, more ochraceous; lining of cheek pouches white; feet and tip of tail whitish.

Skull.—Short; braincase rather wide; rostrum short and wide; posterior tip of nasals emarginate; bullæ very small, short, and rounded; basioccipital short and wide; pterygoids low and wide apart; molars very small but apparently of about the same proportions as those of *fuscus*.

Measurements.—Type (♀ ad.): Total length, 175; tail vertebræ, 54; hind foot, 24. Old male from Chintimini Mountains: 210, 60, 27. *Skull* (of type): Basal length, 27.3; nasals, 10.7; zygomatic breadth, 18; mastoid breadth, 15; interorbital breadth, 6; alveolar length of upper molar series, 6. Skull of old male from Chintimini Mountains: 30, 12.4, 20, 16.5, 6, 7.

Remarks.—This is evidently a little, dark form of the *fuscus* group, which seems to be isolated below the mouth of the Columbia River. In color it strongly resembles *melanops* of the Olympic Mountains and *helleri* from farther south, but the tiny ears and general skull characters seem to place it in the *fuscus* group. Until a good series of specimens of adult males is obtained its true position can not be fully determined. An old male from the top of Chintimini Mountains (near Corvallis) seems to be the same, but may not be wholly typical.

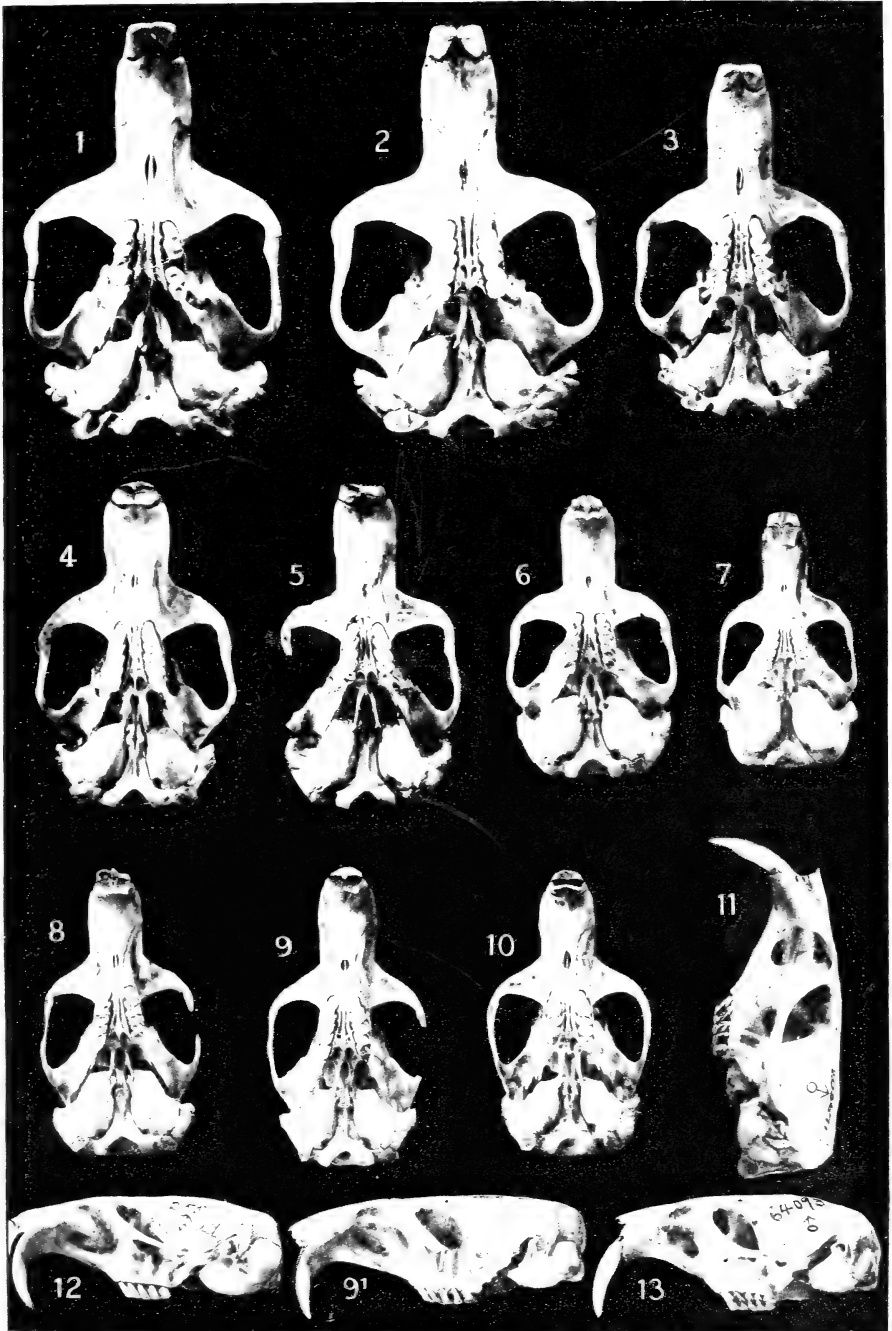
Specimens examined.—Total number, 6, as follows:

Oregon: Chintimini Mountains (at 4,000 feet altitude), 1 old male; Tillamook, 5 (no adult males).

PLATE II.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

- FIG. 1. *Thomomys bulbivorus*, ♂, Beaverton, Oreg. (No. 57337.)
2. *Thomomys townsendi townsendi*, ♂, Nampa, Idaho. (No. 181196.)
3. *Thomomys bottæ bottæ*, ♂, Point Reyes, Cal. (No. 134989.)
4. *Thomomys perpallidus aureus*, ♂, topotype, Bluff, Utah. (No. 57166.)
5. *Thomomys talpoides rufescens*, ♂, near Ft. Clark, N. Dak. (No. 161381.)
6. *Thomomys talpoides clusius*, ♂, topotype, Bridger Pass, Wyo. (No. 25534.)
7. *Thomomys idahoensis*, ♂, type, Birch Creek, Idaho. (No. 30900.)
8. *Thomomys fossor*, ♂, Lake City, Colo. (No. 48190.)
9. *Thomomys monticola monticola*, ♂, topotype, Tallac, Cal. (No. 100660.)
Dorsal and lateral view.
10. *Thomomys douglasi douglasi*, ♂, topotype, Vancouver, Wash. (No. 65928.)
11. *Thomomys bottæ leucodon*, ♂, Ashland, Oreg. (No. 203671.) Lateral view.
12. *Thomomys ocius*, ♂, type, Fort Bridger, Wyo. (No. 25586.)
13. *Thomomys umbrinus umbrinus*, ♂, Boca del Monte, Vera Cruz. (No. 64093.)



SKULLS OF THOMOMYS.

B2035-122

1. *T. bulbivorus*.
2. *T. t. townsendi*.
3. *T. b. bottæ*.
4. *T. p. aureus*.

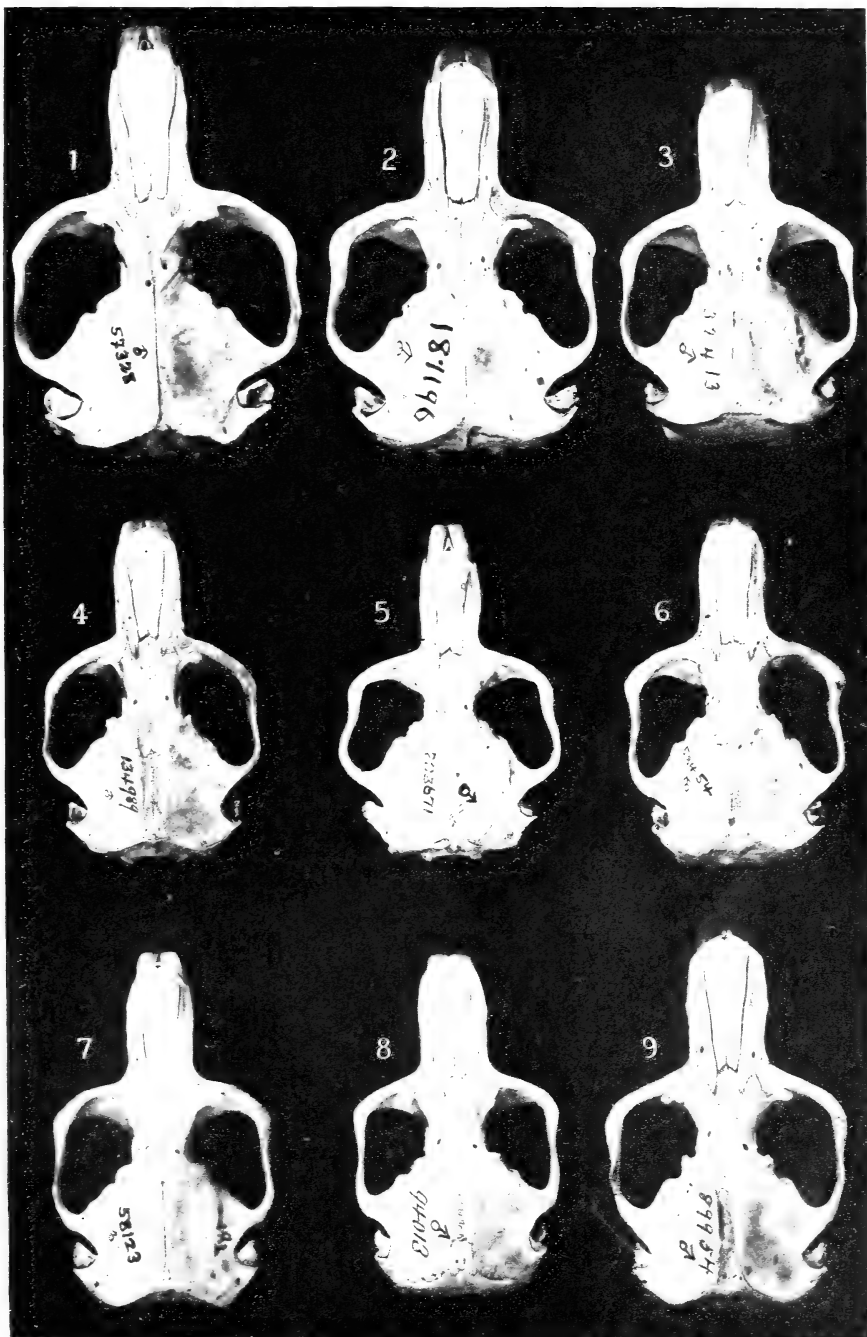
5. *T. t. rufescens*.
6. *T. t. clusius*.
7. *T. idahoensis*.
8. *T. fossor*.
- 9 and 9'. *T. m. monticola*.

10. *T. d. douglasi*.
11. *T. b. leucodon*.
12. *T. oculus*.
13. *T. u. umbrinus*.

PLATE III.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

- FIG. 1. *Thomomys bulbivorus*. ♂, Salem, Oreg. (No. 57328.)
2. *Thomomys townsendi townsendi*. ♂, type, Nampa, Idaho. (No. 181196.)
3. *Thomomys townsendi nevadensis*, ♂, type, Austin, Nev. (No. 32413.)
4. *Thomomys bottæ bottæ*, ♂, Point Reyes, Cal. (No. 134989.)
5. *Thomomys bottæ leucodon*, ♂, Ashland, Oreg. (No. 203671.)
6. *Thomomys bottæ laticeps*, ♂, topotype, Arcata, Cal. (No. 58454.)
7. *Thomomys bottæ angularis*, ♂, type, Los Banos, Cal. (No. 58123.)
8. *Thomomys bottæ pallescens*, ♂, topotype, Grapeland, Cal. (No. 94013.)
9. *Thomomys altivallis*, ♂, topotype, San Bernardino Mountains, Cal. (No. 89954.)



SKULLS OF THOMOMYS.

B2036-122

- 1. *T. bulbivorus*.
- 2. *T. t. townsendi*.
- 3. *T. t. nevadensis*

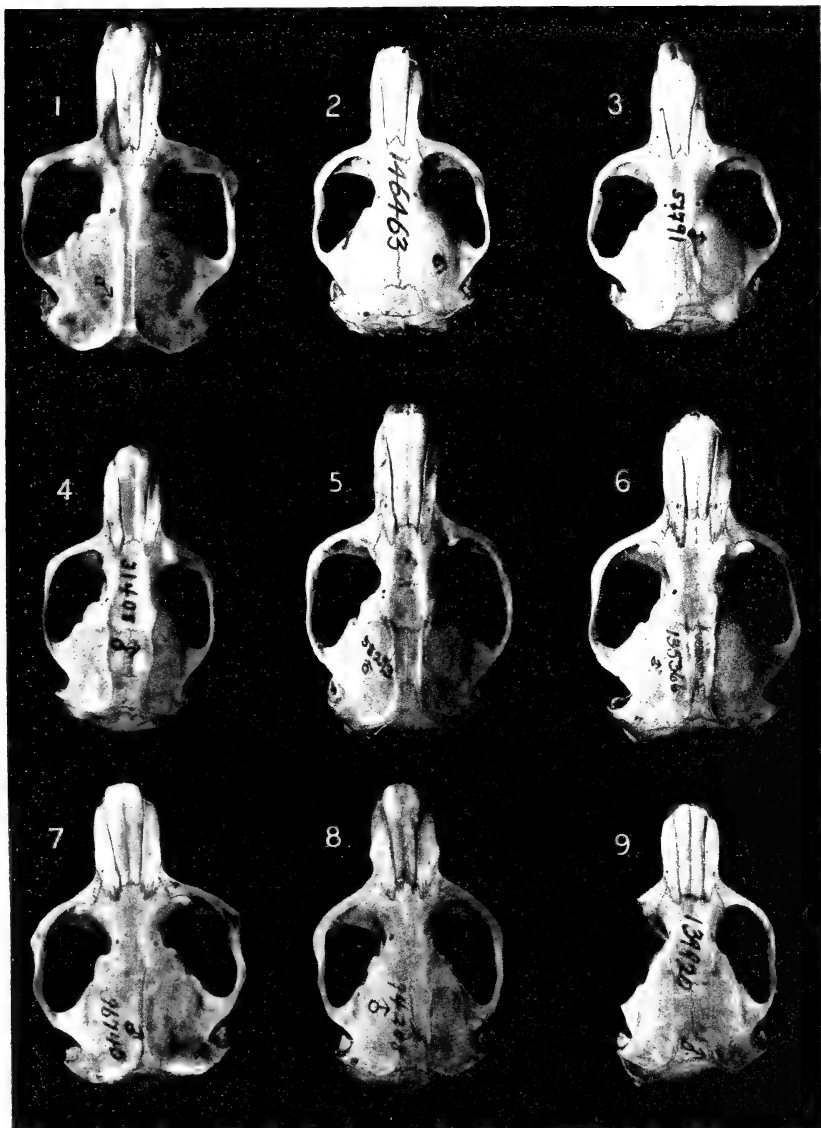
- 4. *T. b. botta*.
- 5. *T. b. leucodon*.
- 6. *T. b. laticeps*.

- 7. *T. b. angularis*.
- 8. *T. b. pallescens*.
- 9. *T. altrivallis*.

PLATE IV.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

- FIG. 1. *Thomomys bottæ pascalis*, ♂, type, Fresno, Cal. (No. 44702.)
2. *Thomomys bottæ minor*, ♂, type, Fort Bragg, Cal. (No. 146463.)
3. *Thomomys bottæ navus*, ♂, type, Red Bluff, Cal. (No. 57791.)
4. *Thomomys fulvus texensis*, ♂, type, Davis Mountains, Tex. (No. 31408.)
5. *Thomomys fulvus pervagus*, ♂, type, Espanola, N. Mex. (No. 58293.)
6. *Thomomys perpallidus apache*, ♂, type, La Jara Lake, N. Mex. (No. 135366.)
7. *Thomomys sinaloæ*, ♂, type, Altata, Sinaloa. (No. 96745.)
8. *Thomomys bottæ alticolus*, ♂, topotype, Victoria Mountains, Lower California.
(No. 74208.)
9. *Thomomys bottæ russeolus*, ♂, type, San Angel, Lower California. (No. 139920.)



B2037-122

SKULLS OF THOMOMYS.

1. *T. b. pascalis*.
2. *T. b. minor*.
3. *T. b. navus*.

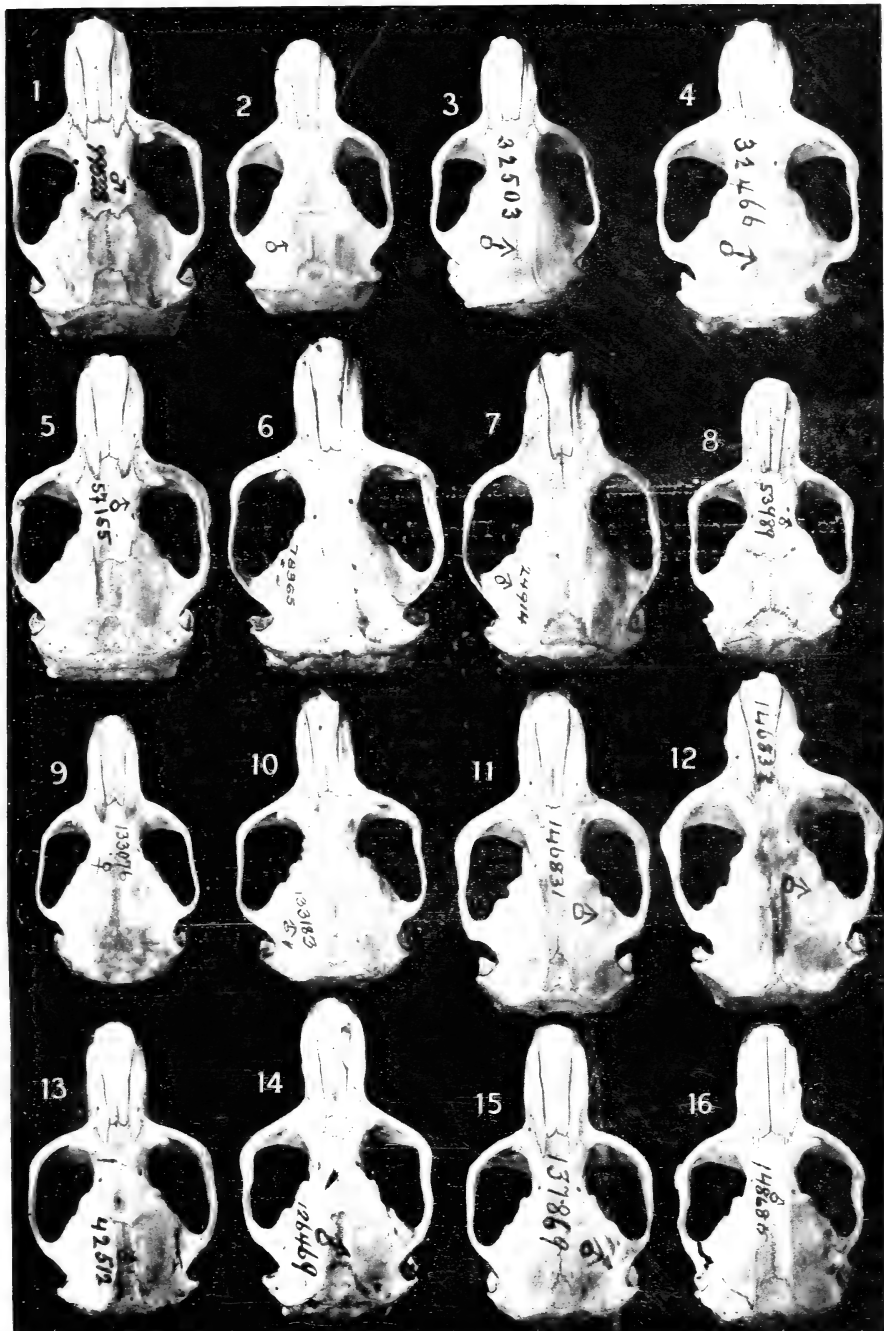
4. *T. f. texensis*.
5. *T. f. pervagus*.
6. *T. p. apache*.

7. *T. sinaloae*.
8. *T. b. alticolus*.
9. *T. b. russeolus*.

PLATE V.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection, except fig. 2.]

- FIG. 1. *Thomomys perpallidus albatrus*, ♂, topotype, Fort Yuma, Cal. (No. 99528.)
2. *Thomomys perpallidus perpallidus*, ♂, topotype, Palm Springs, Cal. (No. 4, collection of Dr. William Bebb.)
3. *Thomomys perpallidus perpes*, ♂, type, Lone Pine, Cal. (No. 32503.)
4. *Thomomys operarius*, ♂, type, Keeler, Cal. (No. 32466.)
5. *Thomomys perpallidus aureus*, ♂, topotype, Bluff, Utah. (No. 57155.)
6. *Thomomys perpallidus canus*, ♂, type, Deep Hole, Nev. (No. 78365.)
7. *Thomomys latirostris*, ♂, type, Painted Desert, Ariz. (No. 24914.)
8. *Thomomys cabezonæ*, ♂, type, Cabezon, Cal. (No. 53989.)
9. *Thomomys alpinus awahnee*, ♀, type, Yosemite Valley, Cal. (No. 133076.)
10. *Thomomys bottæ mewa*, ♂, type, Raymond, Cal. (No. 133183.)
11. *Thomomys bottæ anitæ*, ♂, topotype, Santa Anita, Lower California. (No. 146831.)
12. *Thomomys magdalenæ*, ♂, type, Magdalena Island, Lower California. (No. 146832.)
13. *Thomomys alpinus alpinus*, ♂, type, Mount Whitney, Cal. (No. 42512.)
14. *Thomomys jacinteus*, ♂, San Jacinto Mountains (Tahquitz Valley), Cal. (No. 126469.)
15. *Thomomys neglectus*, ♂, type, San Antonio Mountains, Cal. (No. 137869.)
16. *Thomomys bottæ nigricans*, ♂, topotype, Witch Creek, Cal. (No. 148685.)



SKULLS OF THOMOMYS.

B2038-122

1. *T. p. albatus*.
2. *T. p. perpallidus*.
3. *T. p. perpes*.
4. *T. p. operarius*.
5. *T. p. aureus*.

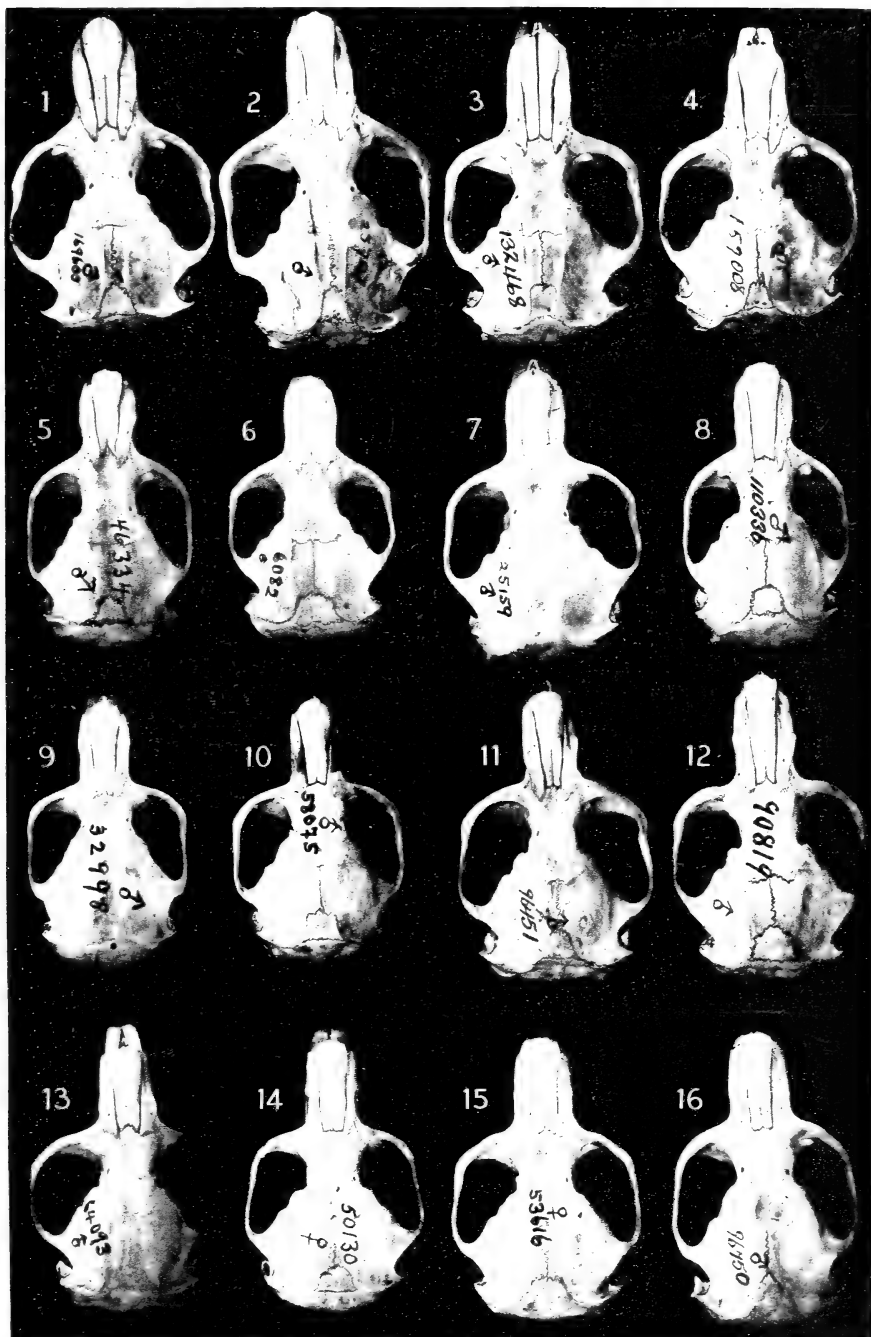
6. *T. p. canus*.
7. *T. latirostris*.
8. *T. cabezonæ*.
9. *T. a. awahnee*.
10. *T. b. mewa*.
11. *T. b. anitæ*.

12. *T. magdaleneæ*.
13. *T. a. alpinus*.
14. *T. jacintus*.
15. *T. neglectus*.
16. *T. b. nigricans*.

PLATE VI.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

- FIG. 1. *Thomomys fulvus fulvus*, ♂, Flagstaff, Ariz. (No. 169603.)
2. *Thomomys cervinus*, ♂, topotype, Phoenix, Ariz. (No. 23707.)
3. *Thomomys fulvus toltecus*, ♂, typical, Colonia Diaz, Chihuahua. (No. 132468.)
4. *Thomomys mearnsi*, ♂, type, Animas Valley, N. Mex. (No. 157008.)
5. *Thomomys fulvus intermedius*, ♂, Fort Huachuca, Ariz. (No. 46334.)
6. *Thomomys fulvus desertorum*, ♂, type, Mud Spring, Ariz. (No. 6082.)
7. *Thomomys baileyi*, ♂, type, Sierra Blanca, Tex. (No. 25159.)
8. *Thomomys lachuguilla*, ♂, type, El Paso, Tex. (No. 110336.)
9. *Thomomys perditus*, ♂, type, Lampazos, Nuevo Leon. (No. 32998.)
10. *Thomomys goldmani*, ♂, type, Mapimi, Durango. (No. 58075.)
11. *Thomomys nelsoni*, ♂, type, Parral, Chihuahua. (No. 96451.)
12. *Thomomys sheldoni*, ♂, type, Santa Teresa, Tepic. (No. 90819.)
13. *Thomomys umbrinus umbrinus*, ♂, Boca Del Monte, Vera Cruz. (No. 64093.)
14. *Thomomys umbrinus peregrinus*, ♀, type, Salazar, Mexico. (No. 50130.)
15. *Thomomys umbrinus orizabæ*, ♀, type, Mount Orizaba, Puebla. (No. 53616.)
16. *Thomomys atrovarius*, ♂, typical, Mazatlan, Sinaloa. (No. 96750.)



SKULLS OF THOMOMYS.

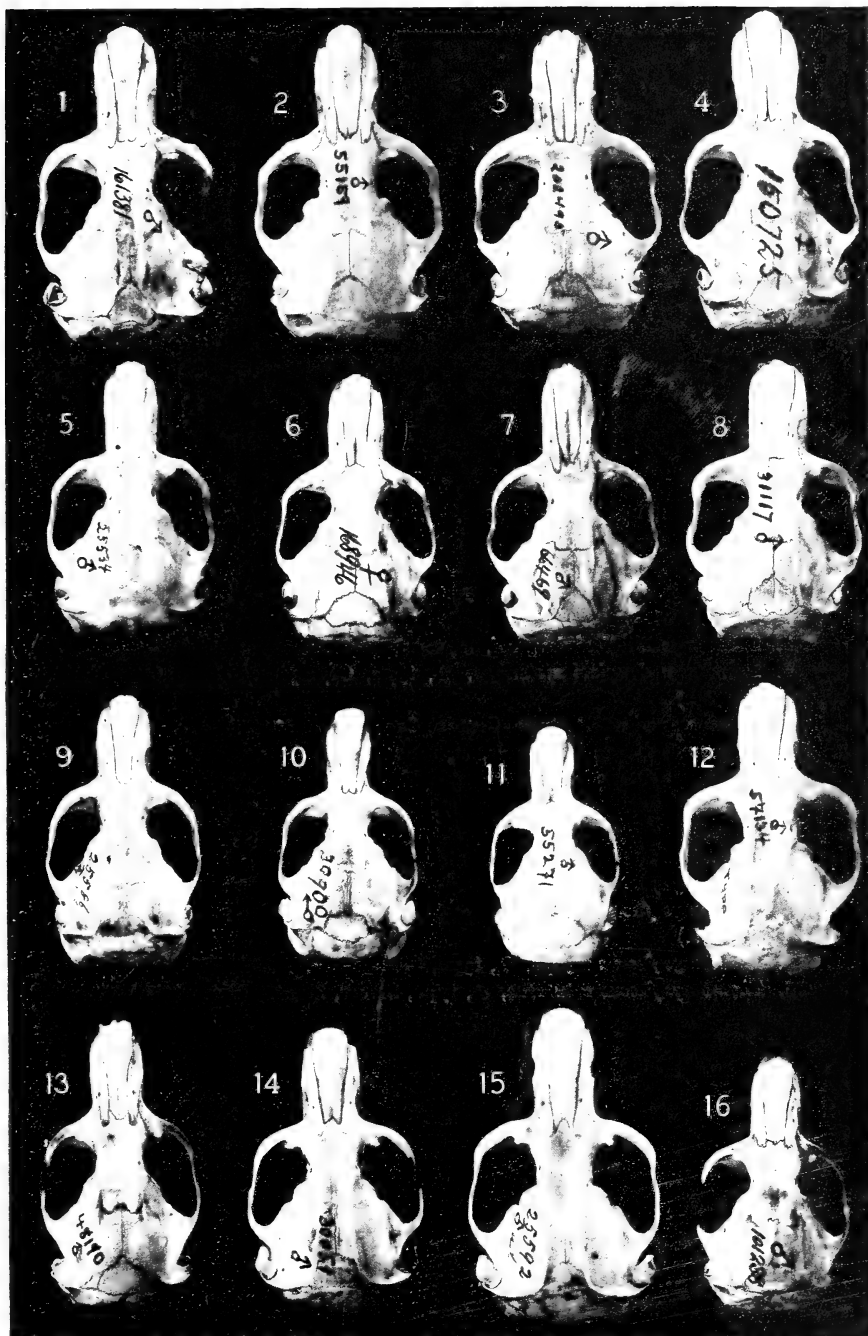
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- | | | |
|------------------------------|-----------------------------|------------------------------|
| 1. <i>T. f. fulvus.</i> | 6. <i>T. f. desertorum.</i> | 12. <i>T. sheldoni.</i> |
| 2. <i>T. cervinus.</i> | 7. <i>T. baileyi.</i> | 13. <i>T. u. umbrinus.</i> |
| 3. <i>T. f. toltecus.</i> | 8. <i>T. lachuguilla.</i> | 14. <i>T. u. peregrinus.</i> |
| 4. <i>T. mearnsi.</i> | 9. <i>T. perditus.</i> | 15. <i>T. u. orizabae.</i> |
| 5. <i>T. f. intermedius.</i> | 10. <i>T. goldmani.</i> | 16. <i>T. atrovarius.</i> |
| | 11. <i>T. nelsoni.</i> | |

PLATE VII.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

- FIG. 1. *Thomomys talpoides rufescens*, ♂, near Fort Clark, N. Dak. (No. 161381.)
2. *Thomomys talpoides bullatus*, ♂, type, Powderville, Mont. (No. 55159.)
3. *Thomomys talpoides nebulosus*, ♂, type, Sand Creek Canyon, Wyo. (No. 202495.)
4. *Thomomys talpoides agrestis*, ♀, type, Medano Ranch, Colo. (No. 150725.)
5. *Thomomys talpoides clusius*, ♂, topotype, Bridgers Pass, Wyo. (No. 25534.)
6. *Thomomys talpoides caryi*, ♀, type, Bighorn Mountains, Wyo. (No. 168946.)
7. *Thomomys talpoides pryor*, ♂, type, Pryor Mountains, Mont. (No. 66469.)
8. *Thomomys quadratus quadratus*, ♂, type, The Dalles, Oreg. (No. 31117.)
9. *Thomomys ocius*, ♂, type, Fort Bridger, Wyo. (No. 25586.)
10. *Thomomys idahoensis*, ♂, type, Birch Creek, Idaho. (No. 30900.)
11. *Thomomys pygmaeus*, ♂, type, Montpelier Creek, Idaho. (No. 55271.)
12. *Thomomys columbianus*, ♂, type, Touchet, Wash. (No. 57134.)
13. *Thomomys fessor*, ♂, Lake City, Colo. (No. 48190.)
14. *Thomomys uinta*, ♂, type, Uinta Mountains, Utah. (No. 30051.)
15. *Thomomys bridgeri*, ♂, type, Fort Bridger, Wyo. (No. 25592.)
16. *Thomomys quadratus fisheri*, ♂, type, Sierra Valley, Cal. (No. 101238.)



SKULLS OF THOMOMYS.

B2040-122

1. *T. t. rufescens*.
2. *T. t. bullatus*.
3. *T. t. nebulosus*.
4. *T. t. agrestis*.
5. *T. t. clusius*.

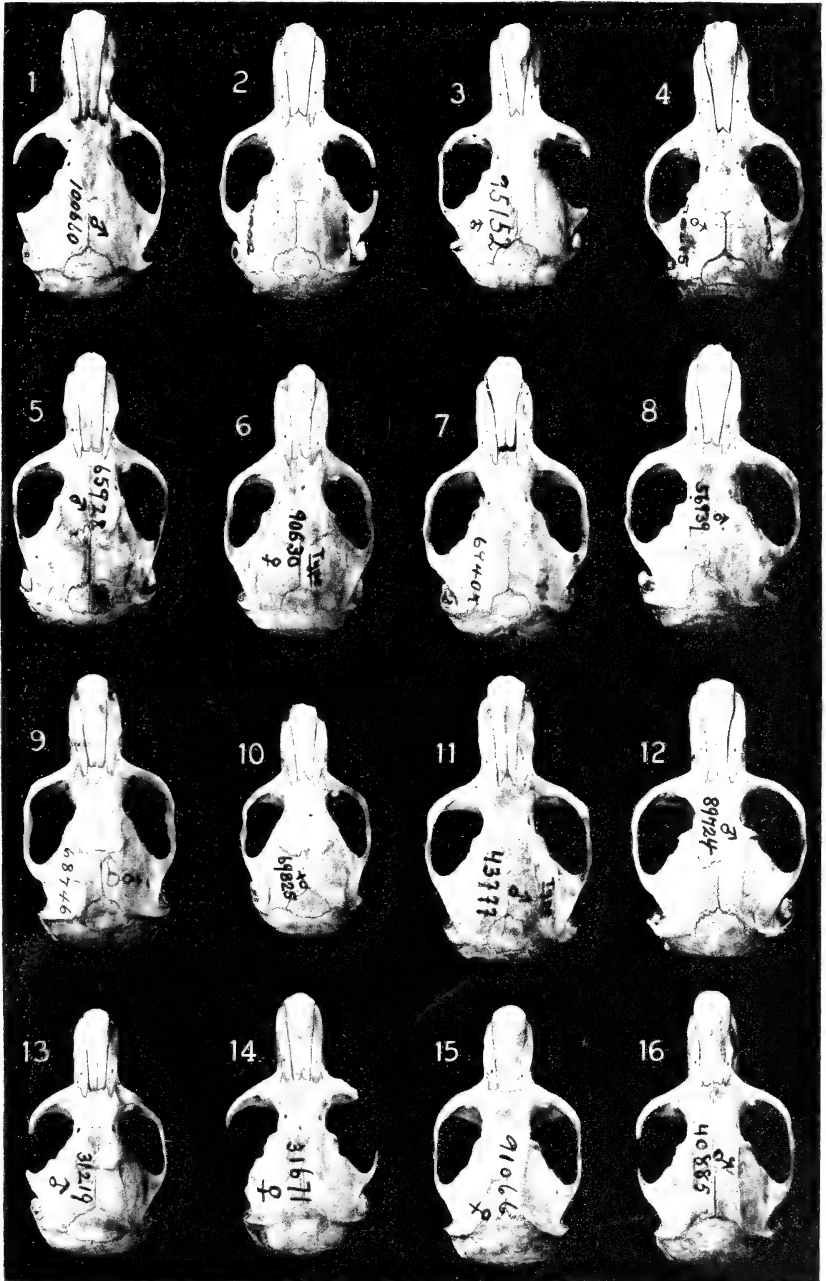
6. *T. t. caryi*.
7. *T. t. pryori*.
8. *T. q. quadratus*.
9. *T. ocius*.
10. *T. idahoensis*.
11. *T. pygmaeus*.

12. *T. columbianus*.
13. *T. fossor*.
15. *T. uinta*.
15. *T. bridgeri*.
16. *T. q. fisheri*.

PLATE VIII.

[Natural size; all from U. S. Nat. Mus., Biological Survey collection.]

- FIG. 1. *Thomomys monticola monticola*, ♂, topotype, Tallac, Cal. (No. 100660.)
2. *Thomomys monticola mazama*, ♂, type, Anna Creek, Oreg. (No. 80502.)
3. *Thomomys monticola pinetorum*, ♂, type, Sisson, Cal. (No. 95152.)
4. *Thomomys monticola nasicus*, ♂, type, Farewell Bend, Deschutes River, Oreg. (No. 79815.)
5. *Thomomys douglasi douglasi*, ♂, topotype, Vancouver, Wash. (No. 65928.)
6. *Thomomys douglasi melanops*, ♀, type, Olympic Mountains, Wash. (No. 90630.)
7. *Thomomys niger*, ♂, type, Seaton, Oreg. (No. 69407.)
8. *Thomomys douglasi oregonus*, ♂, type, Oregon City, Oreg. (No. 56939.)
9. *Thomomys fuscus loringi*, ♂, type, Edmonton, Alberta. (No. 68746.)
10. *Thomomys hesperus*, immature ♀, type, Tillamook, Oreg. (No. 69825.)
11. *Thomomys douglasi yelmensis*, ♂, type, Tenino, Wash. (No. 43777.)
12. *Thomomys limosus*, ♂, type, White Salmon, Wash. (No. 89724.)
13. *Thomomys fuscus fuscus*, ♂, Lemhi, Idaho. (No. 31219.)
14. *Thomomys fuscus fuscus*, ♀, type, head of Big Lost River, Idaho. (No. 31671.)
15. *Thomomys fuscus myops*, ♀, type, Conconully, Wash. (No. 91066.)
16. *Thomomys fuscus saturatus*, ♂, type, Silver, Mont. (No. 40885.)



SKULLS OF THOMOMYS.

B2041-122

1. *T. m. monticola*.
2. *T. m. mazama*.
3. *T. m. pinetorum*.
4. *T. m. nasiscus*.
5. *T. d. douglasi*.

6. *T. d. melanops*.
7. *T. niger*.
8. *T. d. oregonus*.
9. *T. f. loringi*.
10. *T. hesperus*.
11. *T. d. yelmensis*.

12. *T. limosus*.
13. *T. f. fuscus*, ♂.
14. *T. f. fuscus*, ♀.
15. *T. f. myops*.
16. *T. f. saturatus*.

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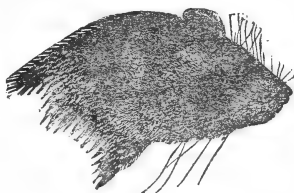
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BUREAU OF BIOLOGICAL SURVEY

HENRY W. HENSHAW, *Chief*

NORTH AMERICAN FAUNA

No. 40

[Actual date of publication, June 20, 1916]



A SYSTEMATIC ACCOUNT OF THE PRAIRIE-DOGS

BY

N. HOLLISTER

ASSISTANT CURATOR OF MAMMALS, UNITED STATES
NATIONAL MUSEUM



WASHINGTON
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., November 16, 1915.

SIR: I have the honor to transmit herewith for publication as North American Fauna No. 40, a systematic account of the prairie-dogs of North America, by Mr. N. Hollister, Assistant Curator of Mammals, of the United States National Museum. This review of the group is based largely upon material in the collection of the Biological Survey. Prairie-dogs are distributed over a large part of the Great Plains and Rocky Mountain regions. Their colonies often number thousands of individuals, and their destruction of grasses and other forage plants makes them of considerable economic importance. Drastic measures are frequently necessary to prevent their destroying crops of grain and hay. The Biological Survey is engaged in exterminating these rodents in national forests and on the public domain. The definite information in this report in regard to the several species and their distribution, as indicated by maps, will materially aid in efforts, National or State, to control or exterminate them.

Respectfully,

HENRY W. HENSHAW,
Chief, Biological Survey.

Hon. DAVID F. HOUSTON,
Secretary of Agriculture.

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A SYSTEMATIC ACCOUNT OF THE PRAIRIE-DOGS.

By N. HOLLISTER.

INTRODUCTION

The prairie-dog is a true ground squirrel, or spermophile, and its common designation "dog" is most unfortunate from the standpoint of exact science. The name is now so generally used, however, that any attempt to substitute one more appropriate would be futile. The animals may be conveniently divided into two general classes—the black-tailed prairie-dogs (subgenus *Cynomys*, three forms of two species) and the white-tailed prairie-dogs (subgenus *Leucocrossuromys*, four forms of three species).

DISTRIBUTION, HABITS, AND ECONOMIC RELATIONS.

Early explorers of the Western States were much impressed by the peculiar habits of the prairie-dog, one of the most abundant and conspicuous mammals over much of what was then "Louisiana" and the region of the upper Missouri River. Their journals and narratives contain numerous references to this spermophile under such names as prairie-dog, petit chien, wishtonwish, barking squirrel, and prairie squirrel, together with long accounts of the "dog-towns" and the social habits and notes of alarm of the animals. As usual in the case of a new and interesting animal, these accounts are partly true and partly erroneous, having been drawn from actual observation supplemented by stories of travelers, settlers, and Indians.

Prairie-dogs are distributed over a large part of the Great Plains and Rocky Mountain regions of the United States and southward into northern Mexico. This actual area is relatively small, however; the animals are found in no other region. Though the several forms are constantly extending their ranges into new valleys and pushing out into new pastures on the plains, the animal has penetrated into only a small area of the Great Basin, and seems sharply restricted by its specialized nature from occupying any great part of the humid eastern plains, the northern prairies of Canada, the Tropics, or the immense stretches beyond the Rockies.

The habits of the black-tailed species and, to a slightly less degree, those of the more mountain-loving white-tailed forms, are decidedly social. The great size of the "dog-towns" on the plains has indeed been one of the principal subjects of comment by early travelers. The villages sometimes extend for many miles and the number of individuals inhabiting a big town is enormous. While in certain localities the white-tailed species are almost as gregarious as the black-tailed forms, in others their dens are much more scattered and the animals live in solitary families. These differences in habit are due mainly to variations in local habitat. In certain parts of the mountainous ranges of *Cynomys gunnisoni* and of *C. leucurus*, the country is broken and otherwise unsuited to sustain large numbers of the animals, and the creatures necessarily live much as do certain rock squirrels of the genus *Citellus*, in isolated pairs or widely separated families.

The prairie-dog is not strictly a hibernating animal except at high altitudes or in the more northern regions where the great depth of snow and the extreme severity of winter make hibernation a virtual necessity. In the more southerly parts of the Great Plains there is actually no period of hibernation. In the central Plains States hibernation is partial and irregular, and even in the extreme north the animals are not infrequently seen out on fine winter days, though they hibernate for long periods during severe weather. In the higher mountainous habitat of the white-tailed forms the villages are often covered for many weeks with a great depth of snow, and activity on the part of the prairie-dogs is, therefore, out of the question. In such regions the animals are rarely seen after November or they may retire even by middle October. In the higher parts of the New Mexican range prairie-dogs cease to appear above ground by approximately the first of December, although, if conditions are favorable, they are out on fine days throughout the winter. In the Green River Basin, Wyoming, Vernon Bailey saw *Cynomys leucurus* eating sage-brush tips on snow a foot deep in zero (Fahrenheit) weather, and also after a night when the temperature had fallen to 22° below zero.

The burrows vary greatly according to local necessities. In some regions the mounds heaped up around entrances to dens are enormous, while in others they are smaller or almost wanting. Much rainfall necessitates high mounds, constant care, and incessant work by the industrious animals until the safety of the home is insured. The mounds in such cases are often especially well made and the earth is very hard packed. Each double armful of wet dirt which is pushed into position by the animal is rammed and packed into a firm condition by repeated drives with the nose; the body, in curved

position, with shoulders bent, acts as a powerful machine to drive the hammerlike muzzle into the earth.

While at times virtually omnivorous, the prairie-dog finds its principal food in grasses and other green plants. Roots and stems are eaten as well as the tender leaves. In times of scant vegetation, or during a drought, the villages are almost destitute of plant life, so closely is every living bit cropped.

Prairie-dogs are unquestionably responsible for great annual damage to crops and pasturage. In certain areas the destruction amounts to virtually the entire forage. Crops of grain and cultivated hay are often entirely ruined unless drastic preventive measures are taken. In other out-of-the-way places the animals do not interfere in the least with the operations of man.

In captivity prairie-dogs eat almost any food, and are especially fond of cakes and fruit; watermelon also is relished.

NATURAL ENEMIES.

Among the principal natural enemies of the prairie-dog are the badger, coyote, black-footed ferret, eagle, rough-legged hawk, and raven. Prairie-dog meat furnishes much of the food of individuals of these species that live in close proximity to the villages. Many absurd stories of the joint occupation of dens by prairie-dogs, rattlesnakes, and burrowing owls have been written, but careful observers have found that whatever the relation between these denizens of the plain may be—and the creatures are often found together in the villages—it is anything but advantageous to the prairie-dog, and large numbers of its young are destroyed by the unwelcome visitors.

NOMENCLATURE.

Several systematic mammalogists early bestowed technical names on the prairie-dog, in some cases basing both names and descriptions wholly upon published accounts in explorers' narratives. The resulting confusion in both zoology and nomenclature was considerable. Systematists supposed the newly discovered prairie-dog to be a species of marmot, and the first technical name properly proposed for it, *Arctomys ludovicianus*, the Louisiana marmot, was given by George Ord in the second American edition of Guthrie's Geography, 1815. Ord's description was drawn from a stuffed specimen of the prairie-dog in Peale's Museum, and his account of the habits of the animal was taken chiefly from the history of Lewis and Clark's expedition, with supplemental observations from the narratives of Pike and Brackenridge. The specimen examined by Ord in Peale's Museum was certainly the skin collected by Lewis and Clark, and

later, 1823, more fully described by Say.¹ This was doubtless the first specimen of the prairie-dog to reach any museum, and Lewis and Clark are probably entitled to the credit for the actual discovery of the species.

Rafinesque, in 1817, proposed the new genus *Cynomys* for the "barking squirrel" of Lewis and Clark, calling the species *Cynomys socialis*. At the same time he provisionally named the "petit chien" of these authors *Cynomys grisea*, not knowing that it too was a "barking squirrel." Warden, in his Historical Account of the United States, 1819, named the species *Monax missouriensis*, basing his description on information obtained in the narratives of late explorers, particularly Maj. Pike; and Harlan, 1825, based still another name, *Arctomys latrans*, on the barking squirrel of Lewis and Clark. These names have now been fixed in the synonymy of one species, but there was considerable confusion regarding the nominal species and their nomenclature up to the time of publication of Baird's Mammals of North America, 1857. In this work two species of *Cynomys* were recognized, one black-tailed and one white-tailed. Baird, who in 1855 had first described his *Spermophilus gunnisoni*, a species of the white-tailed group of prairie-dogs, from Colorado, still, in 1857, entertained considerable doubt as to whether his new species was distinct from a still more recently discovered white-tailed prairie-dog from Wyoming. To this latter form he thought the older name *Arctomys columbianus* of Ord, based on the "burrowing squirrel" of Lewis and Clark, might be applied, should further investigation establish its validity.

The next authoritative work on the group was Allen's Monograph of the Sciuridæ, 1877. In this work, as in his previous list of American Sciuridæ,² Dr. Allen recognized two species of prairie-dogs, the *ludovicianus* of Ord and a white-tailed species to which he applied the name *Cynomys columbianus* (Ord), treating *gunnisoni* of Baird as a synonym. As later pointed out by Dr. Merriam,³ the name *columbianus* really belongs to a spermophile of the genus *Citellus*, and Baird's name *gunnisoni* is the earliest valid name for any member of the group of white-tailed prairie-dogs. Dr. Merriam had been able the previous year to substantiate Baird's suspicions of many years before regarding the existence of two distinct species of white-tailed prairie-dogs, and had named the Wyoming form *Cynomys leucurus*. The same year Dr. Mearns described a southwestern form of the *ludovicianus* type as *Cynomys arizonensis*, and in 1892 Merriam added *C. mexicanus* to the list of known species of the genus. The Sevier River valley white-tailed prairie-dog remained unknown, so far as systematists were concerned, until it was described and named by Dr. J. A. Allen in 1905.

¹ Long's Exped. Rocky Mts., I, pp. 451-452, 1823.

³ North Amer. Fauna No. 5, pp. 39-42, 1891.

² Proc. Boston Soc. Nat. Hist., XVI, p. 294, 1874.

In the present paper two subgenera of *Cynomys* are recognized. These are equivalent to the black-tailed and the white-tailed groups. One new subspecies is described and one currently recognized name is placed in synonymy, leaving the number of recognized forms at seven, the same as in the last (1912) general list of North American mammals.¹

PELAGES AND MOLTS.

In all prairie-dogs, except *Cynomys mexicanus*, there are two well-marked annual molts over the entire animal, except on the tail, where there is only a single renewal each year. The two coats are the harsh, thin, summer pelage and the soft, heavily underfurred winter pelage. In southern States, where the spring molt takes place much earlier than in the North, the two renewals are conspicuous. Farther north and at greater altitudes, where the season is shorter, the summer coat is so little worn and the fall renewal so subtle that the autumnal change is difficult to detect.

In general, the spring molt begins on the pectoral region and axillæ, and the entire underparts from front to back are completely renewed before any real molt is visible above. On the upperparts, the head and shoulders, with occasional irregular areas on the back, renew first, and the renewal progresses posteriorly. Considerable wear is apparent over the anterior half of the back before the tail is in fresh coat. It is quite common to find museum specimens in full summer coat except for the tail, which retains the old pelage of the previous winter. In late summer or early autumn, at about the time when the tail is at last in full fresh pelage, the winter coat begins to appear on the extreme posterior parts of the body. The renewal of the underfur progresses anteriorly in a regular definite area, and the fresh, soft winter coat gradually covers the whole body. The autumnal renewal thus exactly reverses the order of progression in spring. The whole process is much as if there was a continuous summer change of hair which started at the nose in spring, worked backward to the tail, reversed, and in fall traveled forward to the nose again. The tail, midway in the route of this process, receives only one coat annually.

There is, naturally, a considerable variation in the season of renewal according to latitude or altitude. Breeding females are always slow to acquire the fresh coat, renewal being greatly retarded by lack of excess vitality. Young animals of the first year do not molt or renew at the same dates as do adult males and nonbreeding females which have lived over one winter. The molt of *Cynomys mexicanus* appears to be much more complex than in the more northern forms and is almost continuous. Some individuals of this species show parts of three distinct pelages.

¹ Miller, G. S., jr., Bull. 79, U. S. Nat. Mus., pp. 294-295, 1912.

MATERIAL AND ACKNOWLEDGMENTS.

This revision of the prairie-dogs is based upon a study of 876 specimens, almost all of which are well-prepared skins and skulls.¹ A few skeletons and odd skulls also have been examined. The liberal policy of American museums has made it possible to assemble practically all the study material of the group preserved in American collections, including the types and type series. Thanks for these courtesies are especially due Dr. J. A. Allen, American Museum of Natural History; Mr. Samuel Henshaw and Mr. Outram Bangs, Museum of Comparative Zoology; Mr. Edward R. Warren, Colorado Springs, Colo.; and Mr. Charles B. Cory and Mr. W. H. Osgood, Field Museum of Natural History. Mr. Warren's private collection of Colorado specimens of *Cynomys leucurus* and *C. gunnisoni* has been of especial value and help. In the lists of specimens examined the source is indicated of all material from localities not represented in the United States National Museum collections.

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Genus *CYNOMYS* Rafinesque.

1817. *Cynomys* Rafinesque, Amer. Monthly Mag., II, p. 45.
 1819. *Monax* Warden, Stat., Pol., and Hist. Acc. U. S., I, p. 226. Type, *Monax missouriensis* Warden (= *Cynomys ludovicianus*).
 1827. *Cynomis* Lesson, Manuel de Mamm., p. 244 (pro *Cynomys* Rafinesque).
 1894. *Cynomomus* Osborn, Science, XXIII, p. 103 (pro *Cynomys* Rafinesque).
 1899. *Mameynomiscus* Herrera, Sin. Vulg. Cient. Vert. Mexicanus, p. 22. (pro *Cynomys* Rafinesque).

Type species.—*Cynomys socialis* Rafinesque (= *Arctomys ludoviciana* Ord).

Diagnosis.—Like *Citellus*, but with cheek teeth relatively much larger; maxillary tooth rows strongly convergent posteriorly; molari-form teeth with protocone much more hypsodont; and crown of last upper molar with well-developed mesostyle and accompanying additional transverse ridge.

General characters.—Size as in larger species of *Citellus* or greater; form stout; tail short, rarely more than one-fourth the total length; ears short, not extending beyond fur of winter pelage; cheek pouches moderate. Wrist and heel heavily furred; a tuft of hair in center of

¹ The material examined has been assembled from collections as follows:

U. S. National Museum, Biological Survey collection.....	465
U. S. National Museum proper.....	221
American Museum of Natural History, New York, N. Y.....	81
Museum of Comparative Zoology, Cambridge, Mass.....	47
Collection of E. R. Warren, Colorado Springs, Colo.....	44
Field Museum of Natural History, Chicago, Ill.....	18
Total number of specimens.....	876

palm of foot usually extending forward to phalangeal tubercles; manus with five distinct claws, the claw of pollex well developed, subequal to claw of outer (fifth) toe. Mammæ 8 to 12. Skull rather broad and heavily built; sinciput high and rounded; squamosal arm of zygoma widely spreading; occipital crest well developed; sagittal crest moderate anteriorly, but well developed posteriorly in old adults; antorbital foramen subtriangular, with strongly developed tubercular process. Molar series strongly convergent posteriorly; teeth very large and greatly expanded laterally; first premolar large, sometimes nearly equal to second; crown pattern of molars essentially as in true *Citellus*, but teeth with higher crowns and deeper grooves; molars and premolars with protocone much more hypsodont; m^3 with additional transverse ridge extending (from mesostyle) across outer half of center of crown; upper incisors sometimes with very indistinct groove along inner face.

Color pattern.—Simple; body unmarked, not sharply bicolor. Upperparts reddish brown, buffy, or grayish, finely lined with darker or lighter hair-tips; underparts paler, clear buff or pale cinnamon. More or less well-marked dark areas above and below eye; tail conspicuously tipped with black or white.

Geographic distribution.—Rocky Mountain and Great Plains regions of the United States and northern Mexico. From the Milk River near the Canadian boundary in northern Montana south to northern San Luis Potosi, Mexico; east to the Missouri River in North Dakota and to about the ninety-seventh meridian in Nebraska and Oklahoma; west to the Rocky Mountains in Montana, to the valleys of central Utah, and to the border of the Grand Canyon on the Hualpai Indian Reservation, Arizona (figs. 1 and 2).

Remarks.—The prairie-dog is a true ground squirrel, or spermophile; there is no real evidence of the frequently suggested close relationship between *Cynomys* and *Marmota*.

In an article by Prof. K. A. Satunin in the *Mitteilungen des Kaukasischen Museums*, volume IV, pages 175 to 193, 1909, the conclusion is reached that *Colobotis* Brandt, currently recognized as a subgenus of *Citellus*, is a synonym of *Cynomys*. Through the kindness of Mr. Oldfield Thomas, I have been able to examine, from the collection of the British Museum, skulls of the type species of *Colobotis*—*Citellus fulvus* (Lichtenstein). It is at once apparent that *Cynomys* is even less closely related to *Colobotis* than to *Citellus* proper, and that it is unquestionably an error to use the generic name *Cynomys* for any of the Old World spermophiles. *Colobotis* is exceedingly like true *Citellus* and differs generically from *Cynomys* in the same characteristics, especially in the less complicated last upper molar, lack of the striking internal hypsodontism of the molariform teeth, and in the nearly parallel-sided palate.

List of Species and Subspecies with Type Localities.

Subgenus CYNOMYS.

<i>Cynomys ludovicianus ludovicianus</i> (Ord).....	Upper Missouri River.
<i>ludovicianus arizonensis</i> Mearns.....	Point of Mountain, Arizona.
<i>mexicanus</i> Merriam.....	La Ventura, Coahuila, Mexico.

Subgenus LEUCOCROSSUROMYS.

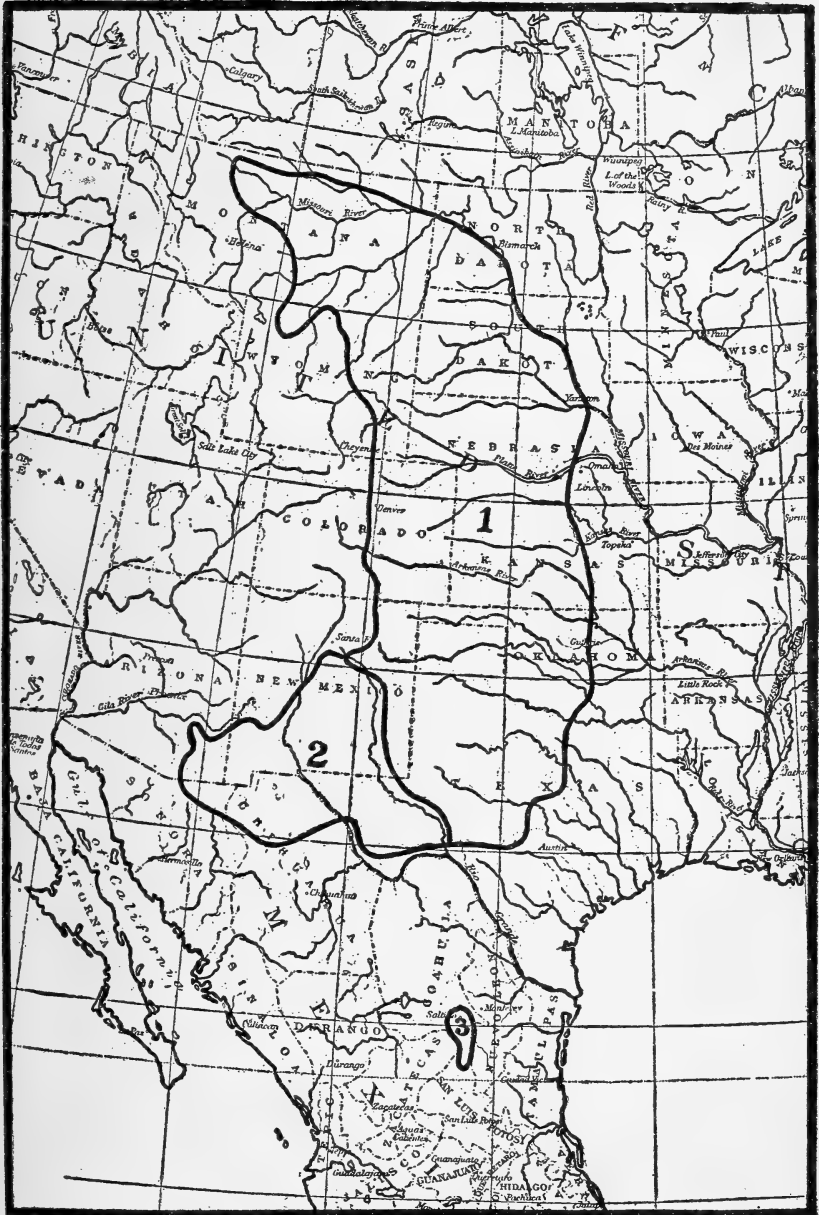
<i>Cynomys leucurus</i> Merriam.....	Fort Bridger, Wyoming.
<i>parvidens</i> Allen.....	Buckskin Valley, Utah.
<i>gunnisoni gunnisoni</i> (Baird).....	Cochetopa Pass, Colorado.
<i>gunnisoni zuniensis</i> nobis.....	Wingate, New Mexico.

Key to Species and Subspecies.

- a.¹ Tail tipped with black; jugal bone heavy, thickened, the outer face at angle of ascending branch presenting a broad triangular surface (*Cynomys*).
- b.¹ Black on tail covering most of distal half; tail longer; audital bullæ large and greatly inflated; posterior border of inflected angle of mandible nearly at right angle to axis of jaw..... **C. mexicanus** (p. 21).
- b.² Black on tail confined to distal third; tail shorter; audital bullæ smaller and less inflated; posterior border of inflected angle of mandible at angle of about 45° to axis of jaw.
- c.¹ Coloration above in fresh summer pelage dark pinkish cinnamon; audital bullæ smaller; anterior face of maxillary root of zygoma deeply emarginate,..... **C. l. ludovicianus** (p. 14).
- c.² Coloration above in fresh summer pelage more vinaceous-cinnamon; audital bullæ larger; superior surface of maxillary root of zygoma very broad, not deeply emarginate anteriorly..... **C. l. arizonensis** (p. 19).
- a.² Tail tipped and bordered with white; jugal bone weak, thin, and flat, the outer surface at angle of ascending branch only very slightly thickened, the margin rounded, not distinctly triangular (*Leucocrossuromys*).
- b.¹ Terminal half of tail white, without dark center.
- c.¹ Size larger; coloration in summer buffy or grayish (not reddish or rich cinnamon); skull with less interorbital breadth..... **C. leucurus** (p. 24).
- c.² Size smaller; coloration in summer reddish or rich cinnamon (not buffy or grayish); skull with greater interorbital breadth..... **C. parvidens** (p. 27).
- b.² Terminal half of tail with gray center, bordered and tipped with white.
- c.¹ Size smaller, with smaller hind foot; coloration more buffy and blackish, less pinkish cinnamon and ochraceous..... **C. g. gunnisoni** (p. 29).
- c.² Size larger, with larger hind foot; coloration more pinkish cinnamon and ochraceous, less buffy and blackish..... **C. g. zuniensis** (p. 32).

Subgenus CYNOMYS Rafinesque.

Characters.—Size large; tail comparatively long, averaging more than one-fifth the total length, and tipped with black; mammæ 8. *Skull*: Angular and massive; general shape of occipital region, viewed from behind, oval; jugal bone heavy, thickened, the outer surface at angle of ascending branch very broad, triangular, with inferior vertex produced far downward; maxillary root of zygoma correspondingly strengthened, the shelf and suprajugal arm much thickened. Teeth larger, more expanded laterally, than in species of the white-tailed group.



B2119-129

FIG. 1.—Distribution of subgenus *Cynomys*: 1, *Cynomys ludovicianus ludovicianus*; 2, *C. l. arizonensis*; 3, *C. mexicanus*.

CYNOMYS LUDOVICIANUS (ORD).

[Synonymy under subspecies.]

Characters.—Differs from *Cynomys mexicanus* in more reddish coloration and shorter tail; black area on terminal portion of tail much more restricted; skull with smaller audital bullæ and less developed triangular plate of jugal; teeth larger.

Subspecies.—Two subspecies of *Cynomys ludovicianus* are here recognized, the typical form, occupying a large part of the Great Plains region from Montana to Texas; and *C. l. arizonensis*, the more arid southwest, in New Mexico, Arizona, and adjacent portions of Mexico and southwestern Texas.

CYNOMYS LUDOVICIANUS LUDOVICIANUS (ORD).

BLACK-TAILED PRAIRIE-DOG.

(Pl. I, figs. 1, 4; Pl. II, figs. 1, 4; Pl. V, fig. 1; Pl. VI; Pl. VII, figs. 1, 7, 8.)

1815. *Arctomys ludoviciana* Ord, Guthrie's Geogr., 2d Amer. ed., II, pp. 292, 302.
 1817. *Cynomys socialis* Rafinesque, Amer. Monthly Mag., II, p. 45, November. (Plains of the Missouri.)
 1817. *Cynomys ? grisea* Rafinesque, Amer. Monthly Mag., II, p. 45, November. ("On the Missouri.")
 1819. *Monax missouriensis* Warden, Stat., Pol., and Hist. Acc. U. S., I, p. 226. ("The Missouri country." Based largely on the account of "Major Pike, in his expedition through Louisiana.")
 1822. *Arctomys missouriensis* Desmarest, Mammalogie, pt. 2, p. 329.
 1825. *Arctomys ludoviciani* Harlan, Fauna Amer., p. 305.
 1825. *Arctomys latrans* Harlan, Fauna Amer., p. 306. (Plains of the Missouri.)
 1827. *Spermophilus ludovicianus* Lesson, Manuel de Mamm., p. 244.
 1827. *Cynomys socialis* Lesson, Manuel de Mamm., p. 244 (syn.).
 1827. *Spermophilus griseus* Lesson, Manuel de Mamm., p. 245.
 1827. *Cynomys griseus* Lesson, Manuel de Mamm., p. 245 (syn.).
 1827. *Cynomys griseus* Lesson, Manuel de Mamm., p. 260.
 1829. *Arctomys ludovicianus* Cuvier, Règne Animal, I, p. 197.
 1829. *Arctomys missouriensis* Fischer, Syn. Mamm., p. 345.
 1829. *Arctomys griseus* Fischer, Syn. Mamm., p. 345.
 1829. *Arctomys (Spermophilus?) ludovicianus* Richardson, Fauna Boreali-Amer., pt. 1, p. 154.
 1829. *Cynomys cinereus* Richardson, Fauna Boreali-Amer., pt. 1, p. 155 (pro *grisea* Rafinesque, 1817).
 1845. *Cynomys cinereus* Schinz, Syn. Mamm., II, p. 64 (syn.).
 1855. *Monax missouriensis* Giebel, Die Säugethiere, p. 630 (syn.).
 1857. *Cynomys ludovicianus* Baird, Gen. Rep. North Amer. Mamm., pp. xxv, 331.
 1905. *Cynomys pyrrhotrichus* Elliot, Proc. Biol. Soc. Washington, XVIII, p. 139, April 18. (White Horse Spring, Woods County, Oklahoma; type in Field Mus. Nat. Hist., Chicago.)

Type locality.—Upper Missouri River ("vicinity of the Missouri, and throughout the greater part of Louisiana").

Geographic distribution.—Great Plains region of western United States, south from near the Canadian border in Montana to west-

central Texas (Mason County to eastern Pecos Valley); east to about the ninety-seventh meridian in Nebraska, Kansas, and Oklahoma; west to the Rocky Mountains in central Montana, Wyoming, and Colorado, and in extreme eastern New Mexico. Chiefly Upper Sonoran, but also ranging into Transition and Lower Sonoran Zones. Introduced colonies exist, or have been reported as formerly existing, in Sac County and at Burlington, Iowa; near Monroe, Louisiana; at Seneca, South Carolina; and on Nantucket Island, Massachusetts.

Characters.—Skull with superior surface of maxillary root of zygoma bordering premaxillary and frontal bones narrow, sharply emarginate anteriorly; audital bullæ comparatively small. Coloration in fresh summer coat less vinaceous-cinnamon than in *Cynomys ludovicianus arizonensis*.

Color.—*Adult in full fresh summer pelage:* Upperparts from nose to between eyes, between ears, nape, and over entire body above, dark pinkish cinnamon, finely lined with black and buff. Individual hairs black at base, followed by buffy white, then cinnamon, with subterminal band of buff, and, in unworn condition, narrow tip of blackish. Mixed with these are numerous wholly black and half-black hairs, rather longer than the ordinary pelage, the chief cause of black streaking. Upper lip, sides of nose, and eye ring buff or buffy white; whiskers black; cheeks and sides of head buffy or vinaceous-cinnamon, with numerous blackish hairs; arms above, sides of body, and legs above pale ochraceous-cinnamon; feet buffy. Tail above for about two-thirds its length like back, below paler vinaceous-cinnamon; terminal third chiefly black or blackish brown above and below, with extreme tip of lighter blackish brown. Underparts of body from chin to near tail whitish or buffy white. Nails blackish, tipped with light horn. Iris hazel. *Adult in full fresh winter pelage:* Pelage much thicker, softer, and longer than in the summer coat; less ochraceous or pinkish cinnamon, more buff and gray. Upperparts grayish cinnamon (mixed pale cinnamon, whitish, and black). Individual hairs intense black at bases, then pale buff, with subterminal band of cinnamon and tip of almost pure white. Mixed throughout this pelage, as in the summer coat, are numerous long overlying hairs of black. Forehead with considerable blackish; tail as in summer. Underparts dark buff or pale cinnamon, the hairs black at bases, whitish midway, and broadly tipped with pale cinnamon-buff. *Juvenile pelage:* Upperparts clear ochraceous-cinnamon, with admixture of a few white and blackish hairs; underparts whitish or pale buffy yellow; tail clear ochraceous-cinnamon, broadly penciled with black; bases of many of the black pencil hairs pure white.

Both the summer and the winter coats rapidly fade and wear, and the resulting variations in color are considerable. Specimens are frequently greatly affected by the color of the soil, and numerous

examples are considerably reddened or darkened by stain, either on the upper and lower body or uniformly throughout the pelage. Specimens in complete fresh summer coat are rather uncommon as the vernal molt is so slow that the forward parts, renewed first, are already considerably worn before the tail, last to renew, is in full fresh coat.

Molt.—The spring molt and renewal are very conspicuous but the fall molt, especially in northern localities, is often obscure. There is considerable variation in the dates of renewal but the following schedule is about the average for northern and central Great Plains States: Late March and early April skins are worn, pale, and faded, but already show some signs of molt and renewal on the underparts, where the first new hair appears on the pectoral region and axillæ. May specimens have completely renewed below and the renewal has commenced on the head, shoulders, and in irregular patches on the back. June specimens are almost completely in fresh coat, but still show, as a rule, some of the old pelage on the rump and tail. July and early August skins are usually completely renewed, except for a few in which the tails above are still in the winter coat. The hair of the body is short and harsh, and rapidly becomes broken, worn, and faded. Late August adults show considerable progress in the fall renewal; the winter underfur and long soft hair is appearing on the lower back, and the animal looks generally lighter colored. The tails are fully renewed. November specimens are in complete new fur, and the hair on the tails still appears fresh and unworn after its single annual renewal; all traces of the summer coat have disappeared. In December skins, the coat has thickened, grown longer, and appears considerably lighter in color. This is in part due to fading, but is also caused by the general effect of the long white underfur showing through the reddish hair tips.

Skull and teeth.—The skull of *Cynomys ludovicianus ludovicianus* differs from that of *C. l. arizonensis* in its distinctly smaller audital bullæ and narrow, deeply emarginate anterior face of maxillary root of zygoma. It may readily be distinguished from skulls of *C. leucurus* (whose range meets that of *C. ludovicianus* in parts of Wyoming) by its slightly larger size, smaller bullæ, more notched anterior face of maxillary root of zygoma, less flattened zygoma (muscle attachment reaching farther forward, nearly or quite to plane of first tooth), generally heavier mandible, lighter postorbital processes, and small auditory meatus. The incisors vary in color from white to deep yellow in specimens from one locality. The variation in size and shape of skull among specimens of the same sex and age from one locality is remarkable (see Pl. VI).

Measurements.—Averages of 13 adult males from South Dakota: Total length, 388 (360–415); tail vertebræ, 86 (75–98); hind foot,

62 (61-83). *Skull*: Condylbasal length, 59.8 (57.2-62.6); zygomatic breadth, 45 (42.9-48.1); mastoid breadth, 28.5 (27.5-31); length of nasals, 23.8 (22-25); length of mandible, 45.9 (43-49.4); maxillary tooth row, alveoli, 16.6 (16-17.5). Females average very slightly smaller than males, but the difference in size is, as a rule, barely perceptible. For detailed measurements of specimens, see page 34.

Weight.—The weights of adult examples of *C. l. ludovicianus* are recorded in collectors' field catalogues as follows: Alma, Nebraska, October 21, ♂, 3 lbs., ♀, 2 lbs. 4 oz.; Tilyou's Ranch, Montana, October 1, ♀, 2 lbs. 3 oz.

Type specimen.—Ord's description of this prairie-dog was drawn from a stuffed skin in Peale's Museum, Philadelphia, supplemented by notes from the narrative of Lewis and Clark. This specimen was without doubt the identical skin which later on was more fully described by Say.¹ It has long since been lost sight of.

Remarks.—As explained in the account of the pelage changes, there is considerable seasonal color variation in the common prairie-dog, but a comparison of specimens in exactly the same state of pelage from all parts of the animal's range proves the absence of any constant geographical differences. There is likewise a remarkable uniformity in size, the averages and extremes of long series from northern States being virtually identical with measurements of specimens from Texas. The alleged form from Oklahoma, described by Dr. Elliot as *Cynomys pyrrotrichus*, is not subspecifically distinguishable from *C. l. ludovicianus*. Specimens from this region are commonly stained by the red soil, and sometimes so naturally as almost to defy detection as a stain. Numerous examples, however, show the telltale red soil on the toes and feet, and a careful microscopic examination of the hairs often shows the particles composing the stain, which can be perceptibly lightened by a moment's washing with alcohol or benzine. There are, furthermore, absolutely normally colored specimens from various parts of the area included in the distribution of the "red-haired" prairie-dogs, and all the young specimens are indistinguishable from juvenile examples from the Dakotas and other parts of the range of the species. Reddish skins, in all respects like the specimens of "*pyrrotrichus*" from Oklahoma, are not infrequently found in other parts of the prairie-dog's range where soil conditions are favorable for producing such a stain.

On the basis of skull characters the subspecies *ludovicianus* is typical over the northern parts of its general distribution, in Montana, the Dakotas, and Wyoming. The "area of intergradation" with *C. l.*

¹ See Guthrie's *Geog.*, 2d Amer. ed., p. 303, under "Columbia Marmot," where Ord states that "A stuffed skin of the Louisiana Marmot is in the Museum of Mr. Peale." Also, Say, in Long's *Exped. to Rocky Mts.*, I, p. 452, 1823.

arizonensis is large, and skulls from Nebraska, Kansas, Oklahoma, and Texas are sometimes difficult to distinguish. As here mapped the range of *C. l. ludovicianus* includes the entire area where typical examples most frequently occur. The characters separating *arizonensis* are slight and are only average. For example, in an examination of 120 adult skulls from Montana, the Dakotas, Arizona, and Chihuahua, about 80 per cent can readily be placed with their proper form; comparing 115 skulls from Wyoming,¹ Nebraska, and New Mexico, about 75 per cent are easily determinable; 31 skulls from Colorado and extreme western Texas (west of Pecos River) still show about 75 per cent readily distinguishable; while of 56 skulls from Kansas and Texas east of the Pecos, there are just about 50 per cent which can be differentiated, and the characters are relatively hard to distinguish satisfactorily.

An albinistic specimen, entirely white, from the Central Park Menagerie, New York, has been examined in the collection of the American Museum of Natural History.

Specimens examined.—Total number, 290, as follows:

Colorado: Boulder County, 1; Colorado Springs, 1;¹ Denver, 1; Don Carlos, 1; Fremont County, 1;² Larimer County, 4;³ Loveland, 3; Monon (Baca County), 2;¹ Olney (Otero County), 4; Pueblo, 1; Rockvale, 2;² Soda Springs, 2;⁴ Springfield, 2.¹

Kansas: Arkansas River, 1; Banner, 8; Cairo, 2; Coyote Station, 1;⁴ Fort Hays, 8;⁴ Garden City, 2;² Garden Plain, 1; Hoxie, 1; Long Island, 3;³ Pendennis (Lane County), 1; Republican River, 1; Trego County, 6.

Massachusetts: Nantucket, 2 (introduced).⁴

Montana: Billings, 1; Boxelder Creek, 1; Calf Creek, 1;³ Craig (10 miles northwest of), 1; Darnall's Ranch, 1; Fort Assinniboine, 5; Fort Custer, 3; Glendive, 6; Great Falls, 2; Milk River (near mouth), 2; Newland, 2; Pompey's Pillar, Yellowstone River, 1; Shelby Junction, 4; Teton River, 2; Tilyou's Ranch, 1.

Nebraska: Alma, 2; Birdwood Creek, 3; Columbus (Platte County), 1; Kennedy, 3; Platte River, 4.

New Mexico: Chico Springs, 1; Koehler Junction, 2; Pecos, 1; Tompkin's Lake, 2.

North Dakota: Glenullin, 2; Little Missouri River, 1; Medora, 7.

Oklahoma: Beaver River, 4;^{2,3} Chattanooga, 1; Mount Scott post office, 3; Neutral Strip, 5;^{2,3} Ponca Agency, 2; White Horse Spring, 5 (including type of "*pyrrotrichus*").²

South Dakota: Armour, 1; Buffalo Gap, 8; Cheyenne River (Custer County), 2;³ Corral Draw, 3;³ Edgemont, 2; Fort Pierre, 6; Fort Pierre to Badlands, 15 (skulls); Fort Randall, 11; Phinney (Cheyenne River), 1; Pine Ridge Indian Reservation, 1;² Rapid City, 10; Upper Missouri River, 3 (skulls and skeletons).

Texas: Brazos River, 1; Colorado, 1; Fort Chadbourne, 1;⁴ Henrietta, 4; Lipscomb, 1; Llano Estacado, 1; Mason, 9; Monahans, 1; Red River, 2; Stanton, 2; Texline, 1; Vernon, 11; Wichita Falls, 3.

¹ Collection E. R. Warren.

² Collection Field Mus. Nat. Hist.

³ Collection Amer. Mus. Nat. Hist.

⁴ Collection Mus. Comp. Zool.

Wyoming: Arvada (Powder River Valley), 2; Camp Carling (=Fort Russell, near Cheyenne), 2; Cheyenne, 6; Deer Creek, 1; Douglas, 4; Fort Fetterman, 2; Ishawooa, 4; Newcastle, 4; Pine Bluff, 2; Pole Creek, 7; Sage Creek, 11.¹

CYNOMYS LUDOVICIANUS ARIZONENSIS MEARN'S.

ARIZONA PRAIRIE-DOG.

(Pl. I, figs. 2, 5; Pl. II, fig. 2; Pl. V, fig. 2.)

1890. *Cynomys arizonensis* Mearns, Bull. Amer. Mus. Nat. Hist., II, no. 4, p. 305, February 21.

1892. [*Cynomys*] *ludovicianus arizonensis* Merriam, Proc. Biol. Soc. Washington, VII, p. 158, July.

Type locality.—Point of Mountain, near Willcox, Cochise County, Arizona.

Geographic distribution.—Southeastern Arizona, southern and central New Mexico, southwestern Texas, and adjacent portions of Sonora and Chihuahua, Mexico. North to San Pedro and Santa Rosa, New Mexico; east to the Pecos Valley; west to Huachuca, Arizona; south to San Diego and Casas Grandes, Chihuahua, and to Presidio County, Texas.

Characters.—Like *Cynomys ludovicianus ludovicianus* but averaging very slightly larger, and brighter colored; skull with larger audital bullæ, and with superior surface of maxillary root of zygoma bordering premaxillary and frontal bones very broad, not deeply emarginate, the zygoma as viewed from above not branching at sharp angle from rostrum.

Color.—Almost precisely as in the typical subspecies, but averaging slightly brighter vinaceous-cinnamon in fresh summer pelage.

There is a single wholly melanistic specimen from south of the Guadalupe Mountains, in Texas, in the National Museum collection.

Molt.—Specimens showing excessive molt are more common than in the northern subspecies, and molting examples frequently exhibit strange patterns of coloration. There are frequent mixtures of the faded, left-over winter coat and the fresh reddish summer coat. Excessive wear before any renewal sometimes leaves large parts of the animal entirely black, the hair having been worn away completely except for the black underfur. Specimens in the much-worn pelage of late summer, before any evidence of fall renewal, frequently present a curious appearance: the color is pale ochraceous or yellowish buff and the hairs appear brittle and dead, often matted and twisted as if scorched by excessive heat.

January and February skins are in the long, soft, faded winter pelage. In the lower levels the spring molt occurs earlier than in the more northern race, and the animals are usually in full fresh summer coat, except for the tail, between the first part and middle of May. The short, stiff, summer coat rapidly wears and is much changed

¹ Collection Amer. Mus. Nat. Hist.

before the hair of the tail has renewed. At higher altitudes the pelage is not completely renewed until the middle of July. When the summer pelage is acquired this late the animals have molted again and renewed into full fall pelage by the first of October, while specimens from the lower levels, which acquired the summer pelage much earlier, are sometimes as late as November in attaining the same condition.

Skull and teeth.—The skull of *C. l. arizonensis* differs from that of *C. l. ludovicianus* in the very broad surface of the superior maxillary arm of the zygoma, bordering the ascending branch of the premaxilla and the frontal bone, which in the typical examples is nearly twice as wide as in *C. l. ludovicianus*, less sharply emarginate anteriorly, and rather more convex on the outer surface along the jugal. As a result the maxillary arm of the zygoma appears to leave the rostrum at a much less sharp angle than in the northern form. The audital bullæ average considerably larger than in typical *ludovicianus*. Teeth essentially as in the northern race.

Measurements.—Averages of 19 adult males from southeastern Arizona: Total length, 388 (350–412); tail vertebræ, 89 (78–100); hind foot, 62 (57–65). *Skull:* Condylbasal length, 60 (56.6–64); zygomatic breadth, 44 (41–47.2); mastoid breadth, 27.3 (26.1–29.5); length of nasals, 24 (22.3–25.4); length of mandible, 45.2 (42.8–47.2); maxillary tooth row, alveoli, 16.2 (15.5–17). Females average slightly smaller. For detailed measurements of specimens, see page 35.

Weight.—Three male specimens from Altuda, Texas, July 30, have the following weights recorded in collector's field catalogue: 2 lbs. 2 oz., 2 lbs. 6 oz., and 2 lbs. 8 oz.

Type specimens.—There are two cotypes, in the American Museum of Natural History, New York: Skin (No. 2509, ♀ ad.), from Point of Mountain, near Willcox, Arizona, April 9, 1885; and skin and skull (No. $\frac{2}{17}\frac{3}{5}$, ♂ ad., teeth considerably worn), from Dragoon Summit, Arizona, May 3, 1885; both collected by Dr. Edgar A. Mearns. Dr. Mearns later¹ restricted the type locality to Point of Mountain, and listed No. $\frac{12}{2509}^2$ as the type specimen. Two female specimens collected on the same date bear this skin number of the American Museum. One has a skull numbered 12162, but the other, without a skull number, bears a red type label, like No. 2185 from Dragoon Summit.

Remarks.—This is a slightly characterized form, barely recognizable except for average skull characters. Remarkable as it may seem, there are specimens from near the type region which can be matched in every particular with examples of typical *ludovicianus* from Montana. Nevertheless, as mentioned under the preceding form, about

¹ Mearns, E. A., Bull. 56, U. S. Nat. Mus., p. 239, 1907.

80 per cent of the skulls examined from the two extremes are readily determinable. The very slight average increase in size and the slightly more vinaceous summer coat are of such trivial degree that alone they would be valueless as characters for subspecific separation. Throughout southeastern Arizona and over most of the New Mexican range of the form the skull characters are well marked, but in western Texas such a strong tendency toward *C. l. ludovicianus* appears as to make identification of single specimens or unsatisfactory series virtually impossible. I have therefore considered the range of the form restricted to the region from the Pecos Valley south and west, where 75 per cent or more of the skulls are determinable. The area of intergradation with the subspecies *ludovicianus* is so extensive (from Texas to Nebraska) that it is really larger than the range of either subspecies in its *typical* form.

Specimens examined.—Total number, 184, as follows:

Arizona: Bonita, 1; Dos Cabezas, 1; Dragoon Summit, 1 (cotype);¹ Fort Huachuca, 10; Huachuca Plains, 4;^{2,3} Point of Mountain, 4 (including cotype);¹ San Pedro River, Mexican Boundary Line, 20; ⁴ Sulphur Spring Valley, 2; ¹ Willcox, 13.

Chihuahua: Colonia Juarez, 5; Juarez, 2; ^{1,3} Sierra en Media, 1.

New Mexico: Animas Valley (Grant County), 14; Cactus Flat (20 miles north of Cliff), 4; Capitan Mountains, 3; Cliff, 1; Cloverdale, 3; Dog Spring (Grant County), 9; Faywood, 2; Gila (Grant County), 1; Hachita, 2; Jornada del Muerto, 1; Lake Valley, 3; Lone Mountain, 1; Manzano Mountains (east foothills), 2; Organ City, 1; Playas Valley, 1; Queen, 3; Roswell, 2; San Luis Springs (=Lang's ranch, Grant County), 26 (including 17 odd skulls); San Pedro, 3; Santa Rosa, 7; Silver City, 5.

Texas: Alpine, 1; Altuda, 3; Belen (El Paso County), 4; El Paso, 4; Fort Davis, 1; Guadalupe Mountains (near), 1; Limpia Mountains (=Davis Mountains), 1; Pecos River, 1; Presidio County, 2; Sheffield, 3; Sierra Blanca, 5

CYNOMYS MEXICANUS MERRIAM.

MEXICAN PRAIRIE-DOG.

(Pl. I, fig. 3; Pl. II, figs. 3, 5; Pl. V, fig. 3; Pl. VII, fig. 2.)

1892. *Cynomys mexicanus* Merriam, Proc. Biol. Soc. Washington, VII, p. 157, July.

Type locality.—La Ventura, Coahuila, Mexico.

Geographic distribution.—Southeastern Coahuila and northern San Luis Potosi, Mexico. North to Saltillo; south to Vanegas.

Characters.—Size of *Cynomys ludovicianus*, but with longer tail; coloration above in summer coat less reddish, more grayish and vinaceous-buff, and much more heavily lined with black; coloration in winter still more hoary; black on terminal portion of tail much more extensive; teeth smaller.

¹ Collection Amer. Mus. Nat. Hist.

² Collection Mus. Comp. Zool.

³ Collection Field Mus. Nat. Hist.

⁴ Dr. Mearns tells me that a few of these specimens were actually collected on the Mexican side of the boundary line, in Sonora.

Color.—*Adult in fresh summer pelage:* Upperparts as in *C. ludovicianus*, but less reddish and much more grayish and vinaceous-buff; entirely black hairs more numerous, giving a much more grizzled general effect. Cinnamon areas less intense, more vinaceous. Tail above like rump for half its length; terminal half chiefly intense black, the black extending forward on sides of tail, leaving a lighter area midway; hairs of sides of pencil tipped with whitish, bases of all the pencil hairs almost pure white. *Adult in fresh winter pelage:* General appearance decidedly hoary or vinaceous-buff, the hairs with broad subterminal bands of whitish, which mix in the general effect with the narrow black tips and cinnamon undercolor. Individual hairs narrowly black at base, then broadly white and narrowly cinnamon, with subterminal band of buff and tip of blackish. The general effect is a glossy marbled vinaceous-buff, making the coat of this species by far the handsomest of all the prairie-dogs. *Juvenile* specimens are much paler than those of the corresponding age in *C. ludovicianus*, and rapidly change into a pelage like the fresh autumnal coat of adults.

Molt.—The molt of *C. mexicanus* is almost continuous and exceedingly complex, and without series of specimens collected in all the summer months it can not be worked out satisfactorily. With only March, April, July, and August skins before me I am inclined to believe that there are three complete renewals of the pelage of the body annually. Specimens collected in March have all renewed below, but are chiefly in the worn winter coat above, except in small areas forward, or even over the greater part of the head, shoulders, and withers, where renewal into a pelage much like the fresh winter coat has commenced. April skins from Saltillo are in a much-worn condition. The real summer pelage is certainly retained only a short time, as specimens collected at La Ventura from July 19 to August 5 exhibit every condition from what appears to be a worn, faded, left-over winter coat; through renewal into a short, stiff summer coat, without underfur; and the progress of the heavy winter pelage with a dense underfur over the posterior half of the back. Several specimens show all three of these pelages in definite areas on the body. Breeding females, as usual, are slow to renew, and the extreme state of wear is common until after the nursing season is over.

Skull and teeth.—Skull broad and angular, with wide-spreading zygomatic arches and sharply defined processes; in general effect more like skulls of *C. l. ludovicianus* from Montana and the Dakotas than like those of *C. l. arizonensis*; upper maxillary root of zygoma narrow along contact with ascending premaxillary bones and along ascending arm of jugal; face of upper incisors bright yellow. Differs from skulls of both *ludovicianus* and *arizonensis* in its much larger,

greatly inflated audital bullæ; teeth smaller; nasals broad and truncate posteriorly; triangular plate of jugal especially well developed and greatly produced at downward point; posterior border of inflected angle of mandible nearly at right angle with axis of jaw (in *ludovicianus* at an angle of about 45° with axis); the indistinct grooves along inner half of face of upper incisors usually more noticeable than in other forms.

Measurements.—Averages of 8 adult males from La Ventura, Coahuila: Total length, 416 (390–430); tail vertebræ, 102 (89–115); hind foot, 63 (59–68.5). *Skull*: Condylbasal length, 59.3 (58.4–60.5); zygomatic breadth, 44.6 (43–45.6); mastoid breadth, 28.6 (27.9–29.5); length of nasals, 23 (22.3–23.8); length of mandible, 43.8 (41.5–45.8); maxillary tooth row, alveoli, 15.9 (15.4–16.3). Females average slightly smaller. For detailed measurements of specimens, see page 35.

Type specimen.—No. $\frac{26423}{33336}$ U. S. National Museum, Biological Survey collection. Adult male, skin and skull (teeth moderately worn). Collected March 24, 1891, by C. P. Streater; original number 625. Except for the underparts, head, nape, and shoulders, which are in process of renewal, the specimen is in the worn, left-over winter pelage.

Remarks.—This is a well-marked species, easily distinguishable externally and by skull characters from the other forms of the genus. It is no more closely related to *Cynomys ludovicianus arizonensis* than to typical *ludovicianus*, and the southern subspecies *arizonensis* can not be considered as intermediate in the true sense between it and *ludovicianus*. In the excessive size of the audital bullæ, *mexicanus* is the extreme of the *arizonensis* type, but in other characteristics it more closely resembles *ludovicianus*, and is separated from both by a number of constant differences. It is completely isolated in its distribution from other forms of *Cynomys* and occupies only a limited range.

Specimens examined.—Total number, 42, as follows:

Coahuila: La Ventura, 37 (including type); Saltillo, 5.¹

Subgenus LEUCOCROSSUROMYS nov.

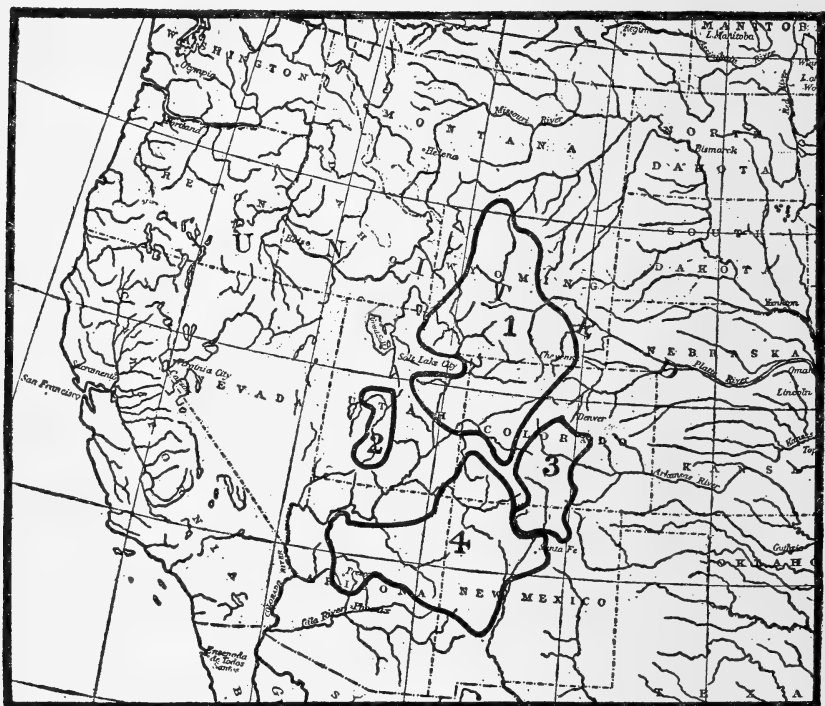
Characters.—Size slightly smaller than in the subgenus *Cynomys*, general appearance more spermophile-like; tail short, averaging less than one-fifth the total length, and tipped with white; mammæ normally 10, rarely 12. *Skull*: General shape of occipital region, viewed from behind, elliptical-oval; jugal bone weak, thin, and flat, the outer surface at angle of ascending branch only very slightly thickened, the margin rounded, not triangular; maxillary root

¹ Collection Mus. Comp. Zool.

of zygoma correspondingly weak, the shelf and suprajugal arm not especially thickened. Teeth smaller than in the subgenus *Cynomys*, not so much expanded laterally.

Type species.—*Cynomys gunnisoni* (Baird).

Remarks.—The mountain-inhabiting group of prairie-dogs commonly known as the "white-tailed" species form a compact group clearly separated from the typical subgenus. It includes three well-



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FIG. 2.—Distribution of subgenus *Leucocrossuromys*: 1, *Cynomys leucurus*; 2, *C. parvidens*; 3, *C. gunnisoni*; 4, *C. g. zuniensis*.

marked species, *leucurus*, *parvidens*, and *gunnisoni*. In habits these are distinctly spermophile-like and in coloration they are peculiar. All have sharply marked areas of color above the eye and on the cheek, and have the tail tipped or bordered with white.

CYNOMYS LEUCURUS MERRIAM.

WHITE-TAILED PRAIRIE-DOG.

(Pl. III, fig. 1; Pl. IV, fig. 1; Pl. VII, fig. 5.)

1874. *Cynomys columbianus* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 294 (part; not *Arctomys columbianus* Ord, 1815).

1890. *Cynomys leucurus* Merriam, North Amer. Fauna No. 3, p. 59, September 11; North Amer. Fauna No. 4, p. 33, October 8.

1898. *Cynomys lewisii* Allen, Bull. Amer. Mus. Nat. Hist., X, p. 456, November 10 (not *Arctomys lewisii* Audubon and Bachman, 1854).

1904. *Cynomys lewisii* Trouessart, Cat. Mamm., suppl., p. 342.

Type locality.—Fort Bridger, Sweetwater County, Wyoming.

Geographic distribution.—Irregular areas in the mountainous parts of Montana, Wyoming, Utah, and Colorado. South from the Bighorn Basin, in southern Montana, across central and southwestern Wyoming into western Colorado and northeastern Utah; east to the Laramie Mountains, Wyoming, and into North Park, Colorado; south into the lower Gunnison Valley; west a few miles across the Bear River Divide into extreme northern Utah and, farther south, into the Green River valley. Chiefly Transition Zone.

Characters.—Size, largest of the subgenus, only slightly smaller than in *Cynomys ludovicianus*, but tail much shorter; general coloration less reddish, more grayish buff than in *C. parvidens*; differs from *C. gunnisoni* in having terminal half of tail entirely white; supraorbital spot and cheek dark brown.

Color.—*Adult in fresh summer pelage*: General color of upper parts yellowish buff, streaked with blackish. Nose yellowish buff, unmarked; spot above eye and large area on cheek dark blackish brown; ears pale cinnamon. Top of head to center of tail uniformly mixed pale cinnamon-buff or yellowish buff and blackish; the individual hairs black at bases, then light gray, then pale cinnamon, with subterminal band of buff and, in unworn condition, tip of blackish. Limbs, feet, and underparts clear buffy; nails blackish, tipped with light horn. Tail white, the hairs of proximal half above with bands of blackish, below pale cinnamon; distal half clear white. *Adult in fresh winter pelage*: Decidedly darker than in summer; more blackish above, especially posteriorly; the buff tints richer in tone and the dark areas on head considerably spread out, less sharply defined. There is a heavy underfur of grayish white, but the bases of all the hairs are clear black; sides of nose, chin, and throat white; nape and flanks lighter, more grayish, than back and rump. *Juvenile pelage*: Above grayish brown; below paler grayish; supraorbital spot of brownish black sharply marked. *Postjuvenile pelage*: Specimens in first fresh autumnal coat darker than adults, more reddish, and hairs of upperparts more heavily tipped with blackish.

Adults in the faded, left-over winter coat are often very yellowish above, with little or no black streaking from the hair tips. Many specimens in various stages of molt and renewal present strange combinations of color. Examples deeply stained by color from the soil are frequently noted.

Molt.—The two annual molts are greatly affected by altitude, with a consequent variation of a month or more in near-by localities. In Wyoming the molt is approximately as follows: Specimens taken

before May 10 are still in the old winter coat, with little evidence of molt. Skins collected from May 20 to June 1 have renewed over most of the underparts and somewhat on the head and shoulders. Numerous examples taken from June 1 to 10 are all in fresh coat except on the lower rump and tail. Skins collected July 15 to 30 are in full summer coat. By August 10 there is much evidence of wear over the forward half of body, and by early September the fall renewal has commenced. As in the case of *C. ludovicianus*, this progresses forward, and by September 25 to October 1 is complete.

Skull.—Larger than in *C. parvidens* or *C. gunnisoni*; otherwise much like skull of *parvidens* but with narrower interorbital region. Differs further from skull of *gunnisoni* in the less broadly spreading maxillary arm of zygoma, large and flat mastoids, larger audital bullæ, and less rounded inferior rim of angle of ascending branch of jugal; occiput viewed from behind broader and flatter.

Measurements.—Averages of 13 adult males from Wyoming: Total length, 358 (340–370); tail vertebræ, 57 (44–60); hind foot, 62 (60–65). *Skull*: Condylbasal length, 58.7 (56–61.3); zygomatic breadth, 43.8 (41.7–45.4); mastoid breadth, 29 (27.4–30); length of nasals, 22 (20.7–23.1); length of mandible, 43.1 (41.6–44.9); maxillary tooth row, alveoli, 15.7 (15.1–16). For detailed measurements of specimens see page 35.

Type specimen.—No. 186472, U. S. National Museum. Adult female, skin and skull (teeth moderately worn). Collected September 15, 1888, by Vernon Bailey; original number 224 (Merriam collection, skin 4668, skull 5319). In worn summer coat anteriorly and in fresh winter coat posteriorly.

Remarks.—In 1898, Dr. J. A. Allen¹ proposed that the name *Arctomys lewisii* of Audubon and Bachman be revived for this species. The specimen on which *Arctomys lewisii* was founded was recorded as No. 461 of the Zoological Society of London collection. In reply to my inquiry as to the possible existence of this type specimen in the British Museum, Mr. Oldfield Thomas wrote, under date of January 6, 1915, that the specimen is still preserved, is numbered 55.12.24.144 of the Museum register, but that it is a species of *Marmota*, and not of *Cynomys* as supposed by Dr. Allen.

The ranges of *Cynomys leucurus* and *C. gunnisoni* are not known actually to meet, but the ranges of *C. leucurus* and *C. ludovicianus* do meet, and for a short distance overlap, at several points in Montana and Wyoming. Both species are constantly enlarging their ranges, pushing out into new valleys, and consequently frequently find themselves in close proximity. Individuals of one species sometimes wander into villages of the other. In the Bighorn Basin, in Montana, Bailey found the species living in close proximity but always apart,

¹ Bull. Amer. Mus. Nat. Hist., X, p. 456, 1898.

although there was no natural barrier. Cary found them intermingling in colonies near Ishawooa, Wyoming, and Bailey captured a specimen of *leucurus* in a "town" of *ludovicianus* in Clark's Fork valley, Montana.

Except for what appears to be a slight average increase in size in the extreme southern portions of its range, the specimens of *C. leucurus* that have been assembled present a remarkably uniform appearance, both in coloration and in skull characters. There has been considerable misunderstanding in times past as to the western limit of distribution of this species. Many writers believed that its range extended to the Plains of the Columbia, and this mistake is one of the principal reasons for past confusion in nomenclature. As a matter of fact the animal is entirely unknown in Idaho, and crosses the Bear River Divide to the Wyoming-Utah boundary at only one place, so far as known. Regarding this western limit of distribution, Dr. Merriam has given me an interesting note. He tells of tracing the species, in 1913 and 1914, across the Utah-Wyoming boundary not far from Evanston, westward into Utah for a distance of six or seven miles where it stops abruptly.

Specimens examined.—Total number, 107, as follows:

Colorado: Beaver Creek to bridge over White River (Rio Blanco County), 2;^{1,2} Big Beaver Creek, 2;¹ Buford, 1; Canadian Creek, 2; Coyote Basin, 1;¹ Craig to Kelly's (Moffat County), 4;¹ Crawford, 1;¹ Douglas Spring, 1;¹ Escalante Hills, 1; Grand Junction, 17; Hayden, 1; Hebron, 1; Hell Creek (Jackson County), 1;¹ Meeker, 4; North Park, 1; Sand Creek to Snake River, 2.^{1,2}

Montana: Clark's Fork, 1; Sage Creek, 2.

Utah: Uinta Mountains, 1;³ Uncompahgre Indian Reservation, 3.²

Wyoming: Bear Creek, 1; Bighorn Basin, 1; Big Piney, 1; Big Sandy, 1; Bridger's Pass, 1; Cheyenne (west of), 2; Cumberland, 2; Deer Creek, 2; Dubois, 1; Fontenelle, 1; Fort Bridger, 10 (including type); Fort Steele, 2; Fossil, 1; Garrett, 2; Green River, 2; Independent Rock (25 miles southwest of), 1; Ishawooa, 1; Lander, 3; Laramie Mountains, 2; Lost Cabin, 1; Medicine Bow Mountains, 4; New Fork of Green River, 6; Otto, 1;² Pole Creek, 1; Shirley Mountains, 1; Spring Creek, 1; Sweetwater, 1; Woods Post Office, 5.

CYNOMYS PARVIDENS ALLEN.

UTAH PRAIRIE-DOG.

(Pl. III, fig. 2; Pl. IV, fig. 2; Pl. V, fig. 4; Pl. VII, fig. 4.)

1905. *Cynomys parvidens* Allen, Science Bull., Mus. Brooklyn Inst. Arts and Sci., I, no. 5, p. 119, March 31.

Type locality.—Buckskin Valley, Iron County, Utah.

Geographic distribution.—Mountain valleys of central Utah in the Sevier River region; south from Nephi to Iron and Garfield Counties.

¹ Collection E. R. Warren. ² Collection Amer. Mus. Nat. Hist. ³ Collection Mus. Comp. Zool.

Characters.—In general like *Cynomys leucurus* but smaller and with color of upperparts in summer and winter decidedly reddish or rich cinnamon, less buffy or grayish; tail with terminal half white, as in *leucurus*. Skull as in *leucurus*, but smaller, with greater interorbital breadth.

Color.—*Adult in late summer:* Entire upperparts of head and body cinnamon or dark buffy cinnamon, with very little admixture of buff or blackish hairs; the individual hairs blackish at bases, then narrowly pale buff, broadly cinnamon, and tipped with dark brown. Spot of black above eye very sharply marked; cheek patch of brown distinct; sides of nose pale buff; eye ring, ears, and limbs cinnamon; feet dark buff; lips and chin whitish; underparts buffy or cinnamon. Tail for half its length above concolor with rump; below cinnamon; terminal half all around white, without markings. *Adult in early winter pelage:* In general like summer coat but with dense underfur which is black at base, then light buff; upperparts rich cinnamon, the long hairs with broad bands of black and buff; sides of body yellowish buff, distinctly marked from color of back, and streaked by the bands of black on the longer overlying hairs.

Molt.—Owing to lack of material collected at certain seasons, the molt of *C. parvidens* is not well known. A single skin collected in the Sevier National Forest, May 19, is still entirely in the old winter coat. Specimens collected in late August and early September are mostly in rather worn summer coat, with little indication of molt. The tails are in freshly renewed pelage. Some specimens, taken the first week in September, are well advanced in renewal of winter pelage, with full underfur and long, fresh coat. Evidently the transition from summer to winter coat is gradual and obscure, without a distinct molt, much as in the animals of the northern part of the ranges of *C. ludovicianus* and *C. leucurus*. A series of skins collected in the Sevier National Forest, October 27 to November 3, are in full winter coat.

Skull and teeth.—Skull much like that of *C. leucurus*, but smaller and with greater interorbital breadth; postorbital processes less abruptly projecting. The teeth are not noticeably smaller.

Measurements.—Averages of 8 adult males from Utah: Total length, 338 (305–360); tail vertebræ, 43 (30–57); hind foot, 59 (55–61). *Skull:* Condylbasal length, 55.9 (53–57.9); zygomatic breadth, 42.2 (38.3–44.5); mastoid breadth, 28.6 (26.7–29.8); length of nasals, 21.8 (20.5–22.4); length of mandible, 42.3 (40.3–43.7); maxillary tooth row, alveoli, 15 (14.8–15.4). For detailed measurements of specimens see page 35.

Type specimen.—No. 28738, American Museum of Natural History, New York. Adult not sexed, but probably a male; skin and skull

(teeth moderately worn). Collected August 25, 1904, by George P. Engelhardt, on the Brooklyn Institute of Arts and Sciences expedition of 1904 (Museum of Brooklyn Institute No. 437). Skin in good condition, but not made up into a modern study specimen. It is in worn summer pelage, but with freshly renewed coat on the tail.

Remarks.—The relationship of this distinct species with *Cynomys leucurus* rather than with *C. gunnisoni* is clear. No evidence of intergradation with *leucurus* is found in the material of each form which I have examined, and every specimen of *C. parvidens* can instantly be distinguished by its marked reddish coloration. The superficial resemblance to certain specimens of *C. g. zuniensis* is striking, but the color of the tail and general skull characters are diagnostic. Specimens of this prairie-dog from many parts of its range and collected at all seasons, particularly early summer and late fall, are much needed.

Specimens examined.—Total number, 46, as follows:

Utah: Buckskin Valley, 18 (including the type¹ and paratype¹); Sevier National Forest, 28.

CYNOMYS GUNNISONI (BAIRD).

[Synonymy under subspecies.]

Characters.—Smaller than *Cynomys leucurus*; larger than *C. parvidens*; general coloration darker; tail gray, with white tip and white border on the terminal half (in *leucurus* and *parvidens* the terminal half of tail is entirely white). Skull smaller than in *leucurus*, larger than in *parvidens*; differs from both in more broadly spreading maxillary arm of zygoma; mastoids smaller and more obliquely placed, rather than in general occipital plane; audital bullæ smaller; occiput viewed from behind higher and less broadened; inferior rim of angle of ascending branch of jugal averaging less pointed, more rounded, with little trace of special lateral flattened surface.

Subspecies.—Two subspecies of *Cynomys gunnisoni* are here recognized. The typical race is confined to parts of Colorado and northern New Mexico, while a paler desert form, *C. g. zuniensis*, ranges from central New Mexico and southwestern Colorado to the San Francisco Mountain region and to the Hualpai Indian Reservation, Arizona.

CYNOMYS GUNNISONI GUNNISONI (BAIRD).

GUNNISON PRAIRIE-DOG.

(Pl. III, fig. 3; Pl. IV, fig. 3; Pl. V, fig. 5; Pl. VII, figs. 3, 6.)

1855. *Spermophilus gunnisoni* Baird, Proc. Acad. Nat. Sci. Philadelphia, VII, p. 334, April.

1857. *Cynomys gunnisonii* Baird, Gen. Rep. North Amer. Mamm., pp. xxv, 335.

1877. *Cynomys gunnisoni* Allen, Proc. Boston Soc. Nat. Hist., XVI, p. 294 (syn.).

¹ Collection Amer. Mus. Nat. Hist.

Type locality.—Cochetopa Pass, Saguache County, Colorado.

Geographic distribution.—Rocky Mountain region of central and central-southern Colorado and northern New Mexico. North into South Park, Colorado; east to El Paso, Fremont, and Huerfano Counties, Colorado; south into the Sangre de Cristo and Jemez Mountains, New Mexico; west to western Gunnison and Hinsdale Counties, Colorado, and to western Rio Arriba County, New Mexico. Chiefly Transition Zone, but also in Upper Sonoran and lower parts of Canadian Zone.

Characters.—Slightly smaller than *Cynomys gunnisoni zuniensis*, with smaller hind foot; coloration more buffy and blackish, less pinkish cinnamon and ochraceous. General coloration much as in *C. leucurus*, but averaging darker, and with only tip and border of terminal half of tail white.

Color.—*Adult in fresh summer pelage:* General coloration, except for tail, very much as in *C. leucurus*, but darker; averaging more drab, less yellowish, and the cheeks less sharply marked by dark patch. Tail for proximal half above concolor with back; distal half dark gray, bordered and tipped with white, and with subterminal band of blackish; underside of tail pale cinnamon, blending into white at tip, and edged with white. The fresh spring coat, which is glossy and much intermixed with blackish, rapidly turns a dull brown, the jet black hair tips having worn away or faded. *Winter pelage,* except for the tail, much like that of *leucurus*.

Molt.—There is a variation of about six weeks in the time of molt, according to altitude, but the average dates in Colorado are about as follows: Spring specimens are in the left-over winter coat or in various degrees of molt up to June 10 or July 1, when the pelage, with the exception of the tail, is entirely renewed. A few specimens have completely renewed the pelage on the tail as early as July 15, but numerous examples collected as late as August 10, still have the tail clothed in the old winter hair. The fresh coat rapidly loses its luster, and during the latter half of August the pelage becomes much worn over the anterior half of the body while the posterior half shows considerable influx of new hair. The molt is usually complete and the animal in full fresh coat again by September 15. Mid-October skins are in full long coat, with a dense underfur.

Skull.—Averaging smaller and of less robust build than skull of *C. g. zuniensis*. Readily distinguishable from skulls of *C. leucurus* by its considerably smaller size (see also specific skull characters, page 29).

Measurements.—Averages of 12 adult males from Saguache County and Fort Garland, Colorado: Total length, 340 (309–365); tail vertebrae, 53 (39–65); hind foot, 56 (52–59). *Skull:* Condylbasal length,

54.8 (52.4-56.5); zygomatic breadth, 42.5 (40.7-44.2); mastoid breadth, 27 (25.7-28.2); length of nasals, 20.5 (18.9-22.3); length of mandible, 41.9 (40.9-43.3); maxillary tooth row, alveoli, 14.5 (14-15). Females average slightly smaller. For detailed measurements of specimens see page 35.

Weight.—An adult male collected September 6 in the Jemez Mountains, New Mexico, weighed $1\frac{1}{2}$ pounds.

Type specimen.—No. 1636, U. S. National Museum. Skull of young adult, not sexed (teeth little worn). Collected in September, 1853, by F. Kreutzfeldt; original number 22. The museum catalogue shows that the skin (No. 501) was formerly preserved in the collection, but it has been lost for many years.¹

Remarks.—So far as known the ranges of *Cynomys gunnisoni* and *C. leucurus* do not actually meet at any point, although, as stated by Cary,² they are separated by only a very narrow strip in the Cimarron region. Though so much alike in general characters the two species seem perfectly distinct, with no evidence of intergradation. While chiefly a Transition Zone form, *gunnisoni* is common and at home in the Upper Sonoran valleys within its range, as throughout suitable places in the upper Rio Grande and San Luis Valleys, Colorado. The range of *gunnisoni* nearly if not quite meets that of the black-tailed prairie-dog at several points in the eastern foothill region of Colorado. Prof. Lantz noted a colony of *gunnisoni* in South Park, Colorado, in which black and partly black individuals were common, a dozen or more melanistic specimens being seen.

This dark form of *C. gunnisoni* intergrades directly with the paler race, next described, of the more arid parts of New Mexico and Arizona, but the two subspecies are well marked and the area of intergradation is small.

Specimens examined.—Total number, 111, as follows:

Colorado: Antonito, 2; Cascade, 1; Castrel's Ranch (Park County), 2;³ Cochetopa Pass, 30 (including type skull); Colorado City (northwest of), 3;³ Colorado Springs (west of), 1; Divide (Teller County), 2;⁴ Florissant, 2;⁴ Fort Garland, 20 (including some older skins labeled "Fort Massachusetts"); Fremont County, 2;⁵ Head of Rio Grande, 1;⁶ Pike's Peak, 3; Poncha Pass, 2;⁴ Querida, 2;⁴ Saguache, 4; Salida, 5;⁴, ⁶ Southfork, 2; Tarryall Creek (Park County), 1;⁴ Twin Creek, 1;³ Twin Lakes, 1; Wagon Wheel Gap, 12.^{3, 4, 6}

New Mexico: Costilla Pass, 3; Coyote Creek, 2; Gallinas Mountains, 1; Jemez Mountains, 1; La Jara Lake, 1; Moreno Valley, 2; Tres Piedras, 2.

¹ See Lyon and Osgood, Bull. 62, U. S. Nat. Mus., pp. 161-162, 1909.

² North Amer. Fauna No. 33, p. 95, 1911.

³ Collection Mus. Comp. Zool.

⁴ Collection E. R. Warren.

⁵ Collection Field Mus. Nat. Hist.

⁶ Collection Amer. Mus. Nat. Hist.

CYNOMYS GUNNISONI ZUNIENSIS SUBSP. NOV.

ZUNI PRAIRIE-DOG.

(Pl. III, fig. 4; Pl. IV, fig. 4; Pl. V, fig. 6.)

Type locality.—Wingate, McKinley County, New Mexico.

Geographic distribution.—Southwestern Colorado, extreme southeastern Utah, northwestern and west-central New Mexico, and north-central Arizona. North in western Colorado to Montrose County; northeast in New Mexico in the Rio Grande Valley to Espanola and east to Pecos and the Manzano Mountains; south on the west side of the Rio Grande Valley to Sierra and Socorro Counties, New Mexico; west in central Arizona to Prescott and the Hualpai Indian Reservation. Chiefly Upper Sonoran, but also in Transition Zone.

Characters.—Slightly larger than *Cynomys gunnisoni gunnisoni*, with larger hind foot and heavier skull. Coloration less buff and blackish, more pinkish cinnamon and ochraceous.

Color.—*Adult in fresh summer pelage*: General color of upperparts pale cinnamon, heavily streaked with lighter cinnamon-buff and blackish; individual hairs blackish at bases, then narrowly buff, then broadly cinnamon, with subterminal band of buff, and tip of blackish. Nose, lips, eye ring, and ears, buff; between eyes, between ears, and over nape darker brown, mixed with blackish; large area of blackish brown on cheek, and a smaller, sharply marked, blackish brown spot above eye; feet, limbs, and underparts pale cinnamon-buff. Basal half of tail above concolor with back; distal half mixed gray and white, bordered and tipped with clear white. The black tips to the hairs of the back rapidly wear away and the pelage becomes a uniform dull cinnamon, mixed with light buff. The distinctive markings of the head become more obscure. *Adult in fresh full winter pelage*: General color more grayish and buff, less cinnamon, than in summer, with greater admixture of blackish hairs on head and more of white and gray on body. General color of upperparts dark cream-buff, heavily mixed with pale buff and blackish, giving a decided grizzled appearance; underfur narrowly black, then broadly whitish; the long hairs with bands of black, pale cinnamon, and white, and narrow tips of black. Top of head and cheeks heavily intermixed with blackish, the spot over eye sometimes intense black; sides of nose, eye ring, ears, limbs, and sides of body rich cream-buff; lips and throat paler; underparts pale cinnamon. Tail above mixed gray and white, with a narrow sub-border of dark gray and border of clear white; below clear pale cinnamon, terminal half with faint sub-border of grayish brown and border and tip of creamy white. *Young examples* in the fresh postjuvenile pelage are more vinaceous or pinkish cinnamon than the corresponding pelage of *C. g. gunnisoni*.

Molt.—The molt of *C. g. zuniensis* is much more conspicuous than in the northern subspecies. May specimens are frequently in a very ragged state, with very little indication of renewal. Specimens in complete summer coat, including the tail, are rarely taken before July 1. The summer coat frequently is so rapidly worn and bleached as to change the entire appearance of the animal before there are any traces of the fall pelage. The new pelage of autumn first appears in adults over the posterior half of the body about September 1. No specimens in full winter coat have been seen which were killed earlier than November 1.

Skull.—As in *C. g. gunnisoni* but averaging larger and more heavily built.

Measurements.—Type specimen: Total length, 363; tail vertebræ, 53; hind foot, 60. *Skull:* Condylbasal length, 57.9; zygomatic breadth, 43.8; mastoid breadth, 29.1; length of nasals, 22.4; length of mandible, 43; maxillary tooth row, alveoli, 15.6. Averages of 9 specimens from Arizona: Total length, 355 (330–373); tail vertebræ, 62 (54–68); hind foot, 60 (57.5–62.5). *Skull:* Condylbasal length, 55.8 (51.9–57.8); zygomatic breadth, 43.5 (39.7–45.5); mastoid breadth, 27.4 (25.7–28.6); length of nasals, 21.9 (20.6–23.5); length of mandible, 42.7 (40.3–44.2); maxillary tooth row, alveoli, 14.5 (14.2–14.8). For detailed measurements of specimens see page 35.

Weight.—An adult male collected at Acoma, New Mexico, September 28, weighed 2 pounds.

Type specimen.—No. 137555, U. S. National Museum, Biological Survey collection. Adult male, skin and skull (teeth considerably worn). Collected at Wingate, New Mexico, June 26, 1905, by N. Hollister; original number 2374. Except on the tail the skin is in fresh summer pelage.

Remarks.—This well-marked-color subspecies of *Cynomys gunnisoni* occupies the arid southwestern part of the range of the species and is the common prairie-dog of large parts of New Mexico and Arizona. Material from southwestern Colorado is not plentiful, but the specimens examined indicate that the range of the pale form extends into that portion of the State. Specimens are wanting from the near-by section of Utah, where this form undoubtedly occurs. Specimens from Flagstaff, Arizona, and the vicinity of San Francisco Mountain in general are slightly darker, more drab, than skins from eastern Arizona and western and central New Mexico, but on the whole the form is very uniform in coloration throughout its range. While in the main an Upper Sonoran form, this prairie-dog is generally distributed in the Transition Zone parks of numerous mountain

ranges. In the Bear Spring Mountains, New Mexico, in 1905, I saw one nearly pure-white animal of this species. Bailey reports finding a mixed colony of individuals of this form and of *C. ludovicianus* near Pecos, New Mexico, and he captured specimens of each form at San Pedro, but the ranges of the two species rarely overlap.

Specimens examined.—Total number, 96, as follows:

Arizona: Agua Fria, 4;¹ Aubrey Valley, 1; Clarks Valley, Mogollon Mountains, 2;¹ Flagstaff, 7; Keams Canyon, 1; Kendrick Park, 4; Little Spring, 6; Mormon Lake, 5; San Francisco Mountain, 7; Spaulding's Ranch, Agua Fria Valley, 1;¹ Springville, 13, Winslow, 2.

Colorado: Bedrock, 2;² Cortez, 1;¹ Coventry, 1.²

New Mexico: Acoma, 1; Albuquerque, 7; Chusca Mountains, 2; Espanola, 2; Fairview, 2; Fruitland, 1; Liberty, 1; Magdalena, 3; Manzano Mountains, 1; Ojo Caliente, 2; Pecos, 3; Rio Alamosa, 3; San Augustine Plain, 2; San Mateo Mountains (Socorro County), 1; San Pedro, 1; San Rafael, 1; Thoreau, 2; Wingate, 3; Zuni Mountains, 1.

TABLES OF MEASUREMENTS.

Adult male specimens of Cynomys.

Species and locality.	Museum number.	Skin.			Skull.				Condition of molar teeth.
		Total length.	Tail vertebra.	Hind foot.	Condylbasal length.	Zygomatic breadth.	Mandible.	Maxillary tooth row.	
<i>C. ludovicianus ludovicianus.</i>									
Montana:									
Shelby Junction.....	66690	375	72	55	59.1	44.7	45.5	16.2	Moderately worn.
Do.....	66691	374	85	60	59.0	44.4	45.3	15.9	Do.
Darnall's Ranch.....	169447	410	95	65	62.5	46.6	47.7	16.9	Do.
North Dakota: Medora.....	161314	405	96	64	61.4	45.5	45.9	16.9	Much worn.
South Dakota:									
Fort Pierre.....	191426	373	76	62	61.0	45.2	45.8	16.8	Considerably worn.
Buffalo Gap.....	191428	384	90	63	60.8	43.8	46.4	16.8	Moderately worn.
Do.....	191429	360	84	61	59.5	42.9	45.0	16.6	Do.
Wyoming:									
Ishawooa.....	169493	396	93	64	60.6	45.2	45.8	17.0	Do.
Newcastle.....	65894	390	79	62	60.9	44.2	46.7	16.8	Do.
Nebraska:									
Kennedy.....	191427	392	78	57	61.4	44.8	46.1	16.8	Do.
Do.....	18678	390	92	63	59.2	45.7	44.8	16.5	Do.
Alma.....	110770	409	89	65	62.1	47.0	48.1	17.2	Do.
Colorado:									
Loveland.....	69521	370	82	62	60.2	45.5	46.0	17.1	Considerably worn.
Olney.....	69952	379	83	61	59.6	44.1	45.5	17.0	Moderately worn.
Do.....	70020	355	82	61	57.2	43.1	43.9	16.9	Do.
Kansas: Pendermis.....	87627	371	81	62	60.3	47.2	46.2	16.9	Considerably worn.
Oklahoma:									
Mount Scott.....	132440	375	115	63	61.5	44.2	47.2	17.3	Moderately worn.
Do.....	132441	376	104	63	59.6	44.8	45.9	17.0	Do.
Texas:									
Vernon.....	64783	365	82	61	60.6	44.4	46.4	16.8	Considerably worn.
Do.....	64784	413	93	60	63.6	48.1	47.3	16.6	Do.
Henrietta.....	64780	386	87	66	62.0	45.3	48.4	17.0	Moderately worn.

¹ Collection Amer. Mus. Nat. Hist.

² Collection E. R. Warren.

Adult male specimens of *Cynomys*—Continued.

Species and locality.	Museum number.	Skin.			Skull.				Condition of molar teeth.
		Total length.	Tail vertebrae.	Hind foot.	Condylbasal length.	Zygomatic breadth.	Mandible.	Maxillary tooth row.	
<i>C. ludovicianus arizonensis.</i>									
Texas:									
Altuda.....	23183	398	96	64	61.5	45.0	46.0	16.7	Moderately worn.
Do.....	23184	400	92	62	60.8	46.2	47.5	16.7	Do.
Do.....	23396	404	89	67	61.7	46.4	47.4	16.8	Much worn.
New Mexico:									
Silver City.....	51279	380	79	61	60.9	47.0	45.0	16.1	Do.
Dog Spring.....	20380	412	94	66	62.2	44.3	45.7	16.9	Do.
Animas Valley.....	58920	395	83	64	59.9	44.5	44.2	16.0	Do.
Chihuahua: Sierra en Media.....	99362	400	80	65	62.9	45.0	46.0	16.6	Do.
Arizona:									
Fort Huachuca.....	34029	412	97	60	61.8	45.2	46.8	16.6	Considerably worn
Do.....	34030	410	100	64	62.8	45.0	44.9	16.1	Much worn.
Do.....	34031	400	93	62	62.3	44.1	45.9	16.5	Do.
<i>C. mexicanus.</i>									
Coahuila:									
La Ventura.....	¹ 26423	419	107	63	59.2	45.6	43.9	16.3	Moderately worn.
Do.....	26426	430	106	64	59.9	45.0	43.9	15.5	Do.
Do.....	26428	415	103	61	59.5	44.7	44.0	15.9	Do.
Do.....	26429	415	102	59	58.5	43.0	42.8	15.8	Do.
Do.....	79546	415	115	64	58.7	44.4	45.8	15.4	Do.
<i>C. leucurus.</i>									
Wyoming:									
Ishawooa.....	169336	370	60	60	60.3	45.4	44.3	15.6	Much worn.
Spring Creek.....	56002	363	60	60	58.7	43.6	43.0	15.4	Moderately worn.
Fontenelle.....	147187	370	48	62	61.3	45.0	44.9	16.0	Much worn.
Cumberland.....	179515	368	60	63	59.9	44.4	44.6	15.9	Do.
Fort Steele.....	171457	367	52	61	59.2	44.9	44.1	15.3	Do.
Colorado:									
Escalante Hills.....	148145	382	65	67	59.4	44.8	45.8	16.1	Moderately worn.
Grand Junction.....	54111	361	55	64	59.9	44.7	44.0	15.6	Considerably worn.
<i>C. parvidens.</i>									
Utah:									
Buckskin Valley.....	158985	337	57	60	54.5	40.7	42.2	14.9	Moderately worn.
Do.....	158992	326	57	59	54.1	40.7	41.8	14.8	Do.
Do.....	158993	305	52	57	53.0	38.3	40.3	14.8	Little worn.
Sevier National Forest.....	206323	335	31	55	57.9	43.9	42.2	15.0	Moderately worn.
Do.....	206337	354	49	60	57.6	43.2	42.9	15.2	Do.
<i>C. gunnisoni gunnisoni.</i>									
Colorado:									
Cochetopa Pass.....	35845	343	52	53	53.8	40.7	41.1	14.7	Moderately worn.
Do.....	35849	323	41	52	52.4	41.5	40.9	14.0	Considerably worn.
Do.....	35854	330	45	56	54.9	42.6	42.5	14.7	Moderately worn.
Do.....	35855	332	45	56	54.9	42.5	42.5	14.6	Do.
Do.....	35856	331	52	55	54.4	42.7	41.4	15.0	Considerably worn.
Mew Mexico: La Jara Lake.....	134908	328	68	54	53.4	41.3	40.0	14.8	Do.
<i>C. gunnisoni zuniensis.</i>									
New Mexico:									
Thoreau.....	160752	340	60	57	53.8	41.1	41.6	14.5	Considerably worn.
Wingate.....	137555	363	53	60	57.9	43.8	43.0	15.6	Much worn.
Acoma.....	148290	360	60	62	55.9	43.5	44.5	15.4	Moderately worn.
Magdalena.....	167574	350	60	61	54.7	43.7	42.0	15.0	Much worn.
Ojo Caliente.....	167021	350	49	60	57.6	43.0	42.2	15.1	Considerably worn.
Arizona:									
Springville.....	24653	355	63	60	55.2	43.4	42.8	14.7	Moderately worn.
Do.....	24654	357	70	60	55.0	43.2	41.7	14.6	Do.
Flagstaff.....	201638	356	64	59	56.4	44.0	42.7	14.3	Much worn.
Kendrick Park.....	202942	373	68	60	57.8	44.5	44.2	14.8	Do.
Little Spring.....	202556	363	54	58	55.9	45.0	42.9	14.4	Considerably worn.

¹Type.

Averages of adult male specimens of *Cynomys*.

Species and locality.	Number of specimens averaged.	Skin.			Skull.					
		Total length.	Tail vertebra.	Hind foot.	Condylbasal length.	Zygomatic breadth.	Maxillary breadth.	Nasals.	Mandible.	Maxillary tooth row.
<i>C. ludovicianus ludovicianus.</i>										
Montana.....	6	383	84	61	60.4	45.1	28.0	22.8	45.8	16.4
North Dakota.....	1	405	96	64	61.4	45.5	28.1	23.1	45.9	16.9
South Dakota.....	13	388	86	62	59.8	45.0	28.5	23.8	45.9	16.6
Wyoming.....	4	393	86	63	60.7	45.3	28.3	24.0	46.2	16.8
Nebraska.....	3	397	86	62	60.9	45.8	28.9	23.4	46.3	16.8
Colorado.....	4	364	82	62	58.9	44.1	27.8	23.1	45.1	16.9
Kansas.....	10	380	88	62	59.7	44.7	27.8	23.1	45.5	16.5
Oklahoma.....	2	376	110	63	60.6	44.5	28.3	23.5	46.6	17.2
Texas.....	7	392	88	62	61.5	45.5	29.0	24.5	46.9	16.7
<i>C. ludovicianus arizonensis.</i>										
Texas.....	7	395	88	64	60.3	44.7	27.7	24.3	46.5	16.6
New Mexico.....	18	381	84	62	60.1	44.3	28.0	23.8	45.0	16.2
Arizona.....	19	388	89	62	60.0	44.0	27.3	24.0	45.2	16.2
Chihuahua.....	1	400	80	65	62.9	45.0	29.1	23.5	46.0	16.6
<i>C. mexicanus.</i>										
Coahuila.....	8	416	102	63	59.3	44.6	28.6	23.0	43.8	15.9
<i>C. leucurus.</i>										
Wyoming.....	13	358	57	62	58.7	43.8	29.0	22.0	43.1	15.7
Colorado.....	6	368	56	63	60.0	44.6	29.8	22.6	45.0	15.6
<i>C. parvidens.</i>										
Utah.....	8	338	43	59	55.9	42.2	28.6	21.8	42.3	15.0
<i>C. gunnisoni gunnisoni.</i>										
Colorado.....	12	340	53	56	54.8	42.5	27.0	23.5	41.9	14.5
New Mexico.....	1	328	68	54	53.4	41.3	25.8	21.5	40.0	14.8
<i>C. gunnisoni zuniensis.</i>										
New Mexico and eastern Arizona.....	17	344	60	58	55.0	41.9	27.4	21.5	42.3	14.8
Arizona: San Francisco Mountain.....	9	355	62	60	55.8	43.5	27.4	21.9	42.7	14.5

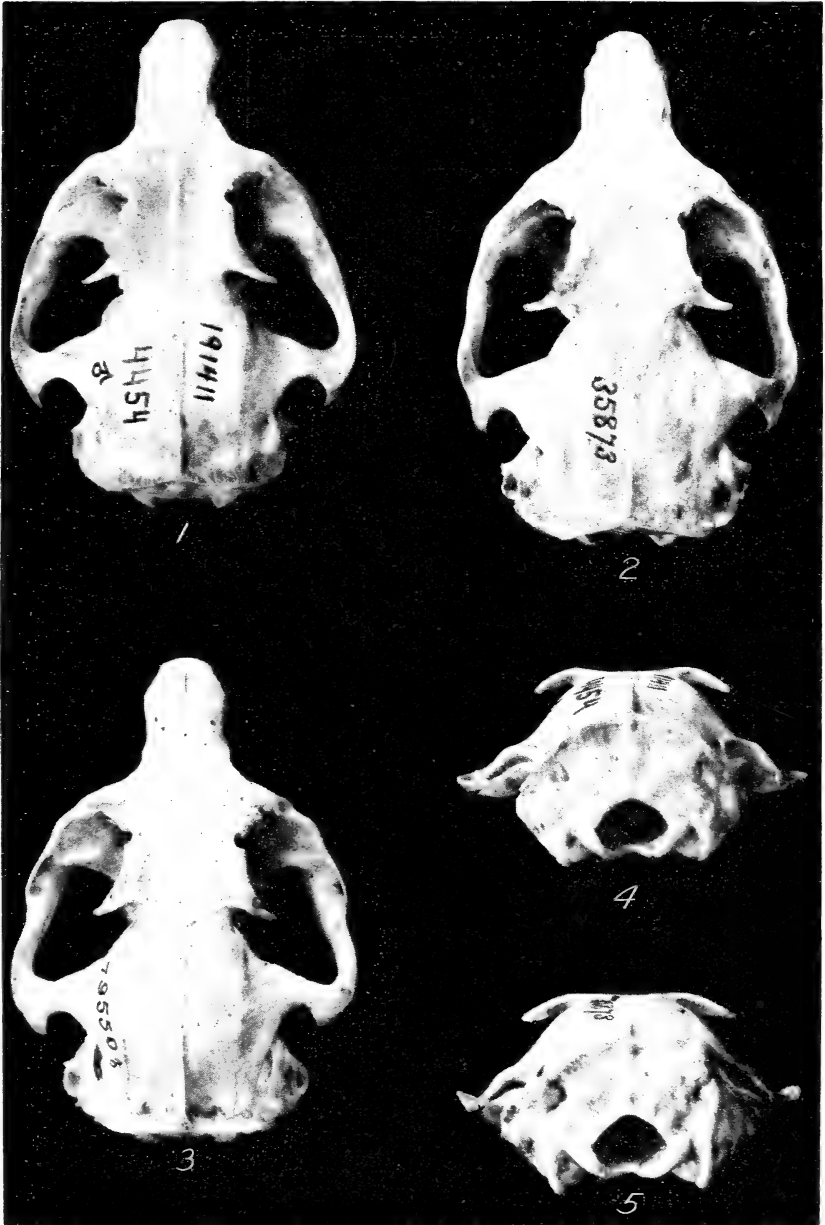
PLATE I.

(About natural size.)

Figs. 1 and 4. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Glendive, Montana. (No. 191411, U. S. Nat. Mus.)

Figs. 2 and 5. *Cynomys ludovicianus arizonensis* Mearns. ♂ ad. San Pedro River, Arizona. (No. 35873, U. S. Nat. Mus.)

Fig. 3. *Cynomys mexicanus* Merriam. ♂ ad. La Ventura, Coahuila, Mexico. (No. 79550, U. S. Nat. Mus., Biological Survey collection.)

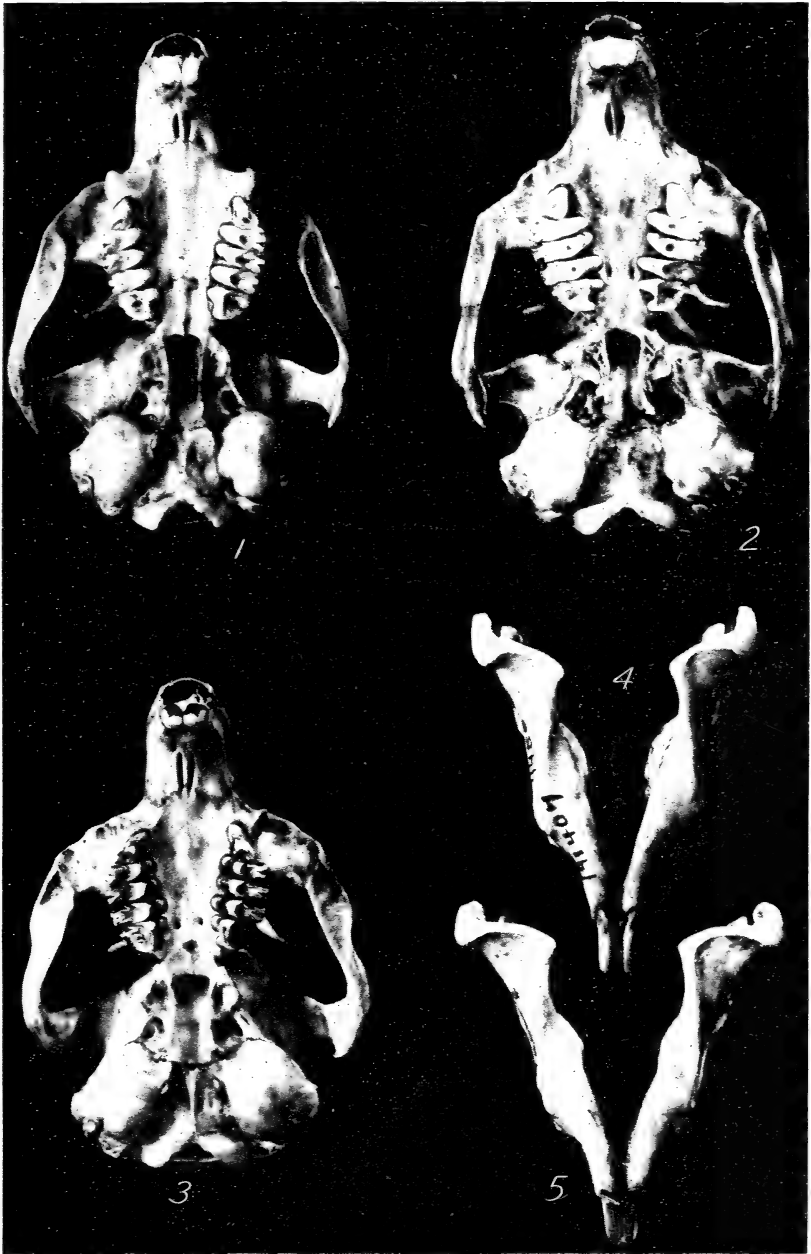


SKULLS OF CYNOMYS.
1, 4. *C. l. ludovicianus*.
2, 5. *C. l. arizonensis*.
3. *C. mexicanus*.

PLATE II.

(About natural size.)

- Fig. 1. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Glendive, Montana. (No. 191411, U. S. Nat. Mus.)
- Fig. 2. *Cynomys ludovicianus arizonensis* Mearns. ♂ ad. San Pedro River, Arizona. (No. 35873, U. S. Nat. Mus.)
- Fig. 3. *Cynomys mexicanus* Merriam. ♂ ad. La Ventura, Coahuila, Mexico. (No. 79550, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 4. *Cynomys ludovicianus ludovicianus* (Ord). ♀ ad. Glendive, Montana. (No. 191407, U. S. Nat. Mus.)
- Fig. 5. *Cynomys mexicanus* Merriam. ♀ ad. La Ventura, Coahuila, Mexico. (No. 79554, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF CYNOMYS.

- 1, 4. *C. l. ludovicianus*.
- 2. *C. l. arizonensis*.
- 3, 5. *C. mexicanus*.

PLATE III.

(About natural size.)

- Fig. 1. *Cynomys leucurus* Merriam. ♂ ad. Cumberland, Wyoming. (No. 179515, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 2. *Cynomys parvidens* Allen. ♀ ad. Buckskin Valley, Utah. (No. 158994, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 3. *Cynomys gunnisoni gunnisoni* (Baird). ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 4. *Cynomys gunnisoni zuniensis* Hollister. ♂ ad. Wingate, New Mexico. (Type, No. 137555, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF CYNOMYS.

B2114-129

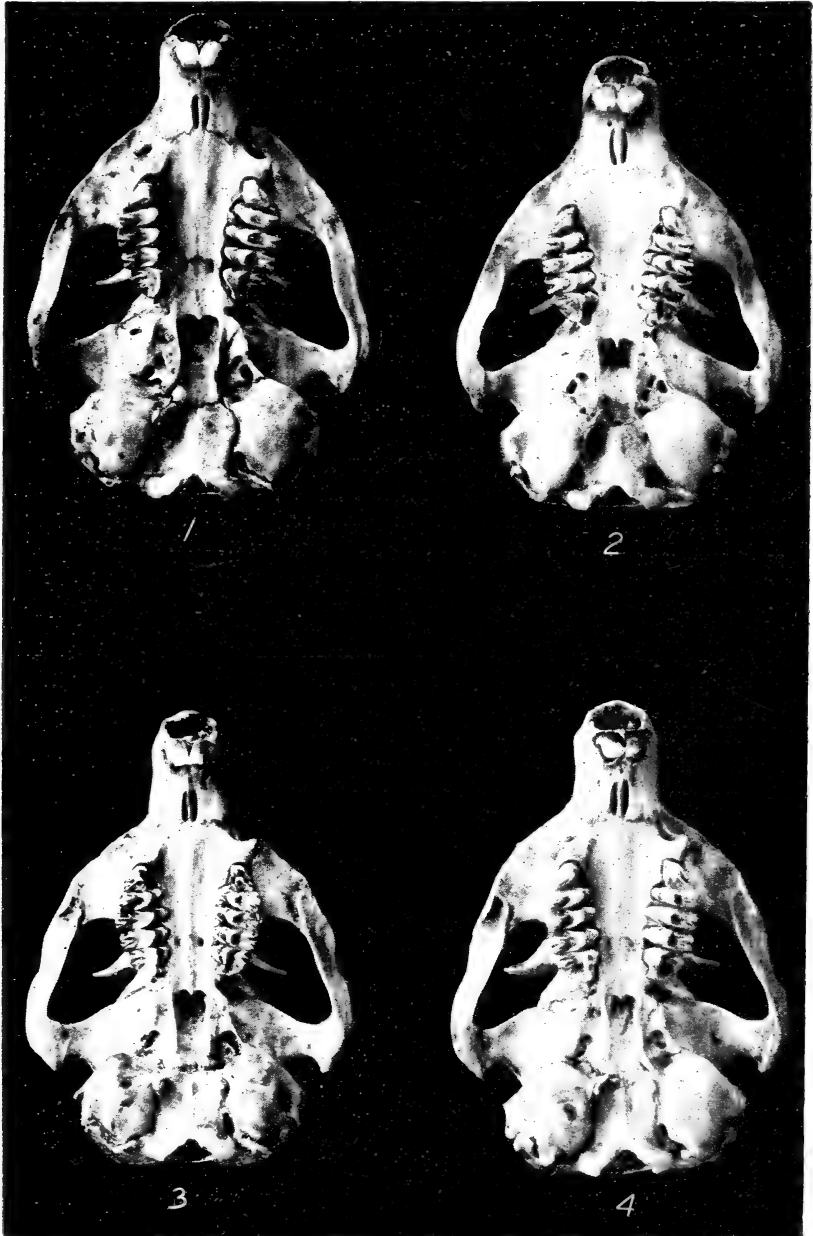
- 1. *C. leucurus*.
- 2. *C. parvidens*.

- 3. *C. g. gunnisoni*.
- 4. *C. g. zuniensis*.

PLATE IV.

(About natural size.)

- Fig. 1. *Cynomys leucurus* Merriam. ♂ ad. Cumberland, Wyoming. (No. 179515, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 2. *Cynomys parvidens* Allen. ♀ ad. Buckskin Valley, Utah. (No. 158994, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 3. *Cynomys gunnisoni gunnisoni* (Baird). ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 4. *Cynomys gunnisoni zuniensis* Hollister. ♂ ad. Wingate, New Mexico. (Type, No. 137555, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF CYNOMYS.

B2115-129

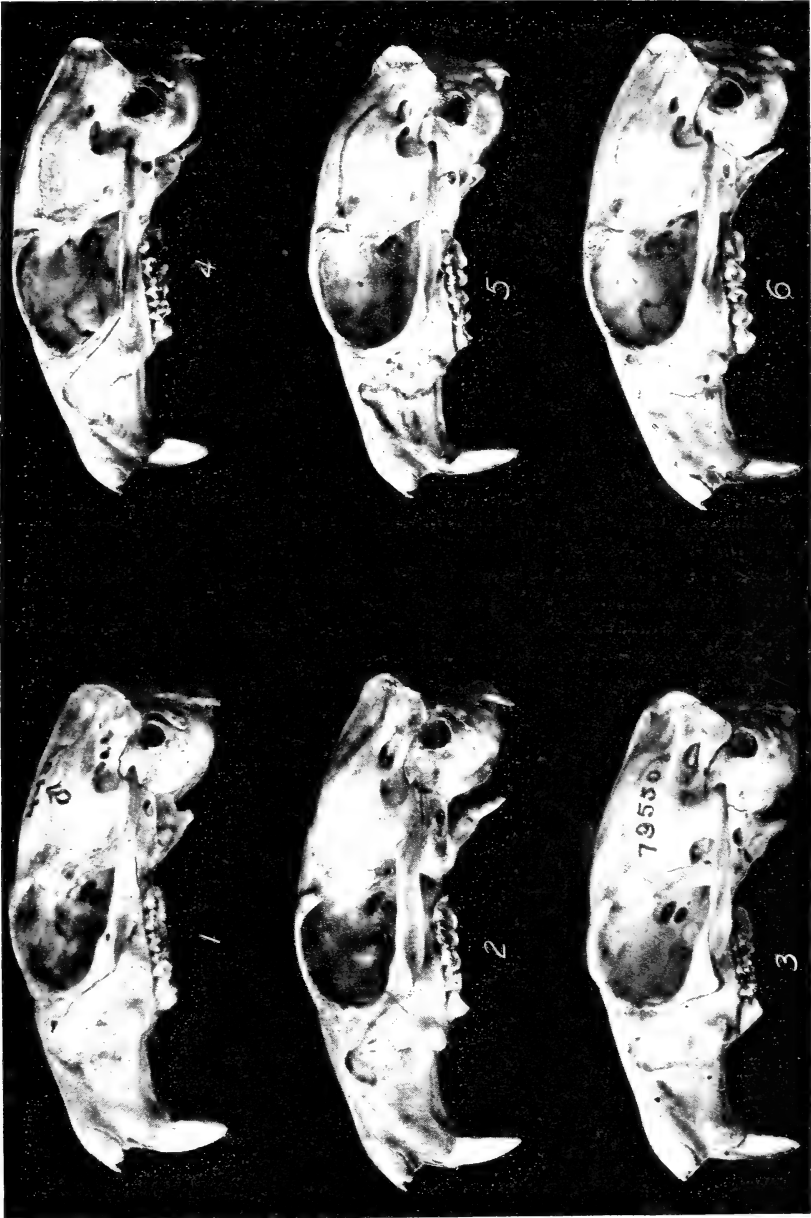
- 1. *C. leucurus*.
- 2. *C. parvidens*.

- 3. *C. g. gunnisoni*.
- 4. *C. g. zuniensis*.

PLATE V.

(About natural size.)

- Fig 1. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Glendive, Montana. (No. 191411, U. S. Nat. Mus., Merriam collection, original number, 4454.)
- Fig. 2. *Cynomys ludovicianus arizonensis* Mearns. ♂ ad. San Pedro River, Arizona. (No. 35873, U. S. Nat. Mus.)
- Fig. 3. *Cynomys mexicanus* Merriam. ♂ ad. La Ventura, Coahuila, Mexico. No. 79550, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 4. *Cynomys parvidens* Allen. ♀ ad. Buckskin Valley, Utah. (No. 158994, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 5. *Cynomys gunnisoni gunnisoni* (Baird). ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 6. *Cynomys gunnisoni zuniensis* Hollister. ♂ ad. Wingate, New Mexico. (Type, No. 137555, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF CYNOMYS.

1. *C. l. hollywoodianus*. 2. *C. l. arizonensis*. 3. *C. mexicanus*. 4. *C. parvidens*. 5. *C. g. gunnisoni*. 6. *C. g. zuniensis*.

8310-13

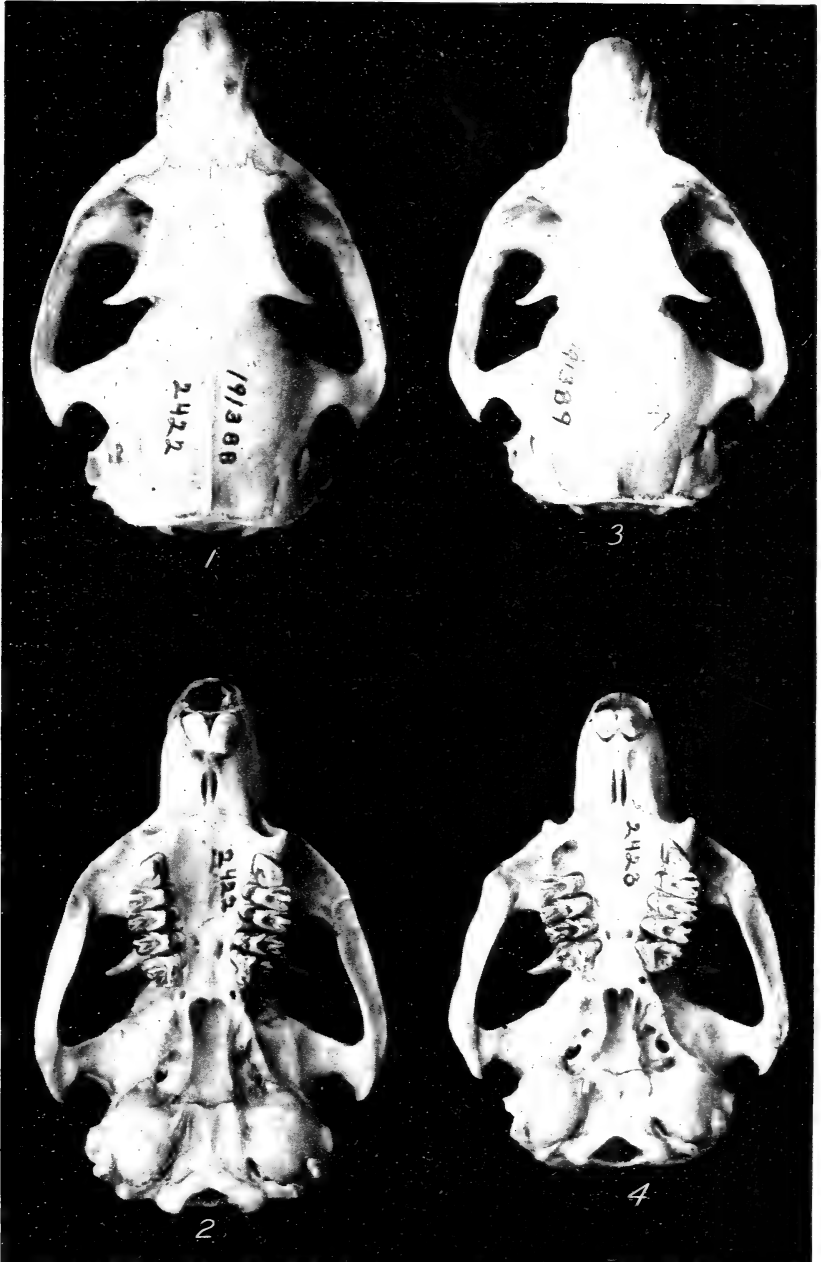
PLATE VI.

(About natural size.)

Figs. 1 and 2. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Mason, Texas.
(No. 191388, U. S. Nat. Mus.)

Figs. 3 and 4. *Cynomys ludovicianus ludovicianus* (Ord). ♂ ad. Mason, Texas.
(No. 191389, U. S. Nat. Mus.)

Selected skulls of same sex and age from one locality; to show the great individual variation frequently noted in skulls of *Cynomys*.

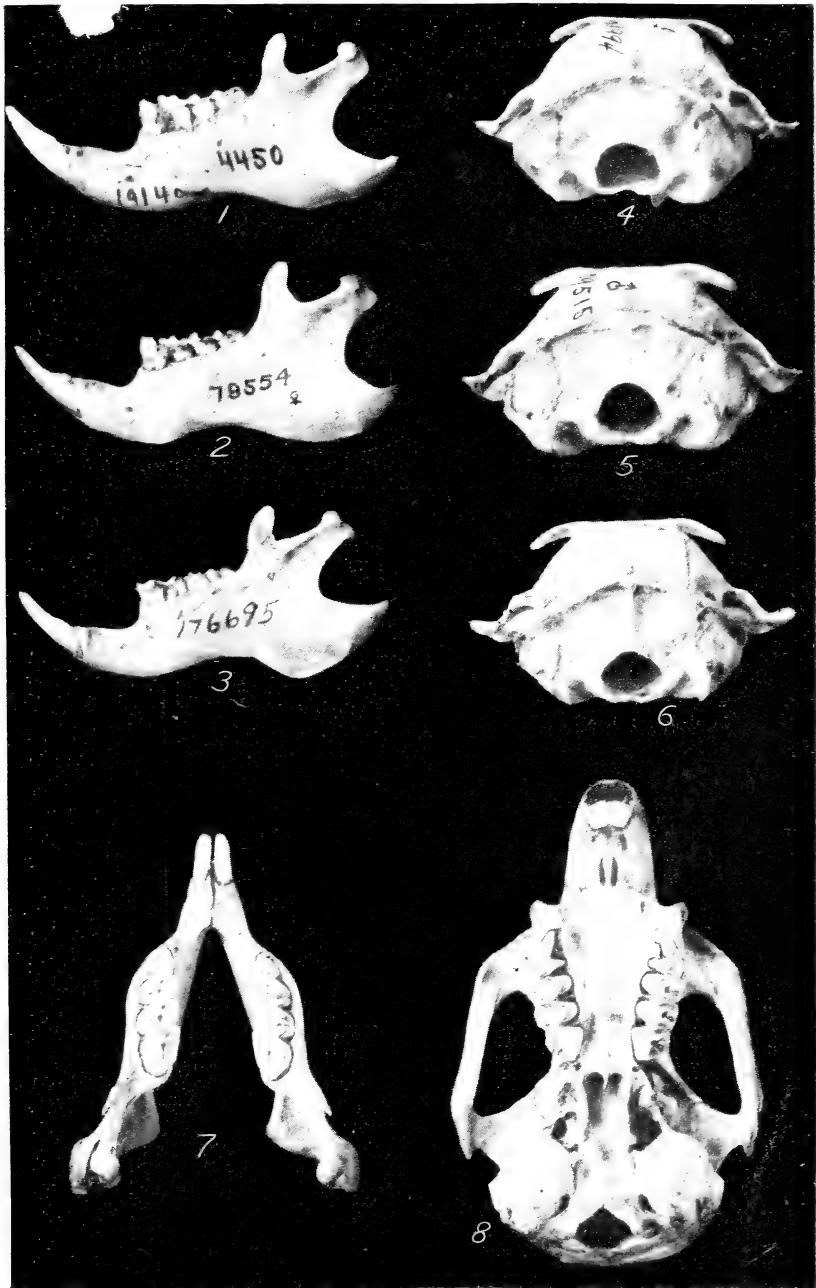


SKULLS OF *CYNOMYS LUDOVICIANUS LUDOVICIANUS*.

PLATE VII.

(About natural size.)

- Fig. 1. *Cynomys ludovicianus ludovicianus* (Ord), left mandibular ramus. ♀ ad. Glendive, Montana. (No. 191407, U. S. Nat. Mus.)
- Fig. 2. *Cynomys mexicanus* Merriam, left mandibular ramus. ♀ ad. La Ventura, Coahuila, Mexico. (No. 79554, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 3. *Cynomys gunnisoni gunnisoni* (Baird), left mandibular ramus. ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 4. *Cynomys parvidens* Allen. ♀ ad. Buckskin Valley, Utah. (No. 158994, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 5. *Cynomys leucurus* Merriam. ♂ ad. Cumberland, Wyoming. (No. 179515, U. S. Nat. Mus., Biological Survey collection.)
- Fig. 6. *Cynomys gunnisoni gunnisoni* (Baird). ♂ ad. Saguache, Colorado. (No. 176695, U. S. Nat. Mus., Biological Survey collection.)
- Figs. 7 and 8. *Cynomys ludovicianus ludovicianus* (Ord). ♀ juv., showing milk premolars and unworn crowns of molars. Ishawooa, Wyoming. (No. 169674, U. S. Nat. Mus., Biological Survey collection.)



SKULLS OF CYNOMYS.

B2119-129

- 1, 7, 8. *C. l. ludovicianus*.
- 2. *C. mexicanus*.
- 3, 6. *C. g. gunnisoni*.

- 4. *C. parvidens*.
- 5. *C. leucurus*.

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[New names in **bold-face type**; synonyms in *italics*.]

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