U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 17

[Actual date of publication, June 6, 1900]

REVISION OF AMERICAN VOLES OF THE GENUS MICROTUS

BY

VERNON BAILEY
CHIEF FIELD NATURALIST

Prepared under the direction of

Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1900

COMMON VOLE OR MEADOW MOUSE (*Microtus pennsylvanicus*).

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 17

[Actual date of publication, June 6, 1900]

REVISION OF AMERICAN VOLES OF THE GENUS MICROTUS

BY

VERNON BAILEY
CHIEF FIELD NATURALIST

Prepared under the direction of

Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1900

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Washington, D. C., March 10, 1900.

Sir: I have the honor to transmit for publication, as No. 17 of North American Fauna, 'A Revision of the American Voles of the Genus *Microtus*,' by Vernon Bailey, Chief Field Naturalist of the Biological Survey.

Respectfully,

C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

No. 17. NORTH AMERICAN FAUNA. June, 1900.

REVISION OF AMERICAN VOLES OF THE GENUS MICROTUS.

By Vernon Bailey.

INTRODUCTION.

The following synopsis of American voles is based on a study of between 5,000 and 6,000 specimens from more than 800 localities, including types or topotypes of every recognized species with a known type locality, and also types or topotypes of most of the species placed in synonymy. Voles, or meadow mice, occur throughout the greater part of the northern hemisphere north of the Tropics. In North America both species and individuals reach their maximum abundance in the Canadian and Transition zones, and from this broad belt the number of species decreases on both sides. On the north a few species occur in the Hudsonian and Arctic zones, and individuals are abundant even in the barren grounds, or 'tundras,' north to the arctic coast. South of the Transition zone the decrease in species and individuals is rapid. In the Upper Austral zone they are scarce; in the Lower Austral rare and exceedingly local; while in the Tropical only a single species, of very limited distribution, is known. To the south, as individuals decrease in abundance and species become restricted to distinct areas, the degree of specific and superspecific differentiation becomes more and more marked. Of the nine American subgenera, one (*Neofiber*) is confined to Florida, and two (*Orthriomys* and *Herpetomys*) are restricted to two isolated mountains in southern Mexico. Another (*Pitymys*) is mainly Austral, and is confined to the southeastern United States and a small area in southeastern Mexico. Three others (*Pedomys*, *Lagurus*, and *Chilotus*) are found mainly in the Transition zone, and reach but little north of the United States. The subgenus *Arvicola* belongs to mountains in the Hudsonian and Canadian zones; and the polymorphous subgenus *Microtus* is the only one that enters the arctic regions.

Voles adapt themselves to the most diverse conditions of environment. Many of the species inhabit moist or wet ground and several are mainly aquatic; others inhabit areas of excessive humidity, while

a few live in dry and even arid regions. Some live in the perpetual shade of dense forests, others are exposed to the full effects of light on the open plains. Some of the most striking peculiarities of the different species result from these different conditions of environment. The development of oil and musk glands is most pronounced in the aquatic species of the subgenera *Neofiber* and *Arvicola* and least in the subgenera *Lagurus* and *Pedomys* of the dry regions. The color is palest in species most exposed to light and dryness, as in *curtatus* and *pallidus*, and darkest and richest in species from shaded and humid areas, as in *quasiater* and *umbrosus*.

The ranges of most of the species and subspecies conform to the limits of well-defined life zones, except in the subaquatic species, which follow water courses and often have the appearance of being out of their proper zones.

HABITS.

Certain peculiarities of habits are common to nearly all of the species. None are known to hibernate, but in the North they have snug winter homes under the snow, where they move about freely in numberless tunnels. They burrow in the ground, and are famous for their little roads or smooth trails which run through the grass from burrow to burrow or away to their feeding grounds. Bulky nests of grass and soft plant fibers are placed in underground cavities, or on the surface of the ground under cover of snow, logs, or dense vegetation. The nest is depressed globular in form, with an open chamber in the center, which contains a soft bed, and has one or two round entrances at the sides. These nests are the sleeping places of the old and the nurseries of the young. They are kept surprisingly clean and fresh, and new ones are frequently made to take the place of those that are old or imperfect.

Breeding.—Voles seem to have no definite breeding season. Four to eight young are usually produced at a birth, and as far north as Minnesota I have found them in the nests at all seasons of the year. Their increase is accordingly very rapid, and is only partially counterbalanced by the host of enemies that prey upon them. They form the principal food of nearly all owls and some hawks, while weasels, minks, foxes, coyotes, cats, badgers, skunks, and many other animals, as well as certain snakes, feed extensively on them. But in spite of their enemies they seem to hold their own, and tend to increase faster as the country becomes more thickly settled and the larger mammals and birds are destroyed.

Food.—Meadow mice choose a somewhat varied diet, but their food consists mainly of green vegetation, roots, and bark. Grass, especially the tender base of grass stems, forms the bulk of their food, but almost every plant with which they come in contact is eaten to some extent. Bark, both from roots and trunks of trees and shrubs, is a favorite winter food. Seeds and grain are eaten when found, but are not especially sought; flesh in any form is never refused. As the animals are

active all winter and food is always abundant, they do not ordinarily lay up stores, although Mr. E. W. Nelson found *M. operarius*, of Alaska, storing roots.[1]

ECONOMIC STATUS.

Injury to trees and crops.—Though small enough to be commonly called mice (meadow mice, upland mice, field mice, pine mice, ground mice, bear mice, etc.), they make up in numbers what they lack in size, and over the whole breadth of the continent lay a heavy tribute on many products of the farm. Too small and too numerous to be successfully destroyed by traps, guns, or poison, they prove one of the most difficult enemies with which the farmer has to contend. If they would confine themselves to meadows, their mischief would be limited to the destruction of a comparatively small amount of grass; but they prefer growing grain to grass, and by running long tunnels under ground, or making little paths under cover of the vegetation, gain easy and safe access to the fields. With a stroke of their chisel-like teeth they fell the stalks of wheat and oats and eat the tender parts, together with some of the grain. It is so easy to cut down the stalks that they destroy many times as much as they need for food. The work of a few animals is insignificant, but the work of millions makes heavy inroads on growing crops. Later in the season, when the grain is cut and left standing in shocks or stacks, the field mice take possession, building their nests and establishing their homes under its cover. In shocks of corn and wheat left for a long time the grain is often completely devoured, and that remaining all winter in stacks suffers in proportion to the number of the little animals that make their homes in it. Even stacks of hay are often found in spring with the lower parts cut to chaff and filled with the nests of meadow mice.

When the snow comes these little rodents can safely leave their cover of weeds, grass, or bushes and plow their way under the snow on long exploring expeditions. The tunnels thus formed remain as open passages until the snow melts in spring, giving the animals free and safe conduct from the meadows to the uplands, into fields, orchards, gardens, and nurseries. There is no sign from above of what is happening below the surface; but later on, in spring, when the snow disappears, trees and shrubs are found stripped of their bark for a wide space near the ground. The marks of tiny teeth remain in the hard wood, and little piles of dry outer bark, mixed with characteristic pellets of excreta, show what animal has been at work. The uncovered roads may be seen leading from tree to tree, to winter nests on the surface of the ground, and back to the cover of brush or meadows. Shrubs and small trees are often stripped of their bark and killed, and sometimes even well-grown apple trees, 10 inches or a foot in diameter, are completely girdled. Usually, however, large trees are

[1] Proc. Biol. Soc. Wash., VIII, 140, 1893.

gnawed on only one side. In this case, although they are not killed at once, the wood thus exposed usually decays in a few years, the trees become hollow at the base, their productiveness is impaired, and they die prematurely.

Protection of trees from voles.—Various means have been resorted to for protecting fruit trees and shrubs from these ravages, but with only partial success. Wire netting and tin cylinders placed around the bases of the trees in autumn are generally considered the surest protection, but in most cases this is too expensive to be practicable. Wrapping the trunks with burlap or twisted ropes of straw, or coating them with whitewash, tar, or other unpalatable substances, are common methods of protection used with varying degrees of success. But as some species of voles eat the bark from the roots below the surface of the ground, none of these resources insure perfect protection.

Destruction of voles.—The importance of placing every possible check on the increase of these animals and of reducing their numbers when they become too numerous is obvious. No direct method of accomplishing these ends has as yet been devised, but the desired result can be attained indirectly by avoiding or preventing the useless destruction of their natural enemies. Owls and some species of hawks live almost exclusively upon them, watching for them night and day in the grass, and are always ready to pounce on any that appear above the snow. Weasels run through their burrows and trails, and not only kill enough for food, but destroy great numbers for the mere pleasure of killing. In spite of these well-known and often reiterated facts, bounties are still paid for the destruction of hawks and owls in counties where the annual loss in fruit trees and grain from the ravages of field mice if computed would amount to a startling sum. In the spring of 1895 I examined a small apple orchard in Washtenaw County, Mich., in which several choice trees had been killed and many others injured during the preceding winter by the common vole (*Microtus pennsylvanicus*). The owner of the orchard considered $50 a low estimate of the damage done. At the same time the county of Washtenaw was taxing the farmers to pay a bounty of 25 cents each on all hawks and owls, while the several gun clubs of the county gave these birds a high count in their competitive hunting matches. Many similar instances could be cited. Who was ever known to miss an opportunity to destroy a hawk or weasel? The diminution of foxes, minks, coyotes, and such predatory mammals may be necessary, but if so, the protection and encouragement of other less harmful species becomes doubly important, and in fact imperative, if we are to escape such devastating hordes of voles as have occasionally swept over certain parts of Europe, particularly in Scotland,[1] Germany,[2] Italy,[2] Russia,[2] and Thessaly.[1]

[1] Parliamentary Report of Plague of Field Voles in Scotland, London, 1893.
[2] U. S. Consular Reports, L, No. 187, 539–543, 1896.

DETERMINATION OF SPECIES.

It is not many years since certain prominent writers treated as mere varieties, or subspecies, animals that belong to widely different subgenera, while others described and named with full specific rank every different condition of pelage in a single species. In some cases the original type was not preserved, or no type was designated by the describer, or still worse, the type locality was not given, so that subsequent writers renamed these same species or confounded them with others. The resulting confusion can now be cleared up by means of series of specimens collected within the past ten years at most of the known type localities, and in the general region of those not definitely known. The series of specimens available, and the number of localities represented, make it possible to define almost every North American species from typical specimens, and in most cases to give the various changes of pelage due to season and age. When possible, the original types have been compared with the new series of specimens from the type localities, and in this way the names *californicus*, *trowbridgi*, *edax*, *occidentalis*, *townsendi*, *longirostris*, and *modestus* have been sifted out with the following result: *californicus* stands for a widely distributed western species with *trowbridgi* as a synonym; *edax* as a well-marked species, but one in which the name has been persistently misapplied; *occidentalis* as a synonym of *townsendi*; *longirostris* as a synonym of *montanus*; and *modestus* as a western form of *pennsylvanicus*. The type of *montanus* is lost, but a series of 57 specimens from the type locality agrees with Peale's description of the species. The types of *modestus* and *edax* are immature specimens made up with the skulls inside the skins. It was only by the removal of the skulls that even the group to which the species belonged could be determined.[1]

MATERIAL EXAMINED.

The following synopsis of the genus *Microtus* is based mainly on a study of specimens in the collection of the Biological Survey and that of Dr. C. Hart Merriam, both of which are in the United States National Museum. For the use of much additional material, including types and topotypes, my thanks are heartily extended to Dr. F. W. True, executive curator, and Mr. Gerrit S. Miller, jr., assistant curator of mammals, United States National Museum; to Dr. J. A. Allen, curator of mammals and birds, and Mr. Frank M. Chapman, assistant curator, American Museum of Natural History; to Mr. D. G. Elliot, curator of the Department of Zoology, Field Columbian Museum; and to Mr. Outram Bangs. Most of all, I am indebted to Dr. C. Hart Merriam,

[1] Through the kindness of Dr. True and Mr. Miller, skulls have also been removed from a large number of specimens from Alaska and Arctic America, so that it has been possible for the first time to identify the species and make use of the localities in determining their ranges.

who, after doing much work on the genus, has placed his manuscript, drawings, and large private collection of specimens at my disposal, besides giving me constant criticism and advice. Among others who have contributed material or notes my thanks are especially due to Mr. E. W. Nelson, who has collected all the known Mexican species of *Microtus* and has contributed the notes on their zonal distribution.

Seventy species and subspecies are here recognized. Of these 54 actual types and series of topotypes of 13 additional forms have been examined, while of the three remaining forms, for which no type exists or is accessible and no definite type locality is known, specimens have been examined from the type region, or as near to it as can be determined. Three forms, *Microtus californicus constrictus*, *M. ludovicianus* and *M. scirpensis* are described as new. Except for a relatively small number of alcoholics and a few skeletons, the specimens are mostly well-prepared skins with cleaned skulls and are accompanied by collectors' measurements.

All measurements are in millimeters, and external measurements, unless otherwise stated, are taken in the flesh by collectors. Skull measurements are my own, made from perfect skulls unless otherwise stated. The skull drawings are by Dr. James C. McConnell. Most of the drawings of teeth have been used in previous publications of the Biological Survey.

Subfamily MICROTINÆ Cope.[1]

The subfamily *Microtinæ* includes the Voles of the genera *Microtus*, *Erotomys*, and *Phenacomys;* the Lemmings of the genera *Lemmus*, *Dicrostonyx*, and *Synaptomys;* and the Muskrats of the genus *Fiber*. As the genera and subgenera of the family have been recently treated in detail by Mr. Gerrit S. Miller, jr.,[2] it is only necessary to give briefly the characters distinguishing the genus *Microtus*.

Genus MICROTUS Schrank.

Generic characters.—Lower incisors with roots extending far behind and on outer side of molar series; upper incisors not grooved; molars rootless, with outer and inner reentrant angles approximately equal. Palate with median ridge, distinct lateral pits, complete lateral bridges[3] (not terminating in posterior shelf in any American species). Tail as long as or longer than hind foot, terete; claw of thumb pointed, not strap-shaped.

SUBGENERA.

Nine subgenera are here recognized among the living species of North America.[4] Five of these (*Chilotus*, *Pedomys*, *Herpetomys*, *Orthriomys*, and *Neofiber*) are found only in North America. The remaining

[1] *Microtidæ* Cope, Syllabus Lectures Geol. and Paleont., p. 90, 1891. *Microtinæ* Rhoads, Am. Nat., XXIX, 940, Oct., 1895.

[2] North American Fauna No. 12, Genera and Subgenera of Voles and Lemmings, 1896.

[3] Usually incomplete in *Neofiber*.

[4] The extinct species of *Microtus* are not included in the present paper.

four (*Microtus*, *Pitymys*, *Arvicola*, and *Lagurus*) include also Old World species. All of the nine subgenera, save *Microtus*, are sharply defined and easily distinguished by either cranial or external characters. The subgenus *Microtus* contains many more species than all of the other subgenera together, and species differing so widely that only the most general characterization can be applied to it. It is a composite group containing all forms that do not fit into the other more restricted subgenera and yet are not sufficiently differentiated to merit subgeneric rank.

KEY TO SUBGENERA OF MICROTUS.

m3 with 3 transverse loops and no closed triangles. Plantar tubercles 5 or 6.

m3 with 3 closed triangles,[1] mammæ 8.[2]

Plantar tubercles 6, side glands on hips in adult males (on flanks in *xanthognathus*) ..... *Microtus*

Plantar tubercles 5, side glands on flanks or else inconspicuous.

Side glands conspicuous on flanks of adult males, size large ..... *Arvicola*

Side glands obscure or wanting, size small ..... *Chilotus*

m3 with 2 closed triangles, mammæ 4 or 6.

Skull wide and flat, tail very short, fur short and dense, mammæ 4.. *Pitymys*

Skull high and narrow, tail medium, fur coarse, mammæ 6. ..... *Pedomys*

m3 with 2 transverse loops and 2 median triangles, plantar tubercles 5.

m1 with 5 closed [illegible]gles.

Side glands conspicuous in both sexes, mammæ 6, size very large, tail long ..... *Neofiber*

Side glands obscure, mammæ 8, size small, tail very short ..... *Lagurus*

m1 with 3 closed triangles.

m3 with 3 closed triangles, mammæ 6, tail short ..... *Herpetomys*

m3 with 2 closed triangles, mammæ 4, tail long ..... *Orthriomys*

LIST OF SPECIES AND SUBSPECIES, WITH TYPE LOCALITIES.

Microtus abbreviatus Miller. Hall Island, Bering Sea, Alaska.

acadicus Bangs. Digby, Nova Scotia.

alleni (True). Georgiana, Brevard County, Florida.

alticolus (Merriam). Little Spring, San Francisco Mountain, Arizona. 8,200 feet.

angusticeps Bailey. Crescent City, California.

arizonensis Bailey. Springerville, Arizona.

arvicoloides (Rhoads). Lake Keechelus, Washington, 8,000 feet.

auricularis Bailey. Washington, Mississippi.

austerus (Le Conte). Racine, Wisconsin.

aztecus (Allen). Aztec, Rio Arriba County, New Mexico, 5,900 feet.

bairdi Merriam. Crater Lake (Glacier Peak), Oregon, 7,800 feet.

breweri (Baird). Muskeget Island, Massachusetts.

californicus (Peale). San Francisco Bay, California.

canescens Bailey. Conconully, Washington.

canicaudus Miller. McCoy, Oregon.

chrotorrhinus (Miller). Mount Washington, head of Tuckerman Ravine, New Hampshire, 5,300 feet.

---

[1] Except *Microtus breweri*, in which 2 are usually confluent, and *chrotorrhinus*, which has 5 closed triangles.

[2] Except in the *Microtus mexicanus* group, in which the number is 4.

Microtus constrictus Bailey. Cape Mendocino, California.

curtatus (Cope). Pigeon Spring, Mount Magruder, Nevada.

drummondi (Aud. & Bach.). Rocky Mountains, vicinity of Jasper House, Alberta, Canada.

dutcheri Bailey. Big Cottonwood Meadows, near Mount Whitney, California, 10,000 feet.

edax (Le Conte). California (south of San Francisco).

enixus Bangs. Hamilton Inlet, Labrador.

fisheri Merriam. St. Matthew Island, Bering Sea, Alaska.

fontigenus Bangs. Lake Edward, Quebec.

fulviventer Merriam. Cerro San Felipe, Oaxaca, Mexico.

guatemalensis Merriam. Todos Santos, Huehuechenango, Guatemala, 10,000 feet.

kaydeni (Baird). Fort Pierre, South Dakota.

innuitus Merriam. St. Lawrence Island, Bering Sea, Alaska.

kadiacensis Merriam. Kadiak Island, Alaska.

labradorius Bailey. Fort Chimo, Ungava, Labrador.

leucophæus (Allen). Graham Mountains, Arizona.

longicaudus (Merriam). Custer, South Dakota.

ludovicianus Bailey. Iowa, Calcasieu Parish, Louisiana.

macfarlani Merriam. Fort Anderson (north of Great Bear Lake), Arctic America.

macropus (Merriam). Pahsimeroi Mountains, Idaho, 9,700 feet.

macrurus Merriam. Lake Cushman, Olympic Mountains, Washington.

mexicanus (De Saussure). Mount Orizaba, Mexico.

minor (Merriam). Bottineau, North Dakota.

modestus (Baird). Sawatch Pass (Cochetopa Pass). Colorado.

mogollonensis (Mearns). Baker Butte, Mogollon Mountains, Arizona.

montanus (Peale). Headwaters of Sacramento River, near Mount Shasta, California.

mordax (Merriam). Sawtooth (or Alturas) Lake, Idaho, 7,200 feet.

nanus (Merriam). Pahsimeroi Mountains, Idaho.

nemoralis Bailey. Stillwell (Boston Mountains), Indian Territory.

nesophilus Bailey. Great Gull Island, New York.

nevadensis Bailey. Ash Meadows, Nye County, Nevada.

nigrans Rhoads. Currituck, North Carolina.

operarius (Nelson). St. Michael, Alaska.

oregoni (Bachman). Astoria, Oregon.

pallidus (Merriam). Fort Buford, North Dakota.

pauperrimus (Cooper). Plains of Columbia, near Snake River, Washington.

pennsylvanicus (Ord). Pennsylvania (near Philadelphia).

phœus Merriam. North slope Sierra Nevada de Colima, Jalisco, Mexico, 10,000 feet.

pinetorum (Le Conte). Pine forests of Georgia (probably near the old Le Conte plantation at Riceboro, Georgia.)

popofensis Merriam. Popof Island, Shumagin Islands, Alaska.

quasiater (Coues). Jalapa, Vera Cruz, Mexico.

rivularis Bailey. St. George, Utah.

richardsoni (De Kay). Near foot of Rocky Mountains, vicinity of Jasper House, Alberta, Canada.

scalopsoides (Aud. & Bach.). Long Island, New York.

scirpensis Bailey. Amargosa River, California, near California-Nevada line.

serpens Merriam. Agassiz, British Columbia.

sitkensis Merriam. Sitka, Alaska.

Microtus terranovæ (Bangs). Codroy, Newfoundland.
tetramerus (Rhoads). Beacon Hill Park, Victoria, British Columbia.
townsendi (Bachman). On or near Wappatoo (Sauvie) Island, Willamette River, Oregon.
umbrosus Merriam. Mount Zempoaltepec, Oaxaca, Mexico, 8,200 feet.
unalascensis Merriam. Unalaska Island, Alaska.
vallicola Bailey. Lone Pine, Inyo County, California.
yakutatensis Merriam. Yakutat Bay, Alaska.
xanthognathus (Leach). Hudson Bay.

Subgenus MICROTUS Schrank.

Type.—*Microtus terrestris* Schrank (=*Mus arvalis* Pallas).
Microtus Schrank, Fauna Boica, I, 1ste Abth., 72, 1798.
Microtus Miller, N. Am. Fauna No. 12, 63, July 23, 1896 (subgenus).

Geographic distribution (in North America).—From the Arctic Ocean southward to southern Mexico, and across the continent, mainly in Boreal, Transition, and Upper Austral zones.

Subgeneric characters.—Plantar tubercles 6; lateral glands on hips in adult males;[1] mammæ normally 8, 4 inguinal and 4 pectoral;[2] ears usually overtopping fur; m1 normally with 5 closed triangles;[3] m3 with 3 transverse loops and no triangles; m2 with 4 closed sections, and in most eastern species an additional posterior inner loop; m3 with 3 closed triangles (except in *chrotorrhinus* and *abbreviatus* groups).

GROUPS IN THE SUBGENUS MICROTUS.

The subgenus *Microtus* is readily divided into 10 fairly well-marked groups of slightly superspecific rank that may be conveniently designated by the name of their best-known or most characteristic species. These groups are not of great importance or of equal rank, but for showing the relationship of species and for convenience in arrangement they serve a useful purpose.

1. **Pennsylvanicus Group**, characterized by a posterior fifth loop to middle upper molar, includes *pennsylvanicus, nigrans, acadicus, modestus, fontigenus, labradorius, enixus, aztecus, drummondi, terranovæ, nesophilus,* and *breweri.*
2. **Montanus Group**, characterized by moderately short tail and constricted incisive foramina, includes *montanus, arizonensis, nanus, canescens, canicaudus, nevadensis, rivularis,* and *dutcheri.*
3. **Townsendi Group**, characterized by large size, long tail, and dark-brown color, includes *townsendi* and *tetramerus.*
4. **Californicus Group**, characterized by large size and wide-open incisive foramina, includes *californicus, constrictus, vallicola, edax,* and *scirpensis.*
5. **Longicaudus Group**, characterized by long tail and gray color, includes *longicaudus, mordax, macrurus, angusticeps, alticolus,* and *leucophæus.*
6. **Mexicanus Group**, characterized by short tail, brown color, and only 4 mammæ, includes *mexicanus, phæus, fulviventer,* and *mogollonensis.*

---

[1] In front of hips in *xanthognathus* and probably in *chrotorrhinus.*
[2] Four in the *mexicanus* group, a pair of inguinal and a pair of pectoral.
[3] With only four closed triangles in most of the Alaska species.

7. **Operarius Group**, characterized by short tail and only 4 closed triangles in anterior lower molar, includes *operarius, macfarlani, kadiacensis, unalascensis, sitkensis, yakutatensis, popofensis,* and *innuitus.*
8. **Abbreviatus Group**, characterized by robust form, very short tail, 5 closed triangles in anterior lower molar, and two closed and one open in posterior upper, includes *abbreviatus* and *fisheri.*
9. **Chrotorrhinus Group**, characterized by yellow nose and five closed triangles in posterior upper molar, includes *chrotorrhinus* and *ravus.*
10. **Xanthognathus Group**, characterized by yellow nose, large size, glands on flanks, and 3 closed triangles in posterior upper molar, includes one species, *xanthognathus.*

In using the following key it will be necessary to have both skins and skulls in hand, and even then it will be impossible to identify some of the forms without actual comparison with their nearest allies. Whenever possible, several specimens should be examined, to avoid the danger of being led astray by abnormal molar patterns, for even the widest ranges of subgeneric differences are sometimes covered by individual variation or abnormal tooth pattern.

KEY TO SPECIES AND SUBSPECIES OF THE SUBGENUS MICROTUS.

m2 with 4 closed angular sections and a rounded posterior loop.
m3 with two of the 3 triangles usually confluent.
Interparietal about as wide as long, colors pale ..... *breweri*
Interparietal much wider than long, colors dark ..... *nesophilus*
m3 with 3 closed triangles.
m1 with usually a sharp point or spur at base of posterior triangle; belly white with a median dusky line ..... *terranovæ*
m1 with normal truncate posterior triangle; belly without median dusky line.
Interparietal more than half as long as wide, belly white.
Skull long and narrow, braincase long, feet and tail stout ..... *aztecus*
Interparietal about half as long as wide, belly usually dull colored.
Skull wide, braincase short, molars small ..... *enixus*
Skull not wide, braincase medium, molars medium.
Colors dusky or blackish.
Size large, hind foot 23 ..... *nigrans*
Size small, hind foot 21 ..... *fontigenus*
Colors brownish or dark grayish.
Size medium.
Belly white or whitish ..... *acadicus*
Belly dull.
Colors bright or dark brownish ..... *pennsylvanicus*
Colors paler, size less ..... *modestus*
Size small, feet and tail very slender.
Skull low, incisors projecting, bullæ not large ..... *labradorius*
Skull high, incisors decurved, bullæ large ..... *drummondi*
m2 with 4 closed sections and no posterior loop (except irregularly in Californicus group.
Mammæ 4, inguinal, 1–1; pectoral, 1–1. Skull short and wide. Incisive foramina not constricted.
Colors bright rich brown above and below ..... *fulviventer*
Colors dull brownish above and below.
Belly but little lighter than back.
Size medium ..... *mexicanus*
Size slightly larger ..... *phæus*
Belly much lighter than back; size small ..... *mogollonensis*

Mammæ 8, inguinal, 2-2; pectoral, 2-2.

m1 with normally 4 closed triangles (sometimes 5 in *sitkensis*) and rounded anterior loop.

Bullæ very small and narrow, molars very light.

Skull narrow and slender ..... *operarius*

Skull wider and heavier ..... *kadiacensis*

Bullæ medium, molars moderately heavy.

Incisors strongly projecting.

Size large, hind foot 23 ..... *innuitus*

Size small, hind foot 19 ..... *macfarlani*

Incisors not strongly projecting, size medium.

Frontals heavily ridged in adult males.

Prezygomatic notch deep, color dusky gray or ochraceous.

Color dark ochraceous, belly dusky ..... *sitkensis*

Color dusky gray, belly buffy gray ..... *yakutatensis*

Prezygomatic notch shallow, color ochraceous ..... *unalascensis*

Frontals not ridged in adults, color ochraceous ..... *popofensis*

m1 with 5 or 6 closed triangles.

A pair of glands on flanks of males, nose yellowish.

Size large, side glands conspicuous in adult males, m3 with 3 closed triangles ..... *xanthognathus*

Size smaller, glands obscure or wanting, m3 with 5 closed triangles.

Color bister ..... *chrotorrhinus*

Color grayish ..... *rarus*

A pair of glands on hips of males, nose not yellow.

Incisive foramina not constricted posteriorly, m2 with or without posterior loop.

Size large, colors dark, young blackish.

Nasals emarginate posteriorly ..... *edax*

Nasals truncate posteriorly ..... *scirpensis*

Size smaller, colors grayish, young dusky ..... *californicus*

Colors clearer gray, bullæ smaller.

Skull wide ..... *vallicola*

Skull narrow ..... *constrictus*

Incisive foramina constricted posteriorly, m2 normally without posterior loop.

Tail very short, size medium.

Belly dusky, lips and tip of nose white ..... *dutcheri*

Belly, lips, and nose buffy.

Rostrum and nasals slender ..... *abbreviatus*

Rostrum and nasals heavy ..... *fisheri*

Tail medium, size large or small.

m1 with 6 closed triangles and deep-lobed trefoil.

Size large, hind foot 24 ..... *nevadensis*

m1 with 5 closed triangles and anterior trefoil.

Size large, hind foot 23 ..... *virularis*

Size medium or small, hind foot 18-22, belly gray or whitish, ears large.

Hind foot 20 or more.

Color dark gray above ..... *montanus*

Color rusty gray above ..... *arizonensis*

Hind foot 20 or less.

Lateral pits of palate deep, tail bicolor.

Color grizzled gray ..... *nanus*

Color ashy gray ..... *canescens*

Lateral pits of palate shallow, tail mostly gray ..... *canicaudus*

KEY TO SPECIES AND SUBSPECIES OF THE SUBGENUS MICROTUS—Cont'd.

Tail long, about ⅓ of total length.
Hip glands conspicuous in males, colors dark brown.
Hind foot averaging 25.4 ..... *townsendi*
Hind foot averaging 22 ..... *tetramerus*
Hip glands not conspicuous, colors grayish, belly whitish.
Size large, hind foot 24 ..... *macrurus*
Size medium, hind foot 22.
Anterior arm of frontal acuminate.
Skull narrow, bullæ small ..... *angusticeps*
Skull normal, bullæ large.
Sides much grayer than back ..... *mordax*
Sides scarcely grayer than back ..... *longicaudus*
Anterior arm of frontal obliquely truncate.
Size small, foot 20 ..... *alticolus*
Size larger, foot 22 ..... *leucophæus*

MICROTUS PENNSYLVANICUS (Ord). Meadow Vole.

Mus pennsylvanica Ord, Guthrie's Geography, 2d American edition, II, 292, 1815. (Rhoads' reprint.) Based on Wilson's description of the meadow mouse from meadows below Philadelphia and along the seashore.

Mynomes pratensis Rafinesque, Am. Monthly Mag., II, 45, 1817. Based on Wilson's description of meadow mouse.

Lemmus noveboracensis Rafinesque, Annals of Nature, 3, 1820. (New York and New Jersey.)

Arvicola riparius Ord, Journ. Acad. Nat. Sci. Philadelphia, IV, Pt. II, 305–306, 1825. (Type locality not given.)

Arvicola palustris Harlan, Fauna Americana, 136–138, 1825. (Swamp along the shores of the Delaware.)

Arvicola hirsutus Emmons, Rept. Quad. Mass., 60, 1840.

Arvicola alborufescens Emmons, Rept. Quad. Mass., 60–61, 1840. (Williamstown, Mass.)

Arvicola fulva Aud. and Bach., Proc. Acad. Nat. Sci. Phila., I, 96, 1841. ("One of the Western States; we believe Illinois.")

Arvicola nasuta Aud. and Bach., Proc. Acad. Nat. Sci. Phila., I, 96–97, 1841. (Near Boston, Mass.)

Arvicola rufescens DeKay, Zool. N. Y., Mammals, I, 85, 1842. (Oneida Lake, N. Y.)

Arvicola oneida DeKay, Zool. N. Y., Mammals, I, 88–89, 1842. (Oneida Lake, N. Y.)

Arvicola dekayi Aud. and Bach., Quad. N. Am., III, 287–288, 1854. (New York or Illinois.)

Arvicola riparia var. *longipilis* Baird, Mammals N. Am., 524, 1857. (West Northfield, Ill., and Racine, Wis.)

Arvicola rufidorsum Baird, Mammals N. Am., 526, 1857.[1] (Holmes Hole, Marthas Vineyard, Mass.)

Type locality.—Pennsylvania (meadows below Philadelphia).

Geographic distribution.—Eastern United States and westward as far as Dakota and Nebraska, shading into *modestus* of the western plains and Rocky Mountains. In a general way it occupies the Transition zone from the Atlantic coast to the edge of the Great Plains.

Habitat.—Meadows, fields, and especially grassy places near water.

[1] Not having seen the type of *rufidorsum* or any specimen from Marthas Vineyard, I hesitate to place this name in synonomy.

General characters.—Size medium; tail at least twice as long as hind foot; fur long, overlaid with coarse hairs; ears moderate, conspicuous above fur in summer, almost concealed in winter pelage; colors dusky gray or brownish; skull long, well arched, and rather smooth; middle upper molar with four triangles and a posterior loop.

Color.—*Summer pelage:* Upperparts dull chestnut brown, varying to bright yellowish chestnut, darkened along the back with coarse black hairs; belly dusky gray or tinged with cinnamon; feet brownish; tail dusky above, slightly paler below. *Winter pelage:* Duller and grayer throughout; tail indistinctly bicolor. *Young:* Blackish.

Cranial characters.—Skull long, usually not angular or much ridged; incisors projecting well in front of nasals; incisive foramina long, occupying two-thirds of the space between molars and incisors; bullæ moderately large and well rounded; molar series long; m2 with 4 closed triangles and a posterior loop; m3 with an anterior crescent, 3 closed triangles, and a posterior loop with two inner lobes; m1 with 5 closed triangles, anterior trefoil, 4 outer and 5 inner salient angles; m3 with 3 long inner and 3 short outer salient angles.

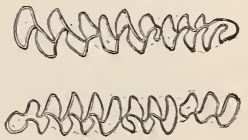


FIG. 1.—Molar enamel pattern of *Microtus pennsylvanicus* (×5).

Measurements.—Average of 5 adults from Washington, D. C.: Total length, 171; tail vertebræ, 46; hind foot, 21.2. *Skull* (No. 30321, ♀ ad., from Washington, D. C.): Basal length, 27.4; nasals, 8.3; zygomatic breadth, 17.2; mastoid breadth, 12.7; alveolar length of upper molar series, 7.2.

Remarks.—The above description is based on a good series of specimens from the District of Columbia, showing the seasonal changes of pelage and agreeing perfectly with the Pennsylvania animal. From Pennsylvania south along the Atlantic coast, specimens show a noticeable increase in size and intensity of coloration, which reaches its maximum in the subspecies *nigrans* of North Carolina; while to the north they show a corresponding decrease in size and intensity of coloration, which reaches its extreme in the subspecies *acadicus* of Nova Scotia. To the westward *pennsylvanicus* is fairly typical as far as southern Michigan and Iowa, but on the plains of Nebraska and South Dakota it grows paler as it grades into *modestus*. Northward in Minnesota it becomes smaller until scarcely distinguishable from and perhaps grading into *drummondi* of northwest Canada. Three skulls in the U. S. National Museum, that seem to be typical *pennsylvanicus*, are labeled as coming from Prairie Mer Rouge, La., but I am inclined to question the authenticity of the labeling.

Specimens examined.—Total number, 716, from the following localities:

Pennsylvania: Philadelphia, 1; Chester County, 1; Carlisle, 6; Columbia, 2; Drurys Run (near Renovo), 6; Foxbury, 2; Pine Glen, 1; Leasuresville, 2; Bear Lake (Warren County), 2.

New York: Owego, 2; Nichols, 24; Lake George, 20; Alder Creek, 2; Locust Grove, 55; Peterboro, 9; Troy, 5; Geneva, 5; Brandon, 4; Catskill Mountains, 3; Highland Falls, 12; Mott Haven, 1; Oyster Bay, 2; Lake Grove, 2; Montauk Point, 45; Shelter Island, 6; Plum Island, 14; Roslyn, 4.
Connecticut: East Hartford, 2.
Massachusetts: Wilmington, 13; Middleboro, 19; Newtonville, 4; Holmes Hole, 1; Woods Holl, 1.
Vermont: Burlington, 4.
New Hampshire: Ossipee, 15.
Maine: Addison, 1; Calais, 1.
New Jersey: Tuckerton, 4; Mays Landing, 1; Sea Island City, 1.
Maryland: Laurel, 23; Hyattsville, 7; Bladensburg, 1; Mountain Lake Park, 2; Finzel, 1; Grantsville, 1.
District of Columbia: Washington, 64.
Virginia: Falls Church, 2; Dunn Loring, 2; Arlington, 2; Fort Myer, 1; Bristoe, 1.
West Virginia: Travellers Repose, 2; White Sulphur Springs, 3.
North Carolina: Roan Mountain, 45; Old Richmond, 3; Raleigh, 20.
Ohio: Garrettsville, 10; Salem, 1.
Michigan: Detroit River, 1; Manchester, 3; Ann Arbor, 2.
Illinois: West Northfield, 6.
Wisconsin: Racine, 14; Busseyville, 1; Milwaukee, 4; Saxeville, 1; Fisher Lake (Iron County), 14.
Iowa: Knoxville, 2.
Missouri: St. Louis, 5.
Louisiana: Prairie Mer Rouge, 3.
Nebraska: Blair, 3; Valentine, 2.
Minnesota: Elk River, 112; Fort Snelling, 3; Heron Lake, 1; Ortonville, 1; Tower, 6.
South Dakota: Vermilion, 2; Pierre, 2; Travere, 1; Flandreau, 4; Fort Sisseton, 18; Fort Wadsworth, 2.
Ontario: Toronto, 1; Lorne Park, 6.

MICROTUS PENNSYLVANICUS NIGRANS Rhoads. Albemarle Meadow Vole.

Microtus pennsylvanicus nigrans Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, 307–308.

Type locality.—Currituck, N. C.

Geographic distribution.—(Typical form.) Coast region of northern North Carolina and southern Virginia, in the Austroriparian zone.

Habitat.—Marshes and localities close to water.

General characters.—Slightly larger than *pennsylvanicus*, with noticeably larger hind feet and darker coloration.

Color.—*Summer pelage:* Upperparts dull bister, much obscured by black hairs; belly smoky gray to dull cinnamon; tail black above, sooty below; feet blackish. *Winter pelage* (partly retained in April specimens): Darker, with dorsal area almost black. *Young* (to nearly half grown): Sooty black all over.

Cranial characters.—Skull averaging slightly larger than in typical *pennsylvanicus;* rostrum slightly heavier, incisive foramina wider; dentition the same.

Measurements.—Average of three not fully adult males from type locality: Total length, 165; tail vertebræ, 48; hind foot, 23. *Skull* (No. 72374, ♂ ad., from Eastville, Va.): Basal length, 29; nasals, 8.5; zygomatic breadth, 17.5; mastoid breadth. 13.4: alveolar length of upper molar series, 7.3.

Remarks.—Specimens of *Microtus* from a chain of localities along the Atlantic coast, from North Carolina to Nova Scotia, show a decrease in size and intensity of coloration from the south northward. Unfortunately the type of *pennsylvanicus* was taken from an intermediate locality, and it becomes necessary to recognize the extremes—*acadicus* and *nigrans*—as slightly differentiated forms.

Specimens examined.—Total number of typical specimens, 16, from the following localities:

North Carolina: Currituck, 6.
Virginia: Wallaceton, 7; Eastville, 1; Smiths Island, 2.

MICROTUS PENNSYLVANICUS ACADICUS Bangs. Acadian Vole.

Microtus pennsylvanicus acadicus Bangs, Am. Nat., XXXI, 239–240, March, 1897.

Type locality.—Digby, Nova Scotia.

Geographic distribution.—Nova Scotia and Prince Edward Island.

Habitat.—Fields and fresh-water marshes.

General characters.—Slightly smaller than *M. pennsylvanicus;* color slightly paler, both in summer and winter.

Color.—*Summer pelage* (July to October): Upper parts yellowish bister, slightly lined with black hairs; belly washed with white or smoky gray; tail indistinctly bicolor, brownish black above, slightly paler below; feet dusky plumbeous. *Winter pelage:* Back buffy gray; sides paler; ears nearly concealed under bright ochraceous patch; belly washed with pure white; tail sharply bicolor, blackish above, white below; feet plumbeous. *Young:* Not so dark as those of *pennsylvanicus.*

Cranial characters.—Skull usually distinguishable from that of *pennsylvanicus* by projecting posterior point of palate; posterior tip of nasals slightly emarginate or truncate, never rounded. Dentition as in *pennsylvanicus.*

Measurements.—Type: Total length, 172; tail vertebræ, 49; hind foot, 20. Average of 5 topotypes: 170; 47; 21. *Skull* (No. 2145, ♂ —not fully adult): Basal length, 25.5; nasals, 7.7; zygomatic breadth, 14.8; mastoid breadth, 12; alveolar length of upper molar series, 6.5.

Remarks.—None of the 19 topotypes before me are old, and the majority are not fully adult, but in a series of 40 specimens from Prince Edward Island, including fully adult specimens in both summer and winter pelages, the principal characters of *M. acadicus* are accentuated. The winter pelage is rather more distinctive than the summer.

Specimens examined.—Total number, 67, from the following localities:

Nova Scotia: Digby, 19; Halifax, 1.
Prince Edward Island: 47.

MICROTUS PENNSYLVANICUS MODESTUS (Baird). Sawatch Vole.

Arvicola modesta Baird, Mamm. N. Am., 535–536, 1857.
Arvicola insperatus Allen, Bul. Am. Mus. Nat. Hist., 347, 1894 (Custer, S. Dak.).

Type locality.—"Sawatch Pass, Rocky Mountains" [same as Cochetopa Pass], Colorado.

Geographic distribution.—Rocky Mountains and western Plains from New Mexico to British Columbia, and from the Black Hills of South Dakota to central Idaho, and beyond, with slight variation, to the plains of the Columbia, mainly in Transition zone.

Habitat.—Marshes and damp grassy places.

General characters.—Size of *M. pennsylvanicus*, tail slightly shorter, color paler, more yellowish, never chestnut in summer pelage; skull heavier, becoming more ridged and angular with age.

Color.—*Summer pelage:* Upperparts dull ochraceous, darkened with black-tipped hairs; belly washed with soiled whitish, smoky gray or pale cinnamon; feet plumbeous; tail indistinctly bicolor, blackish above, dull grayish below. *Winter pelage:* Much darkened above by long black hairs, especially early in the season, later becoming paler than in summer as the under-fur grows longer; belly heavily washed with creamy white; feet paler; tail more sharply bicolor. *Young:* Slightly less blackish than in *pennsylvanicus*.

Cranial characters.—Skull not positively distinguishable from that of *pennsylvanicus*, but in adults averaging heavier and more ridged.

Measurements.—Average of 10 adults from Cochetopa Pass, Colorado: Total length, 176; tail vertebræ, 44; hind foot, 20.6. *Skull* (No. 48053, ♀ ad.): Basal length, 27; nasals, 7.6; zygomatic breadth, 16; mastoid breadth, 12.4; alveolar length of upper molar series, 6.7.

Remarks.—Baird's type of *modestus* was collected at Sawatch or Cochetopa Pass in the Cochetopa Mountains. The type specimen in the United States National Museum is a half-grown young in the black pelage, and agrees perfectly in both external and cranial characters with specimens of the same age since collected at the type locality. The other specimen from Sawatch Pass (No. 593), which Professor Baird examined and believed to be distinct from *modestus*, but refrained from describing from a single immature specimen,[1] is also in the United States National Museum, and proves to be *Microtus nanus*, a good series of which has since been collected at a point 3 miles east of Cochetopa Pass. *Microtus mordax* is the only other species known to occur in this part of Colorado. These three widely different species are readily distinguishable at any age.

Microtus modestus decreases in size to the northward until, in northwestern Montana, it seems to merge into the little *drummondi* of the region farther north. Westward it becomes darker, specimens from Salt Lake Valley, Utah, being practically indistinguishable from typical *pennsylvanicus*, while those from Cœur d'Alene, Idaho, and the

[1] Mamm. N. Am., p. 535, 1857.

plains of the Columbia in eastern Washington are too small and dark to be typical *modestus*.

Specimens examined.—Total number, 259, from the following localities:

Colorado: Cochetopa Pass, 89; Fort Garland, 15; Loveland, 7; Twin Lakes, 1.

Wyoming: Newcastle, 1; Bear Lodge Mountains, 2; Sundance, 1; Lower Geyser Basin, Yellowstone Park, 1.

South Dakota: Custer, 2; Hill City, 1.

North Dakota: Fort Buford, 1.

Montana: Little Bighorn River, 2; Fort Custer, 3; Bozeman, 2; Fort Ellis, 1; Big Snowy Mountains, 13; Philbrook, 1; Stanford, 1; Choteau, 1; Robare, 1; Blackfoot, 1; Fort Assinniboine, 1; Tobacco Plains, 3; Stillwater Lake, 8; Flathead Lake, 9; Little Bitterroot Creek, 2; Hot Springs Creek, 1; Horse Plains (8 miles east), 1.

Idaho: Lemhi, 1; Salmon River, 3; Challis, 3; Birch Creek, 24; Cœur d'Alene, 3; Fort Sherman, 1.

Washington: Marshall, 15; Coulee City, 4; Conconully, 4; Colville, 20; Marcus, 1.

Utah: Ogden, 7; Salt Lake, 1.

MICROTUS PENNSYLVANICUS FONTIGENUS (Bangs). Forest Vole.

Microtus fontigenus Bangs, Proc. Biol. Soc. Wash., X, 48–49, March 9, 1896.
Microtus pennsylvanicus fontigenus Miller, Proc. Boston Soc. Nat. Hist., XXVIII, 14, April, 1897.

Type locality.—Lake Edward, Quebec.

Geographic distribution. Eastern Canada, in the Hudsonian zone.

Habitat.—Marshes, fields, dry banks, and deep woods.

General characters.—Smaller than *pennsylvanicus*, with short wide skull, large round bullæ, and short incisive foramina.

Color.—*Autumn pelage* (September specimens in long fur): Upper-parts dark bister mixed with black, slightly paler on sides and cheeks; belly washed with whitish or smoky gray; tail bicolor, blackish above, grayish below; feet plumbeous.

Cranial characters.—Skull light and smooth, not ridged or angular; rostrum and incisive foramina short; braincase wide; audital bullæ large and smoothly rounded; interpterygoid space narrow, ending squarely at palate; dentition as in *pennsylvanicus*.

Measurements.—Type, ♀ ad.: Total length, 151; tail vertebræ, 41; hind foot, 21. Topotype, ♂ ad.: 150; 45; 21. *Skull* (No. 3839, ♂): Basal length, 23, nasals, 6.2; zygomatic breadth, 14.3; mastoid breadth, 11.5; alveolar length of upper molar series, 6.

Remarks.—The short rostrum, short, wide braincase, and short incisive foramina distinguish *fontigenus* from both *pennsylvanicus* and *drummondi*, with both of which species it seems to intergrade.

In size it is intermediate, and in external characters not very different from either. It is recorded by Mr. Miller from Nepigon and Peninsula Harbor, Ontario, but he considers the specimens obtained at those places not quite typical.[1] A series of 10 specimens from Godbout, Quebec, are rather nearer *fontigenus* than *acadicus*.

Specimens examined.—Total number, 6, topotypes (from the Bangs Coll.).

[1] Proc. Boston Soc. Nat. Hist., XXVIII, 14, April, 1897.

MICROTUS PENNSYLVANICUS LABRADORIUS Bailey. Little Labrador Vole.

Microtus pennsylvanicus labradorius Bailey, Proc. Biol. Soc. Wash., XII, 88, April 30, 1898.

Type locality.—Fort Chimo, Ungava, Labrador.

Geographic distribution.—Known only from the type locality.

General characters.—Size of *Microtus drummondi* and of approximately the same proportions. Skull flatter, with smaller audital bullæ and more protruding upper incisors.

Color.—(Much changed by alcohol.) Upperparts dark brownish; belly whitish; tail bicolor; feet pale.

Cranial characters.—Skull low, not much ridged or angled; postorbital ridge prominent; nasals short, cuneate and scarcely reaching base of incisors; audital bullæ small; incisive foramina short; first upper molar usually with an inner posterior point, molar pattern otherwise as in *pennsylvanicus*. The skull is readily distinguishable from that of either *drummondi* or *fontigenus* by the protruding incisors and small audital bullæ.

Measurements.—Type, ♀ ad. (in alcohol), measured by Dr. C. Hart Merriam: Total length, 139; tail vertebræ, 39; hind foot, 20. Average of 7 alcoholic specimens from type locality: 137; 37; 19. *Skull* (of type): Basal length, 24.3; nasals, 6.7; zygomatic breadth, 14.4; mastoid breadth, 11; alveolar length of upper molar series, 6.2.

Remarks.—*M. labradorius* shows closer affinity with *drummondi* than with *fontigenus*, though no doubt meeting and grading into the latter. It is widely different from *enixus*, and the two occur together at Fort Chimo.

Specimens examined.—Total number, 9, from the type locality.

MICROTUS DRUMMONDI (Aud. & Bach.). Drummond Vole.

Arvicola drummondi Aud. and Bach., Quad. N. Am., III, 166–167, 1854.

Arvicola (*Mynomes*) *microcephalus* Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, 286–287 (Lac La Hache, B. C.).

Microtus stonei Allen, Bul. Am. Mus. Nat. Hist., XII, 4, March, 1899 (Liard River, N. W. T.).

Type locality.—Rocky Mountains, vicinity of Jasper House, Alberta.

Geographic distribution.—From Hudson Bay to the west slope of the Rocky Mountains and Alaska, and from the northern edge of the United States north to Fort Anderson, N. W. T., in Canadian and Hudsonian zones.

Habitat.—Both marshes and dry upland.

General characters.—Similar to *Microtus pennsylvanicus*, but much smaller, with slenderer feet and tail, and paler color.

Color.—*Summer pelage:* Upperparts yellowish bister with numerous dark-brown- or black-tipped hairs, sides of nose and hairs in front of ears more decidedly yellowish; belly white or rarely tinged with buffy, sometimes dusky during the molt; feet silvery gray; tail bicolor, blackish above, whitish below. *Winter Pelage:* Paler than in summer; yellow on ears and nose more conspicuous; *Young:* Paler and not so sooty as young *pennsylvanicus*.

Cranial characters.—Skull not much arched and rather flat topped, slender but sharply ridged in adults; audital bullæ large and smoothly rounded; palate flattened in immature specimens, becoming higher with deep lateral pits in adults. Dentition as in *pennsylvanicus*. Except for the larger bullæ and a few characters of minor weight, the skull of *drummondi* is a miniature of the skull of *pennsylvanicus*.

Measurements.—Average of 6 adult males and females from Muskeg Creek, Alberta: Total length, 145; tail vertebræ, 39; hind foot, 17.8. Largest specimen from Muskeg Creek: 160; 41; 18. *Skull* (No. 81487, ♀ ad., same locality): Basal length, 23; nasals, 6; zygomatic breadth, 14; mastoid breadth, 11; alveolar length of upper molar series, 6.

Remarks.—The characters separating *drummondi* from *pennsylvanicus* and *modestus* are relative. There is no sharp distinction and the forms either merge into each other, or after approaching each other in size overlap in range and occur together at the same localities. Specimens from Blackfoot, Montana, are nearer *modestus*, while those from Summit and St. Marys Lake are almost typical *drummondi*. At Elk River, Minnesota, about half of the specimens are almost typical *drummondi*, while the others are a small form of *pennsylvanicus;* but, as others fall between and cannot positively be placed with either form, it is impossible to decide whether the difference is due to individual variation in an intermediate form or whether two species meet and interbreed.

To the eastward *drummondi* merges into *fontigenus*, from which it differs in such slight degree that the two are not easily distinguishable. On the west slope in British Columbia *drummondi* becomes slightly darker, and in that respect less unlike *fontigenus* in appearance, but retains its cranial characters, Alaska and northwestern specimens (from Fort Wrangel, Nulato, and Fort Simpson) are larger and in general appearance less different from *pennsylvanicus*, but detailed cranial characters show them to be but a robust form of *drummondi*. Specimens from Liard River, including the type of *M. stonei*, are indistinguishable from typical *drummondi*.

Specimens examined.—Total number, 355, from the following localities:

Alberta: Muskeg Creek (15 miles south of Smoky River), 13; Smoky Valley (50 miles north of Jasper House), 5; Fishing Lake (90 miles north of Jasper house), 2; Henry House (15 miles south), 4; South Edmonton, 110; St. Alberts, 26; Canmore, 2; Banff, 1; Red Deer, 1.

Athabasca: Lesser Slave Lake, 1.

Assiniboia: Indian Head, 30; Medicine Hat, 1.

British Columbia: Shuswap, 13; Sicamous, 1; Cariboo Lake, 2; Okanagan, 11; Ducks, 2; Stuart Lake, 1.

Saskatchewan: Cumberland House, 2; St. Louis, 1.

Manitoba: Carberry, 2.

Ontario: Rat Portage, 2; Coney Island (Lake of the Woods), 2.

Northwest Territory: Fort Churchill, 2; Fort Simpson, 2; Fort Rae, 3; Fort Reliance, 1; Big Island (Great Slave Lake), 1; Fort Good Hope, 1; Fort MacPherson, 1; Fort Anderson, 2; head of Liard River, 1; Chandindu River, 1; Dawson, 1; Sixty-Mile Creek, 1; Fort Selkirk, 3; 50 miles below Fort Selkirk, 1; Rink Rapids, 6; Thirty-Mile River, 3; Lake Lebarge, 4; Fifty-Mile River, 6; Lake Marsh, 22; Caribou Crossing, 16.

Alaska: Fort Wrangell, 1; Nulato, 1; Charlie Creek (Yukon River), 2; Canadian Boundary and Yukon River, 4.
North Dakota: Portland, 4; Lisbon, 1; Bottineau, 1.
Montana: St. Marys Lake, 6; Summit, 8.
Idaho: Priest Lake, 5.
Washington: Loon Lake, 9.

MICROTUS AZTECUS (Allen). Aztec Vole.

Arvicola (Mynomes) aztecus Allen, Bul. Am. Mus. Nat. Hist., V, 73–74, April 28, 1893.

Type locality.—Aztec, New Mexico (altitude, 5,900 feet).

Geographic distribution.—Valley of the San Juan River in northwestern New Mexico, in Transition zone.

Habitat.—Grassy places along the river banks and near irrigation ditches.

General characters.—In size similar to *M. pennsylvanicus*, but with shorter tail and larger hind foot; skull long; braincase narrow; interparietal long.

Color.—*Winter pelage:* Upperparts dull buffy, heavily mixed with black hairs; belly washed with creamy or pale buff; feet plumbeous; tail sharply bicolor, black above, soiled whitish below. *Young* (half-grown specimens in Dec.): Scarcely different in color from adults. (*Summer pelage* not examined.)

Cranial characters.—Skull long; braincase high and narrow; interparietal more than half as long as wide, extending back to plane of foramen magnum; audital bullæ large; mandible short and heavy; angular process of mandible wide; dentition as in *pennsylvanicus*.

Measurements.—Average of 7 adults from type locality: Total length, 171; tail vertebræ, 43; hind foot, 22. *Skull* (No. 57432, ♂ ad.): Basal length, 28.8; nasals, 8.4; zygomatic breadth, 17; mastoid breadth, 12.5; alveolar length of upper molar series, 7.2.

Remarks.—*Microtus aztecus* belongs to the *pennsylvanicus* group. Externally it is not very different from *modestus*, but none of the specimens show any signs of intergradation; and the skull characters are so well marked that there seems no doubt of its full specific rank.

Specimens examined.—Total number, 45, from the following localities:

New Mexico: Aztec, 42; La Plata, 3.

MICROTUS ENIXUS Bangs. Large Labrador Vole.

Microtus enixus Bangs, Am. Nat., XXX, 1051–1052, Dec. 5, 1896.

Type locality.—Hamilton Inlet (north shore), Labrador.

Geographic distribution.—Eastern coast of Labrador from Hamilton Inlet to Ungava Bay, in Hudsonian zone.

General characters.—Size slightly larger than *M. pennsylvanicus*, with relatively longer tail and larger ears; coloration duller and darker; skull smaller, shorter, and wider, with lighter molars. Hip glands present in adult males.

Color.—*Summer pelage* (July and Aug. specimens): Upperparts dark yellowish bister mixed with blackish; belly smoky gray or soiled whitish, sometimes tinged with buffy; feet dusky or blackish; tail black above, grayish brown below.

Cranial characters.—Outline of skull shorter, wider, and less arched than in *pennsylvanicus*; prezygomatic notch deep; coronoid notch of mandible wide and rounded; molar series small and slender; m2 with posterior loop completely closed and circular in form; m3 with terminal loop shortened; dentition otherwise as in *pennsylvanicus*.

Measurements.[1]—Type, ♀ ad.: Total length, 210; tail vertebræ, 67; hind foot, 22.5. Average of 10 adult topotypes: 189.4; 60.4; 22.4. *Skull* (No. 4018, ♀ ad.): Basal length, 27.3; nasals, 8.6; zygomatic breadth, 16.7; mastoid breadth, 12.3; alveolar length of upper molar series, 6.5.

Remarks.—*Microtus enixus* appears to be a distinct and well marked species of the *pennsylvanicus* group, the long tail and small molars being the most convenient characters for recognition. From its geographically nearest neighbors, *Microtus p. fontigenus*, of Lake Edward, Quebec, and *Microtus p. labradorius*, of Ungava, it shows a wider difference than from typical *pennsylvanicus*.

Specimens examined.—Total number, 16, from the following localities:

Labrador: Hamilton Inlet, 13; Fort Chimo, Ungava, 3.

MICROTUS TERRÆNOVÆ (Bangs). Newfoundland Vole.

Arvicola terrænovæ Bangs, Proc. Biol. Soc. Wash., IX, 129–132, July 27, 1894.

Type locality.—Codroy, Newfoundland.

Geographic distribution.—Newfoundland and Penguin Island.

General characters.—Slightly larger than *pennsylvanicus*, with decidedly larger hind foot, and more yellowish colors; belly with dusky median line; nose patch buffy; skull wide and angular.

Color.—*Summer pelage* (in July and August specimens): Upperparts dark russet, darkened by brown-tipped hairs, becoming paler on sides and across face; nose patch dark buffy or dull russet; belly whitish or smoke gray with a median streak of dusky cinnamon; tail distinctly bicolor, blackish above, soiled whitish below; feet grayish brown. *Winter pelage* (retained in April specimens): Slightly paler russet above, whiter below, with sharper markings throughout. *Young* (nearly half-grown): Similar to adults.

Cranial characters.—Skull short with wide-spreading zygomata; prezygomatic notch deep; nasals terminating even with arms of premaxillæ; lateral pits of palate deep and wide; interpterygoid space narrow with median constriction; m1 with an anterior spur or loop; m3 with posterior loop short, irregularly rounded, triangular or trifoliate; m2 and m3 normally with anterior point or spur.

[1] From original description.

Measurements.—Average of 10 adults from type locality: Total length, 182; tail vertebræ, 52; hind foot, 23.4. *Skull* (No. 74029, ♂ ad.): Basal length, 28.5; nasals, 8.4; zygomatic breadth, 17; mastoid breadth, 13; alveolar length of upper molar series, 7.

Remarks.—*Microtus terrænovæ* shows very distinctive characters, and no close affinity with any neighboring species. Specimens showing very young and full winter pelage are still needed for a comprehensive description

Specimens examined.—Total number, 43; from the following localities:

Newfoundland: Codroy, 35; Penguin Island, 8.

MICROTUS BREWERI (Baird). Beach Vole.

Arvicola breweri Baird, Mamm. N. Am., 525–526, 1857.

Type locality.—Muskeget Island, Massachusetts.

Geographic distribution.—Muskeget Island.

Habitat.—Beach plum thickets on the sandy island.

General characters.—Size a little larger than *pennsylvanicus;* colors pale grayish; pelage long and coarse; skull heavy with wide nasals and quadrate interparietal.

Color.—*Summer pelage* (July 18): Upperparts buffy gray with scattered brown- and black-tipped hairs, paler on sides; belly tinged with sulphur yellow; feet silvery gray; tail bicolor, rusty brown or blackish above, soiled whitish below. *Young:* Rather paler and duller than adults.

Cranial characters.—Skull massive; nasals wide anteriorly; interparietal more than half as long as wide; inner edges of zygomata sharply notched close to lachrymals; rostrum heavy; upper incisors bent abruptly downward; molar pattern not very different from that of *pennsylvanicus.*

Measurements.—Average of 10 adults from Muskeget Island: Total length, 182; tail vertebræ, 54; hind foot, 22.3. *Skull* (No. 73141, ♂ ad.): Basal length, 28.7; nasals, 8.3; zygomatic breadth, 17.3; mastoid breadth, 13; alveolar length of upper molar series, 7.2.

Remarks.—Nine of the 26 specimens have a small white spot on the forehead. This may be accidental or an only partially acquired character.

Specimens examined.—Total number, 26; all from the type locality.

MICROTUS NESOPHILUS Bailey. Gull Island Vole.

Microtus insularis Bailey, Proc. Biol. Soc. Wash., XII, 86, April 30, 1898. Name preoccupied by *Lemmus insularis,* Nillson (= *Microtus agrestis* L.).
Microtus nesophilus Bailey, Science, N. S., VIII, 782, Dec. 2, 1898.

Type locality.—Great Gull Island, New York.

Geographic distribution.—Great Gull Island (at entrance to Long Island Sound).

General characters.—Size of *pennsylvanicus;* colors darker; skull shorter and wider with more spreading zygomata and deeper prezygomatic notches.

Color.—Summer pelage: Upperparts, dark yellowish bister heavily mixed with black hairs, darkest on nose and face; belly dusky, washed with cinnamon; feet blackish; tail blackish above, dark brown below.

Cranial characters.—The skull differs from that of *pennsylvanicus* in shorter, wider braincase, wider and more abruptly spreading zygomatic arches, more expanded jugal, and smaller audital bullæ; palate short, with a median point or spur and deep lateral pits; m3 normally with anterior inner and outer triangles approximately opposite and confluent; dentition otherwise similar to that of *pennsylvanicus.*

Measurements.—Type (measured in dry skin): Tail, 29; hind foot, 20. No. 1943, Am. Mus., ♂ ad., 185: 41 : 21. *Skull* (No. 53969): Basal length, 26; zygomatic breadth, 16.2; mastoid breadth, 12.3; alveolar length of upper molar series, 6.8. (No. 1943) 26.6; 8.5; 16.2; 13; 6.6.

Remarks.—Microtus nesophilus needs no comparison with *breweri* or *terrænovæ*, the other two insular forms from the Atlantic coast. In general appearance it more nearly resembles *pennsylvanicus*, but in cranial characters it is as distinctly different as either of the other island species.

During the month of August, 1898, Mr. A. H. Howell visited Great Gull Island for the purpose of getting specimens of *Microtus*, but he found their old haunts covered by the earth moved in grading the island for fortifications, while no trace of the animals remained. He thinks they are completely exterminated.

Specimens examined.—Total number, 15; all from the type locality.

MICROTUS MONTANUS (Peale). Peale Vole.

Arvicola montanus Peale, U. S. Exploring Exp'd., Mammalogy, 44, 1848.
Arvicola longirostris Baird, Mamm. N. Am., 530–531, 1857. (From upper Pitt River, California.)

Type locality.—Headwaters of Sacramento River, near Mount Shasta, California.

Geographic distribution.—Northeastern California, eastern Oregon, northern Utah and Nevada, in the Upper Sonoran and Transition zones.

Habitat.—Marshes, meadows, and tule swamps.

General characters.—Size medium (about as in *pennsylvanicus*); tail about twice as long as hind foot; colors dark; hip glands conspicuous in adult males; incisors projecting well in front of nasals; incisive foramina narrow and constricted posteriorly.

Color.—Summer pelage: Upperparts bister or ashy mixed with blackish; belly washed with soiled whitish, giving a smoky gray or dusky color; feet plumbeous; tail indistinctly bicolor, blackish above, plumbeous below; lips usually showing a trace of whitish.

Cranial characters.—Skull generally slender and smooth, becoming angular and ridged in only a few very old individuals; nasals narrow and short; interparietal wide and normally strap-shaped; incisive foramina narrow and constricted posteriorly; bullæ medium and well rounded; dentition rather light; m2 with 4 closed sections; m3 with 3 closed triangles; m1 normally with 5 closed triangles.

Fig. 2.—Molar enamel pattern of *Microtus montanus* (×5).

Measurements.—Average of 10 specimens from Sisson, Cal.: Total length, 175; tail vertebræ, 52; hind foot, 21.5. Extremely large specimens from Sisson run as high as 192; 54; 23. *Skull* (No. 98689, ♂ ad., from Sisson): Basal length, 28; nasals, 8; zygomatic breadth, 17; mastoid breadth, 13.5; alveolar length of upper molar series, 7.3.

General remarks.—The original description of *M. montanus*, though meager, agrees in all particulars with the animal from Sisson, at the west base of Mount Shasta. The measurements (total length, 6⅛ inches; tail, 1½ inches=156 mm. and 38 mm.) give it too short a tail, which only serves to restrict it more closely to this form in distinction from either of the longer-tailed species (*mordax* or *californicus*) that occur at or near the type locality. Three mounted specimens in the United States National Museum, which Baird referred to *montanus*,[1] and which came from Upper Klamath Lake and the Upper Des Chutes, are identical with those of the present series from Sisson, Fort Klamath, and Fort Crook. Specimens from the south end of Goose Lake, which is the source of Pitt River, are the same as those from Sisson and from Fort Crook, lower down the river, and also the same as Baird's type of *M. longirostris* from 'Upper Pitt River.'

M. montanus has a somewhat scattered and interrupted distribution and shows considerable geographic variation in widely separated localities. The extreme development of large size, large feet, and heavy angular skull is found in the big marshes of the Carson Sink, Nevada, while specimens from higher levels in the Transition zone are smaller, with slenderer feet and grayer coloration. The variation is mainly, but not entirely, zonal. To separate either extreme would tend to confusion rather than convenience, as the extremes point to *nevadensis* on the one hand and to *nanus* on the other.

Specimens examined.—Total number, 263, from the following localities:

California: Sisson, 57; Fort Crook, 23; Hayden Hill, 2; Fall Lake, 2; Cassel, 1; Tule Lake, 2; Goose Lake, 8; Greenville (8 miles NW.), 3; Bucks Ranch (Plumas Co.), 1; Quincy, 3; Summit, 1.

Nevada: Washoe, 1; Deep Hole (south end of Granite Range), 1; Pine Forest Range, 1; Mountain City, 4; Wells, 13; Austin, 7; Carson, 16; Stillwater, 10; Newark Valley, 5; Monitor Valley, 5; Ruby Lake, 5; Ruby Mountains, 3.

[1] Mamm. N. Am., 530, 1857.

Oregon: Klamath Basin (Lost River), 8; Klamath Falls, 1; Fort Klamath, 5; Swan Lake Valley, 5; Plush (west side Warner Lake), 9; Shirk, 2; Steen Mountains (east slope), 1; Summit NE. of Steen Mountains), 2; Burns, 2; Wapinitia, 4.

Utah: Ogden, 16; Salt Lake City, 3; Provo, 1; Fairfield, 10; Manti, 20.

MICROTUS MONTANUS ARIZONENSIS Bailey. Arizona Vole.

Microtus montanus arizonensis Bailey, Proc. Biol. Soc. Wash., XII, 88, April 30, 1898.

Type locality.—Springerville, Ariz.

Geographic distribution.—Plateau country of eastern Arizona, at head of Little Colorado, in the Transition Zone.

Habitat.—Creek banks and damp meadows.

General characters.—Similar to *M. montanus*, but brighter and more ferruginous in color; lateral pits of palate shallower.

Color.—*Early winter pelage* (October and November specimens): Upperparts yellowish or rusty brown; belly washed with white; feet dark grayish; tail bicolor, blackish above, grayish below; lips whitish. Slightly immature specimens are a little duller colored than adults.

Cranial characters.—Skull very similar to that of *montanus*, but easily distinguished by the flatter palate with shallower lateral pits and by thicker pterygoids; condyloid process of mandible slightly shorter. Dentition not different.

Measurements.—Type: Total length, 184; tail vertebræ, 55; hind foot, 20. Average of 7 specimens from type locality: 158; 41; 20.6. *Skull* (of type): Basal length, 27.3; nasals, 8; zygomatic breadth, 16; mastoid breadth, 12.2; alveolar length of upper molar series, 6.5.

General remarks.—Although widely separated geographically from *M. montanus* by desert country through which continuity of range is improbable, this form is so closely related to that species that its position is best indicated by subspecific rank.

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

Arizona: Springerville, 11.

New Mexico: Nutria, 1.

MICROTUS MONTANUS RIVULARIS Bailey. Utah Vole.

Microtus nevadensis rivularis Bailey, Proc. Biol. Soc. Wash., XII, 87, April 30, 1898.

Type locality.—St. George, Utah.

Geographic distribution.—Known only from type locality, probably restricted to Lower Sonoran zone.

Habitat.—Tule marshes along the banks of the Virgin River. The runways were always found in wet places among sedges and rushes.

General characters.—Larger and lighter colored than typical *montanus;* skull more arched; nasals narrower.

Color.—*Winter pelage:* Upperparts dull bister, darkened with blackish-tipped hairs; sides scarcely paler; belly washed with white; feet dull grayish; tail bicolor, blackish above, grayish below. *Young:* Darker than adult, but not black backed as in *nevadensis.*

Cranial characters.—Skull well arched, not much ridged; nasals conspicuously narrower than in *montanus;* frontals narrower posteriorly; basioccipital more constricted anteriorly; dentition essentially the same.

Measurements.—Type: Total length, 179; tail vertebræ, 48; hind foot, 23. A nearly adult female topotype: 163; 43; 21. *Skull* (of type): Basal length, 28.2; nasals, 8.3; zygomatic breadth, 17; mastoid breadth, 13.3; alveolar length of upper molar series, 7.3.

General remarks.—Since *rivularis* was described in 1898 as a subspecies of *nevadensis*, a series of 50 specimens has been collected at the type locality of *montanus*, showing for the first time the real characters and the range of variation in that species, and, moreover, as Dr. Merriam had previously suggested to me, that *rivularis* comes nearer to typical *montanus* than to *nevadensis*. So far as at present known it has an isolated range in a Lower Sonoran valley, but it may readily extend northward to meet and merge into *montanus* in central Utah.

Specimens examined.—Total number, 4, from the type locality.

MICROTUS NANUS (Merriam). Dwarf Vole.

Arvicola nanus Merriam, North American Fauna No. 5, 62–63, pl. II, figs. 5 and 6, July 30, 1891.

Type locality.—Pahsimeroi Mountains, Idaho (altitude 9,350 feet).

Geographic distribution.—Rocky Mountains and outlying ranges, from central Idaho southward to central Nevada and southern Colorado, in Canadian zone.

Habitat.—Dry, grassy parks on mountain slopes.

General characters.—Size small; tail short; ears short and rounded; color dark grayish; skull slender.

Color.—Summer pelage: Upperparts uniformly grizzled gray mixed with sepia and blackish hairs; belly washed with white; feet grayish or plumbeous; tail bicolor, dusky gray above, whitish below. (*Winter pelage* unknown.) *Young:* Similar to adult, but slightly duller throughout.

Cranial characters.—Skull small, slender and well arched, with slender zygomata and large well-rounded bullæ; superciliary ridges prominent, sometimes confluent in old age; incisors projecting well beyond nasals; molars light, with short, wide triangles; enamel pattern scarcely distinguishable from that of *mordax* and *montanus*.

Measurements.—Type, ♂ ad.: Total length, 151; tail vertebræ, 41; hind foot, 18. Average of five adults from type locality: 143; 37; 18.4. *Skull* (of type): Basal length, 23.7; nasals, 6.7; zygomatic breadth, 14; mastoid breadth, 10.8; alveolar length of upper molar series, 5.8.

Remarks.—*Microtus nanus* belongs to the *montanus* group but occupies a higher zone and has more of the habits of *Pedomys* or *Lagurus*. It is rarely found in wet places or near water. Specimens from certain isolated localities are not entirely typical, but do not differ enough to warrant separation.

Specimens examined.—Total number, 114, from the following localities:

Idaho: Pahsimeroi Mountains, 13; Lost River Mountains, 1; Challis, 7; Sawtooth Lake, 5; Three Creek, 3; Montpelier Creek, 3; Seven Devils Mountains, 4.
Utah: Uinta Mountains, head of Smith Fork, 1.
Wyoming: Fort Bridger, 9; Kinney Ranch, 6; Beaver, 1 (no skull); La Barge Creek (near head), 1; Cheyenne, 3; Sherman, 2; Laramie, 2; South Pass City, 20; Bighorn Mountains, head of Powder River, 9.
Montana: Beartooth Mountains, 3; Big Snowy Mountains, 1.
Colorado: Estes Park, 1; Cochetopa Pass, 17; Twin River, 1; Twin Lakes, 1.

MICROTUS NANUS CANESCENS Bailey. Gray Vole.

Microtus nanus canescens Bailey, Proc. Biol. Soc. Wash., XII, 87, April 30, 1898.

Type locality.—Conconully, Washington.

Geographic distribution.—Northern Washington and southern British Columbia, east of the Cascades. Apparently confined to the Transition zone.

Habitat.—Dry grassy ground.

General characters.—Like *nanus* but lighter, clearer gray; skull with larger bullæ and greater mastoid breadth; zygomatic arches less widely spreading; upper incisors bent more abruptly downward. Hip glands conspicuous in adult males.

Color.—*Summer pelage:* Upperparts clear, dark grayish, formed by pale buffy and black-tipped hairs; sides shading to lighter gray and belly to white; feet dark gray; tail bicolor, blackish above, grayish below. (*Young* and *winter pelage* not shown in present material.)

Cranial characters.—Skull slightly narrower and more elongate than in *nanus;* interparietal averaging longer; bullæ decidedly larger and fuller; mastoid breadth relatively greater; incisors scarcely reaching beyond nasals; molar pattern as in *nanus.*

Measurements.—Type: Total length, 149; tail vertebræ, 42; hind foot, 20. *Skull* (of type): Occipital condyle to anterior base of molars, 17.4; posterior tip of nasals to foramen magnum, 19.2; zygomatic breadth, 15; mastoid breadth, 12.3; alveolar length of upper molar series, 6.3.

General remarks.—In its extreme development this northern form is readily distinguishable from typical *nanus.* From intermediate localities, Flathead Lake and the Plains of the Columbia, specimens are not typical of either but show slight peculiarities of local development interesting in themselves but not sufficiently marked for even subspecific distinction. To a certain extent they are intermediate between *nanus* and *canescens.*

Specimens examined.—Total number, 47, from the following localities:

British Columbia: Okanagan, 11; Ducks, 2; Vernon, 7.
Washington: Conconully, 1; Wenatchee, 1; Fort Walla Walla, 1; Oakesdale, 2; Wawawai, 4; Cheney, 1.
Oregon: Elgin, 2; Wallowa Mountains (near Joseph), 6.
Montana: West arm of Flathead Lake, 5; Hot Spring Creek (a branch of the Little Bitterroot), 4.

MICROTUS CANICAUDUS Miller. Gray-tailed Vole.

Microtus canicaudus Miller, Proc. Biol. Soc. Wash., XI, 67–68, April 21, 1897.

Type locality.—McCoy, Oregon.

Geographic distribution.—Willamette Valley, Oregon, and the east base of the Cascades in southern Washington, in Transition zone.

General characters.—Size and proportions about as in *nanus;* ears larger, skull heavier, more arched, with fuller, rounder bullæ, and shallower lateral pits of palate, coloration more yellowish, tail grayer.

Color.—*Winter pelage:* Upperparts bright yellowish bister, darkened with blackish-tipped hairs, slightly paler on sides; belly and whole lower parts whitish-gray; feet grayish or pale plumbeous; tail in winter adults uniformly grayish, with a half-concealed dusky dorsal line. In the only *summer* specimen (from North Yakima, Wash., and perhaps not typical) the tail is sharply bicolor with a blackish dorsal line. *Young* (half-grown November specimens): Sooty gray above and scarcely lighter below; feet dusky; tail gray, with a blackish dorsal stripe.

Cranial characters.—Skull high, smooth, and well arched, with scarcely a trace of superciliary ridges; interparietal lozenge-shaped; bullæ larger and more rounded than in *nanus;* interpterygoid fossa narrower and more acuminate; lateral pits of palate shallower; incisors less protruding; enamel pattern of molars the same as in *nanus.*

Measurements.—Type: Total length, 135; tail vertebræ, 33; hind foot, 20. Average of 8 adults from type locality: 141; 35.7; 20. *Skull* (of type): Basal length, 24.2; nasals, 7.3; zygomatic breadth, 15.3; mastoid breadth, 12.8; alveolar length of upper molar series, 6.

Remarks.—A single specimen with a badly broken skull from North Yakima, Wash., seems to be true *canicaudus* in summer pelage, and indicates that the range of the species is much more extensive than is at present known.

Specimens examined.—Total number, 14, from the following localities:

Oregon: McCoy, 9; Beaverton, 2; Sheridan, 2 (im).
Washington: North Yakima, 1.

MICROTUS DUTCHERI Bailey, Dutcher Vole.

Microtus dutcheri Bailey, Proc. Biol. Soc. Wash., XII, 85, April 30, 1898.

Type locality.—Big Cottonwood Meadows, near Mount Whitney, California (altitude, 10,000 feet).

Geographic distribution.—Hudsonian zone of the southern Sierra Nevada.

Habitat.—Wet alpine meadows.

General characters.—Size rather small; tail short; ears small, nearly concealed by fur; colors dark above and below; lips and usually nose white; hip glands present in adult males.

Color.—*Summer pelage:* Upperparts dark bister with brown tips to the long hairs; below, dull cinnamon or buffy-brown; feet whitish or

plumbeous-gray; tail bicolor, brown or blackish above, whitish below; lips and usually tip of nose white. (*Winter pelage* unknown.) *Young:* Dull brown above and scarcely lighter below; feet and tail blackish; lips and nose usually white.

Cranial characters.—Skull similar to that of *montanus* but differing in many details; rostrum slightly longer; bullæ smaller and less globular; lateral pits of palate shallower; dentition the same.

Measurements.—Type, ♂ ad.: Total length, 167; tail vertebræ, 35; hind foot, 20. Average of 10 adults, 5 males and 5 females, from type locality: 163; 37; 20.6. *Skull* (of type): Basal length, 27.4; nasals, 8; zygomatic breadth, 16.7; mastoid breadth, 12.2; alveolar length of upper molar series, 6.5.

General remarks.—The nearest relative of *M. dutcheri* is *montanus*, but the two species occupy widely separated zones, and show no evidence of intergradation.

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

California: Big Cottonwood Meadows, 28; Whitney Meadows, 11; Menache Meadows, 2; Olancha Peak, 3; Head of Kern River, 1; Mammoth, 12; Pine City, 3; Head of San Joaquin River, 5.

MICROTUS NEVADENSIS Bailey. Nevada Vole.

Microtus nevadensis Bailey, Proc. Biol. Soc. Wash., XII, 86, April 30, 1898.

Type locality.—Ash Meadows,[1] Nye County, Nevada.

Geographic distribution.—Known only from the type locality and Pahranagat Valley, about 100 miles to the northeast. Both localities are in the Lower Sonoran zone.

Habitat.—Salt grass and tule marshes in alkaline valleys. Runways always found in wet, muddy places, and often extending through shallow water.

General characters.—Size large; ears small; tail rather short; fur coarse and lax; colors dark; hip glands conspicuous in adult males. Skull massive and angular; incisive foramina narrow and closing to a point posteriorly.

Color.—*Winter pelage* (March specimens): Upperparts dark sepia or bister, much obscured by blackish hairs; sides lighter; belly smoky gray; feet dark gray; tail indistinctly bicolor, blackish above, gray or brownish below; lips usually white; tip of nose usually whitish. *Young:* With a blackish dorsal stripe and dusky feet and tail.

Cranial characters.—Skull heavy, angular, and much ridged; frontals high; rostrum bent downward: nasals truncate or rounded posteriorly, terminating even with arms of premaxillæ; incisive foramina short, rather narrow and constricted to a point posteriorly; dentition heavy; upper incisors curved abruptly downward; molar pattern vari-

[1] Ash Meadows is on the Nevada side of the Nevada-California line near where the Amargosa River crosses the boundary. The exact locality is a big salt marsh below Watkins ranch.

able; m2 with 4 closed sections in 8 out of 16 specimens, in the other 8, with a slight inner lobe or loop at base of posterior triangle; m3 with anterior crescent, three closed triangles, and a posterior loop with two inner lobes; m1 usually with 6 closed triangles.

Measurements.—Type: Total length, 210; tail vertebræ, 55; hind foot, 25.5. Average of 8 specimens from type locality: 176; 47; 23. *Skull* (of type): Basal length, 32; nasals, 10.2; zygomatic breadth, 19.3; mastoid breadth, 14.3; alveolar length of upper molar series, 8.

Remarks.—Three specimens taken May 26 in Pahranagat Valley differ slightly from the type series, but the cranial differences are slight and the darker color may be only seasonal. The species inhabits marshes and wet places, which are so rare and isolated in the desert region that it can have no extensive continuous range. It is one of the few forms of *Microtus* inhabiting a part of the Lower Sonoran zone.

Specimens examined.—Total number, 19, from the following localities:

Nevada: Ash Meadows, 16; Pahranagat Valley, 3.

MICROTUS CALIFORNICUS (Peale.) California Vole.

Arvicola californica Peale, U. S. Expl. Expd., Mammalogy, 46, 1848.
Arvicola trowbridgi Baird, Mamm. N. Am., 529, 1857. (Monterey, California.)

Type locality.—San Francisco Bay, California.

Habitat.—Dry meadows and grassy uplands, Upper Sonoran zone.

Geographic distribution.—California, west of the Colorado Desert and the Sierra Nevada, and from Santa Ysabel, San Diego County, Calif., north to the Rogue River and Umpqua valleys, Oregon.

General characters.—Size rather large, ears conspicuous above fur; pelage coarse and harsh, color similar to that of the house mouse; skull of adult heavy and angular, incisive foramina wide and open, usually widest posteriorly; a trace of hip glands in adult males.

Color.—Summer pelage: Upperparts dull buffy or clay-colored, slightly lined with blackish-tipped hairs; sides paler; belly light buffy or soiled whitish; tail bicolor, brownish above, buffy below; feet clear gray. *Winter pelage:* Much darker than the summer, with an excess of black-tipped hairs over the back; tail more sharply bicolor, blackish above. *Young:* Fur woolly and soft, duller and darker throughout than in the adult; belly dusky or plumbeous; feet and tail dusky.

Cranial characters.—Skull of adult heavy, angular, and ridged; nasals long, bent well down, widening abruptly in front, narrow and notched at posterior end, not reaching tip of ascending arm of premaxillæ; prezygomatic notch deep; postorbital processes prominent; frontals concave posteriorly; incisive foramina open, rounded at both ends and usually widest posterior to middle. Incisors heavy, the upper bent abruptly downward, not extending beyond tip of nasals; molars large and irregular, posterior triangle of m1 normally with an inner point or angle; posterior triangle of m2 with an inner point or angle or loop,[1]

[1] In 100 specimens, 77 have 4 closed triangles in m2, 20 have an open posterior loop, and 3 have a closed posterior loop as in *pennsylvanicus*.

suggesting the posterior loop in *pennsylvanicus:* m3 with three closed triangles, 3 outer and 4 inner salient angles; m1 with 5 closed triangles and 9 or 11 salient angles.

Measurements.—Average of 4 adults, 2 males and 2 females from Walnut Creek, Calif.: Total length, 171; tail vertebræ, 49; hind foot, 21.1. Of 10 adults from Monterey: 172; 52; 22.3. *Skull* (♂ ad., No. 44678, from Walnut Creek, Calif.): Basal length, 27.5; nasals, 8.5; zygomatic breadth, 16.6; mastoid breadth, 13.6; alveolar length of upper molar series, 6.8.

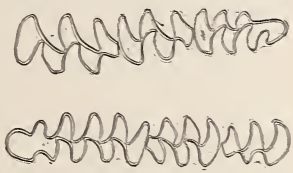


FIG. 3.—Molar enamel pattern of *Microtus californicus* (×5).

Remarks.—But slight variation is shown throughout the range of the species. Specimens from Santa Ysabel and the base of San Bernardino Mountains are indistinguishable from those of the shores of San Francisco Bay or from the Rogue River Valley, Oregon. A slight brightening in color is noticeable in specimens from Auburn.[1] The species is conspicuously absent from the bottom, or Lower Sonoran area, of the San Joaquin and Sacramento valleys, its place being taken in the tule marshes of these valleys by the larger, darker, longer-tailed species, *M. edax.*

The skin of the type of *M. californicus* in the United States National Museum agrees perfectly with series of specimens from Berkeley, Walnut Creek, and other localities around San Francisco Bay, but the slightly immature skull is either abnormal or else never came from the same animal as did the skin. By some error it was given the same catalogue number as the type skull of *M. occidentalis*, a synonym of *M. townsendi*, but it is not the skull of that species.

Specimens examined.—Total number, 338, from the following localities:

California: Walnut Creek, 6; Oakland, 1; Berkeley, 44; San Lorenzo, 3; San Mateo, 14; Novato, 7; Glen Ellen, 9; Nicasio, 16; Point Reyes, 34; Cape Mendocino, 2; Mill Valley, Marin County, 3; Olema, 5; Cloverdale, 14; Ukiah, 2; Laytonville, 2; Round Valley, 1; Upper Lake, 1; Leesville, 10; Bartlett Mountain, 1; Rio Dell, 1; Hornbrook, 3; Little Shasta, 4; Mayten, 2; Cassel, 6; Red Bluff, 1; near Edgewood, 2; Grindstone Creek, Tehama County, 2; Auburn, 5; Jackson, 7; Chinese Camp, 2; Boulder Creek, 2; Monterey, 22; Jamesburg, 12; Jolon, 4; San Simeon, 1; Paso Robles, 1; Morro, 4; Pozo, 1; Gaviota Pass, Santa Barbara County, 4; Santa Barbara, 2; Ventura River, 3; San Emigdio Canyon, Kern County, 7; Mount McGill, Ventura County, 2; Calabasas, 3; San Fernando, 4; San Bernardino, 2; San Bernardino Mountains, 9; San Diego, 1; Riverside, 5; Techelote Canyon, Riverside County, 1; Little Bear Valley (San Bernardino Mountains), 1; Las Virginias Creek, 1; Radec, Riverside County, 1; Santa Ysabel, 10; near Tejon Pass, 1; Fort Tejon, 1; South Fork Kern River, 6.

Oregon: Rogue River Valley (near Grants Pass), 7; Siskiyou, 4; Drain, 6.

[1]The effect of red soil is noticeable in these as in some other mammals from the vicinity of Auburn.

MICROTUS CALIFORNICUS VALLICOLA Bailey. Valley Vole.

Microtus californicus vallicola Bailey, Proc. Biol. Soc. Wash., XII, 89, 1898.

Type locality.—Lone Pine, Inyo County, California.

Geographic distribution.—Valleys east of the Sierra Nevada, California. Confined mainly to Upper Sonoran zone.

Habitat.—Dry, grassy banks, upland meadows, and old weedy fields.

General characters.—Similar to *californicus*, but averaging slightly larger and darker. Proportions the same.

Color.—*Summer pelage:* Upperparts dull sepia, darkened by black-tipped hairs, darker and with less buffy suffusion than in *californicus;* belly dull grayish or smoky plumbeous; feet dusky; tail bicolor, blackish above, grayish below. *Winter pelage:* Darker throughout, with the black hairs of the back longer and more conspicuous. *Young:* Sooty gray above, plumbeous below, not black backed; feet and tail dusky.

Cranial characters.—Skull like that of *californicus,* but usually with smaller audital bullæ, more abruptly truncated occiput, and nasals reaching nearer to tips of premaxillæ; lobe at base of 4th triangle of middle upper molar sometimes developed into a loop.

Measurements.—Type, ♀ ad.: Total length, 200; tail vertebræ, 57; hind foot, 23. Average of 7 specimens from type locality: 188; 56; 23. *Skull* (of type): Basal length, 29.4; nasals, 9.5; zygomatic breadth, 17.6; mastoid breadth, 13.4; alveolar length of upper molar series, 7.4.

Remarks.—The range of this form is not widely separated from that of *californicus* on the west slope of the mountains, and the two forms may meet by way of Walker Pass and the South Fork of Kern River. The difference is not sufficiently marked to warrant full specific separation, in view of the fact that their ranges are so nearly continuous that they occupy the same zone and have essentially the same habits.

Specimens examined.—Total number, 52, from the following localities:

California: Lone Pine, 26; Olancha, 3; Cartago (west side of Owens Lake), 3; Independence Creek, 1; Alvord, 8; Bishop Creek, 2; Panamint Mountains (head of Willow Creek at east end of Nelson Range), 9.

MICROTUS CALIFORNICUS CONSTRICTUS subsp. nov. Coast Vole.

Type from Cape Mendocino, California. No. 98347, U. S. Nat. Mus., Biological Survey Collection. Collected Sept. 6, 1899, by Vernon Bailey. Original number, 7174.

Geographic distribution.—Coast region near Cape Mendocino.

Habitat.—Open grassy hillsides and old fields and pastures.

General characters.—Smaller and grayer than *californicus*, with narrower skull, smaller audital bullæ, and narrower interpterygoid fossa.

Color.—*Summer pelage* (in September specimens): Buffy gray above, whitish below; tail almost concolor, dull grayish; feet gray.

Cranial characters.—Skull smaller and especially narrower than that of *californicus*, with slender nasals and rostrum; bullæ small and narrow; pterygoids close together; zygomatic arches not abruptly spreading and not notched at anterior junction with premaxillæ; dentition as in *californicus;* tooth rows noticeably closer together.

Measurements.—Average of 4 adults from type locality: Total length, 163; tail vertebræ, 55; hind foot, 21.5. *Skull* (of type): Basal length, 26; nasals, 8.9; zygomatic breadth, 15.6; mastoid breadth, 12; alveolar length of upper molar series, 6.7.

General remarks.—There is a striking similarity in the characters separating this narrow-skulled form from its widely distributed species *californicus*, and those separating *angusticeps* of the coast region a little farther north from the still more widely distributed *mordax*, that shows an interesting parallelism in geographic modifications. Both forms are from the wind-beaten coast strip where arboreal vegetation is scanty and dwarfed, and, like some of the trees, they apparently represent depauperate forms of widely distributed and more protected inland species. At Capetown, just back of Cape Mendocino, California, I found *constrictus* in great abundance on the open grassy hills. In some places the ground was perforated with their burrows, while on the surface their runways crossed in all directions.

Specimens examined.—Four from the type locality, besides a large number in the flesh.

MICROTUS EDAX (Le Conte). Tule Vole.

Arvicola edax Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 405, 1853.

Type locality.—California [south of San Francisco].[1]

Geographic distribution.—Bottom of the San Joaquin and Sacramento valleys, in Lower Austral zone.

Habitat.—Tule swamps and wet places, under heavy grass, where the runways usually extend through mud and water and in places are flooded by the tide.

General characters.—Size large; feet large and stout; hair long and coarse; skull long, angular, and much ridged in adults; hip glands inconspicuous or rudimentary in adult males.

Color.—*Winter pelage:* Much blacker than in *californicus;* gray of upperparts more or less obscured by black; that in full, ripe pelage is glossed with iridescent purple;[2] sides more grayish; belly washed with whitish; feet dusky; tail bicolor, black above and gray below or dusky gray above and whitish below. *Summer pelage:* Upperparts less glossed with black. *Young:* With black back, dusky sides, and paler dusky belly; feet and tail dark.

Cranial characters.—Skull similar to that of *californicus*, but larger, more elongated, more heavily ridged in adults, with more expanded jugal and heavier dentition; molar pattern similar; m2 with usually an open posterior fifth loop.

Measurements.—No. 58128, ♂ ad., from near Tracy, Calif.: Total length, 217; tail vertebræ, 72; hind foot, 25. An immature ♀ from the same place: 167; 49; 23. An adult ♂, No. 70602, from near Marysville Buttes: 208; 67; 25. *Skull* (No. 70602, ♂ ad.): Basal length, 30; nasals, 9.2;

[1] Baird, Mamm. N. Am. 532, 1857.

[2] *M. californicus* and many other species show a purple gloss in high pelage, but less marked than in some specimens of *edax*.

zygomatic breadth, 17.7; mastoid breadth, 13.9; alveolar length of upper molar series, 7.8.

Remarks.—The type of *M. edax* in the United States National Museum, at Dr. Merriam's request, has been relaxed, the skull removed, and the skin made over and greatly improved for purposes of comparison. The base of the skull has been cut away, but enough remains to show that the specimen is immature and is the large swamp species, instead of *californicus*. The hind foot gives the only reliable measurement. In the dry skin it measures, flattened out, 23.5, and is proportionately stout. This is fully up to the flesh measurement of No. 57900 from Tracy, though the skull shows the latter to be slightly older.

M. californicus and *M. edax* differ widely in habits, their ranges conform to different zones, the distinctive characters are certainly strong enough for full specific recognition, and the present series shows no intergradation.

Specimens examined.—Total number, 50, from the following localities:

California: Tracy, 2; Marysville, 1; near Marysville Buttes, 1; Union Island (San Joaquin River), 1; Suisun, 24; Tulare Lake, 2; Mendota, 19.

MICROTUS SCIRPENSIS sp. nov. Desert Vole.

Type from Amargosa River (near Nevada line), Inyo County, Calif. No. $\frac{25379}{33385}$, ♀ ad., U. S. Nat. Mus., Biological Survey Collection. Collected February 26, 1891, by Vernon Bailey. Original number, 2520.

Geographic distribution.—Known only from the type locality.

Habitat.—Wet ground under tall tules (*Scirpus olneyi*), where the runways extend through mud and water in a little marsh around a warm spring.

General characters.—Size and proportions about as in *edax*, colors not so dark, tail long, skull heavy and angular, middle upper molar with rounded open or closed posterior loop.

Colors.—*Winter pelage:* Upperparts dark buffy gray, slightly darker than in *californicus*, but not so black as in *edax;* belly smoky gray, tail indistinctly bicolor, brown above, grayish below; feet brownish gray, not dusky. *Young:* Upperparts black, belly grayish, a black dorsal stripe retained until the animals are half grown.

Cranial characters.—Skull of adult angular and heavily ridged; in general characters resembling that of *edax*, but with more truncate posterior tip of nasals, heavier dentition, and well-developed inner posterior loop of middle upper molar. The same characters and larger size distinguish it from those of *vallicola* and *californicus*, and the wide incisive foramina with many other characters distinguish it from that of its nearest neighbor—*nevadensis*.

Measurements.—Type: Total length, 210; tail vertebræ, 67; hind foot, 25. Average of 6 adults: 203; 65; 25.1. *Skull* (of type): Basal length, 31; nasals, 10; zygomatic breadth, 19; mastoid breadth, 13.6; alveolar length of upper molar series, 8.7.

General remarks.—*Microtus scirpensis* stands nearest to *M. edax*, and, except for the more completely developed posterior loop of middle upper molar, fits into the *californicus* group. Among 14 specimens the loop is closed in 7 and open in 7, while among 43 specimens of *edax* it is closed in 2, open in 32, and absent in 9, and among 100 specimens of *californicus* it is closed in 3, open in 20, and absent in 77. Although resembling *pennsylvanicus* in the fifth loop, in other characters it does not approach that group or any of its forms. In range it comes nearer to *vallicola* than to *edax* or *californicus*, but from *vallicola* it differs in the same way as from *californicus*.

Specimens examined.—Total number, 14, from the type locality.

MICROTUS OPERARIUS (Nelson). Tundra Vole.

Arvicola operarius Nelson, Proc. Biol. Soc. Wash., VIII, 139, Dec. 28, 1893.

Type locality.—St. Michael, Alaska.

Geographic distribution.—Barren grounds from Bristol Bay, St. Michael, and Kowak River, Alaska, east to Anderson River.

Habitat.—Mossy tundras.

General characters.—Size small; tail short, densely haired; ears small and wholly concealed in long winter fur; colors yellowish; skull slender and narrow; dentition light.

Color.—*Winter pelage:* Upperparts dark rich buff, slightly tinged along back with black-tipped hairs; sides paler; belly pale buffy or creamy white; tail soiled whitish below and on sides, a partly concealed blackish dorsal line; feet gray; heels tinged with dusky. *Summer pelage:* Darker yellowish above, more buffy below.

Cranial characters.—Skull rather slender and narrow, angular and well ridged in adults; nasals slender, ending even with arm of premaxillæ; bullæ small and narrow; palate low; incisive foramina short, constricted posteriorly; incisors projecting well in front of nasals; molars very light; m2 with 4 closed sections; m3 with 3 closed triangles, 3 outer and 3 inner salient angles and terminal loop; m1 with 4 closed triangles, 3 outer and 5 inner salient angles, and fifth triangle open and confluent with short terminal loop, as in *M. ratticeps* of Europe.

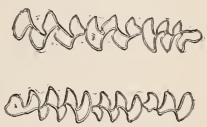


FIG. 4.—Molar enamel pattern of *Microtus operarius* (× 5).

Measurements.—Type (immature, measured in dry skin): Total length, 110; tail vertebræ, 28; hind foot, 18. Average of 10 adult topotypes, 168; 40; 19.7. *Skull* (of type): Basal length, 22.4; nasals, 5.8; zygomatic breadth, 12.4; mastoid breadth, 10.7; alveolar length of upper molar series, 5.5. Skull (of adult ♂, No. 9899): 27; 8; 16; 12.3; 6.3.

General remarks.—Mr. E. W. Nelson found these voles abundant along the coast tundras of Bering Sea from Cape Vancouver north to Bering

Strait, and on Nelson, St. Michael, and Stewart islands.[1] Mr. W. H. Osgood found them extending southward into the timbered region as far as the point where the Yukon crosses the Alaska boundary.

Specimens examined.—Total number, 81, from the following localities:

Alaska: St. Michael, 65; Kowak River, 1; Kagiktowik, 1; Bristol Bay, 1; Fort Yukon, 8; Circle, 1; 40 miles above Circle, 2; International boundary on Yukon, 1; Yukon River (200 miles southwest of Fort Yukon), 1.

MICROTUS MACFARLANI Merriam. Macfarlane Vole.

Microtus macfarlani Merriam, Proc. Wash. Acad. Sci., II, 24, March 14, 1900.

Type locality.—Fort Anderson, Anderson River, Northwest Territory.

Geographic distribution.—Tundra region of Arctic America, east of the Mackenzie River.

General characters.—Similar to *operarius* in external characters, but with shorter tail, shorter, wider skull and more projecting incisors. Fur very long and soft in winter specimens.

Color.—*Winter pelage:* Upperparts light buffy gray; belly whitish; feet silvery gray; tail sharply bicolor, black above, white below. *Summer pelage:* Darker and brighter buff or ochraceous. *Young:* More grayish.

Cranial characters.—Compared with *operarius:* Skull short and wide; nasals shorter; incisors more projecting; bullæ wider; incisive foramina shorter; molars slightly heavier; enamel pattern the same. With *yakutatensis:* Size smaller; coloration brighter; skull flatter; nasals shorter; incisors more projecting; interparietal smaller.

Measurements.—Type (in dry skin): Tail vertebræ, 29; hind foot, 18.5; topotype (No. 9144): tail. 27; hind foot, 19. *Skull* (of type): Basal length, 26; nasals, 7; zygomatic breadth, 15.5; mastoid breadth, 12.5; alveolar length of upper molar series, 6.

General remarks.—Material is so scanty from the Arctic regions that little is known of the range of this form, whether it meets and grades into *operarius* or *yakutatensis*, or whether it has a restricted and isolated range.

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

Northwest Territory: Fort Anderson, 4; Mackenzie River, 11; 'Arctic Coast,' 3.

MICROTUS YAKUTATENSIS Merriam. Yakutat Vole.

Microtus yakutatensis Merriam, Proc. Wash. Acad. Sci., II, 22. March 14, 1900.

Type locality.—Yakutat Bay (north shore), Alaska.

Geographic distribution.—Mainland of Alaska from Glacier Bay to Prince William Sound.

[1] Proc. Biol. Soc. Wash., VIII, 140, 1893.

General characters.—Size medium, about equal to *operarius*, less than that of any of the island forms of the group. Color dusky, as in *sitkensis*, but belly whitish. Skull of adult male heavily ridged; bullæ medium, rounded; interparietal large, shield-shaped.

Color.—*Summer pelage:* Upperparts dusky gray, with a trace of brownish, darker dorsally; belly washed with soiled white or pale buffy; tail sharply bicolor, sooty or black above, whitish below; feet silvery gray, soles black. *Young:* Quarter-grown specimen (June 19), darker gray than adult, with black nape, whitish belly, sharply bicolor, black and white tail.

Cranial characters.—Skull heavy, ridged and angular in adult male; interparietal large, shield-shaped; nasals long, with median constriction; dentition heavy. From the skull of *operarius* it differs in greater width, larger bullæ, heavier dentition; from that of *unalascensis* in smaller size, larger interparietal, slenderer nasals, smaller bullæ, shorter pterygoids. Molar pattern as in *operarius*. Skulls of adult females conspicuously smoother and less ridged than in males.

Measurements.—Average of 10 adults (5 males and 5 females) from type locality: Total length, 161; tail vertebræ, 37; hind foot, 20.6. *Skull* (of type, ♂ ad., No. 98005): Basal length, 28; nasals, 8; zygomatic breadth, 16; mastoid breadth, 13; alveolar length of upper molar series, 7.

General remarks.—This mainland form is readily distinguished from any of the island species of the group by either cranial or external characters, although it shows closer relationship with some of them than with the neighboring mainland species, *operarius*. If it has an uninterrupted range to the north it may grade into *operarius*, but at present there is no intermediate material to show whether it does or not.

Specimens examined.—Total number, 47, from the following localities:

Alaska: Yukutat, 29; Glacier Bay, 17; Prince William Sound, 1.

MICROTUS KADIACENSIS Merriam. Kadiak Vole.

Microtus kadiacensis Merriam, Proc. Biol. Soc. Wash., XI, 222, July 15, 1897.

Type locality.—Kadiak Island, Alaska.

Geographic distribution.—Known only from the type locality.

General characters.—Size about that of *sitkensis;* belly white; ears very small; bullæ small and narrow; basioccipital short and wide.

Color.—*Summer pelage:* Yellowish brown above, with scattered black hairs; sides paler; belly washed with pure white; feet silvery gray, heels dusky, soles blackish; tail not sharply bicolor, black above, whitish below. *Young* (in June): Dull buffy gray above, maltese below.

Cranial characters.—Skull flat, long, and narrow; audital bullæ small and laterally compressed; basioccipital short and wide; palate low, with sloping median ridge, lateral pits deeper, and incisive foramina wider than in *sitkensis;* nasals short, not reaching posterior tips of pre-

maxillæ; incisors projecting; molars small; m3 with 3 closed triangles and elliptical terminal loop, making 3 inner and 3 outer salient angles, as in *operarius*.

Measurements.—Average of five adult males: Total length, 188; tail vertebræ, 50; hind foot, 21. *Skull* (of topotype, ♂ ad. No. 97969,): Basal length, 28; nasals, 8; zygomatic breadth, 16.5; mastoid breadth, 13.2; alveolar length of upper molar series, 6.4.

Remarks.—This insular species belongs to the *operarius* group, but differs from *operarius* in larger size, smaller bullæ, and transversely longer and narrower interparietal.

Specimens examined.—Total number, 12, from the type locality.

MICROTUS UNALASCENSIS Merriam. Unalaska Vole.

Microtus unalascensis Merriam, Proc. Biol. Soc. Wash., XI, 222, July 15, 1897.

Type locality.—Unalaska, Alaska.

Geographic distribution—Island of Unalaska.

General characters.—Larger and more robust than *operarius*; belly white; feet light gray; skull well arched and heavily ridged; bullæ large and well rounded.

Color.—Upperparts dull yellowish brown, darkest on head and rump; end of nose whitish; belly white or slightly soiled whitish; feet light gray with dusky soles; tail bicolor, a narrow line of blackish above, soiled white below. *Young:* Similar to adult.

Cranial characters.—Skull considerably arched, deep, heavy, and angular; frontals heavily ridged in old age; bullæ medium, much larger than in *operarius* or *kadiacensis*; basioccipital narrowly constricted between bullæ; dentition actually and relatively heavier than in *operarius*; molar pattern the same; m3 with 3 closed triangles and an inner salient angle confluent with rounded posterior loop; m1 with 4 closed triangles, the fifth triangle confluent with shortened anterior loop.

Measurements.—Type, ♀ im.: Total length, 122; tail vertebræ, 28; hind foot, 19. Adult ♂ topotype, No. 97963: 181; 38; 22. *Skull* (of topotype): Basal length, 30; nasals, 8; zygomatic breadth, 17.7; mastoid breadth, 14; alveolar length of upper molars, 7.

Specimens examined.—Total number, 9, from the type locality.

MICROTUS UNALASCENSIS POPOFENSIS Merriam. Popof Island Vole.

Microtus unalascensis popofensis Merriam, Proc. Wash. Acad. Sci., II, 22, March 14, 1900.

Type locality.—Popof Island, Shumagin group, Alaska.

Geographic distribution.—Known only from Popof Island.

General characters.—Similar to *kadiacensis*, but slightly larger, with larger feet, relatively shorter and sharply bicolor tail. Skull less ridged, with larger bullæ and heavier molars. In size and proportions more nearly agreeing with *unalascensis*, from which it differs in wholly dusky nose, less ridged skull, smaller audital bullæ and deeper prezygomatic notch.

Color.—General coloration not readily distinguishable from that of *kadiacensis;* upperparts dark yellowish brown; nose dusky to tip; belly soiled white or pale buffy; tail sharply bicolor, whitish below, dusky or black above; feet silvery gray, with black soles and dusky heels.

Cranial characters.—Skull rather long and narrow; frontals not ridged in adults; prezygomatic notch deep; audital bullæ medium, not narrowly constricted as in *kadiacensis*, nor large and rounded as in *unalascensis;* palate with posterior point projecting into pterygoid fossa; incisive foramina short and wide; molar pattern as in *operarius* except in m3, which has normally 4 inner and 3 or 4 outer salient angles; m1 has 4 closed and 1 open triangle as in *operarius.*

Measurements.—Average of 3 topotypes: Total length, 165; tail vertebrae, 38; hind foot, 22.4. An adult ♀, No. 97959: 188; 43; 22. *Skull* (of type, No. 97956, ♂ ad.): Basal length, 29.4; nasals, 8.5; zygomatic breadth, 17.5; mastoid breadth, 13.5; alveolar length of upper molar series, 7.2.

General remarks.—This species needs comparison only with *unalascensis* and *kadiacensis*, from both of which it differs in slight external and well-marked cranial characters. The three are evidently from the same original stock that from long insular separation has been modified by somewhat varied conditions.

Specimens examined.—Total number, 7, from the type locality.

MICROTUS SITKENSIS Merriam. Sitka Vole.

Microtus sitkensis Merriam, Proc. Biol. Soc. Wash., XI, 221, July 15, 1897.

Type locality.—Sitka, Alaska.

Geographic distribution.—Known only from Baranof Island, Alaska.

General characters.—Size medium, about that of *unalascensis;* color yellowish brown above and below; skull rather flat, wide interorbitally; interparietal triangular; molars small; m1 with 4 or 5 closed triangles.

Color.—*August pelage:* Upperparts rusty brown, brightest on rump and nose, besprinkled with blackish hairs; sides paler; belly washed with dark buff; nose blackish; feet silvery plumbeous; heels and soles black; tail sharply bicolor, black above, pale buff below.

Cranial characters.—Skull long and flat, with no trace of superciliary ridges, wide interorbitally; tip of nasals reaching back of premaxillæ; interparietal narrow, subtriangular; bullæ medium and globose; palate long and flattened, lateral bridges low, lateral pits shallow; incisive foramina short and narrow; incisors projecting well beyond nasals; dentition slightly more intricate than in *operarius;* m1 has 4 or 5 closed triangles and a rounded terminal loop with a sharp inner salient angle; m3 has 3 closed triangles and 4 inner and 4 outer salient angles.

Measurements.—Type, ♂ ad.: Total length, 155; tail vertebræ, 42; hind foot, 23. Adult ♀ topotype: 190; 45; 22. *Skull:* Basal length, 25.5; nasals, 7; zygomatic breadth, 14.2; mastoid breadth, 11.3; alveolar length of upper molar series, 6. *Skull* (of topotype, ♀ ad.): 30; 8; 17.7; 14; 7.

Remarks.—*Microtus sitkensis* belongs to a well-marked group of the subgenus *Microtus* with the molar pattern of *M. ratticeps* of Europe, although in *sitkensis* m1 is usually closed up, making 5 triangles instead of 4.

Specimens examined.—Total number, 2, from the type locality.

MICROTUS INNUITUS Merriam. Innuit Vole.

Microtus innuitus Merriam, Proc. Wash. Acad. Sci., II, 21, March 14, 1900.

Type locality.—St. Lawrence Island, Bering Sea, Alaska.

Geographic distribution.—Known only from St. Lawrence Island.

General characters.—Size large; tail of medium length, sharply bicolor; skull wide and low, with projecting incisors; dentition mainly as in the *operarius* group.

Cranial characters.—Skull ridged and angular, not much arched; braincase short and wide; nasals short and cuneate, falling considerably back of base of incisors; interparietal small, semicircular; bullæ large, somewhat flattened and angular; pterygoids short; interpterygoid fossa very narrow; dentition heavy, incisors conspicuously projecting; molars with sharply constricted enamel folds; m1 with only 4 closed triangles, m3 with three closed triangles, a short posterior loop, and long posterior inner salient angle.

Measurements.—Tail vertebræ, 44; hind foot, 23. *Skull* (of type): Basal length, 32.5; nasals, 9; zygomatic breadth, 19.5; mastoid breadth, 15.3; alveolar length of upper molar series, 7.2.

General remarks.—The specimens from St. Lawrence Island were taken from regurgitated pellets of owls and jaegers, and consist of skulls, feet, tails, and imperfect skeletons. The animals are abundant. Many were seen running in the grass by members of the Harriman party who landed for a short time on the island. The species of *Microtus* coming geographically nearest to St. Lawrence Island is *tshuktshorum* Miller, from Plover Bay, on the Siberian coast, a tiny species bearing little resemblance to the present one.

Specimens examined.—Ten more or less imperfect skulls, besides feet, tails, and parts of skeletons, from the type locality.

MICROTUS ABBREVIATUS Miller. Hall Island Vole.

Microtus abbreviatus Miller, Proc. Biol. Soc. Wash., XIII, 13, Jan. 31, 1899.

Type locality.—Hall Island, Bering Sea, Alaska.

Geographic distribution.—Known only from Hall Island.

General characters.—Size rather large; tail very short, and densely haired; ears concealed in long fur; feet large and stout, measuring about 23.

Color.—July pelage: Upperparts dark buff or yellowish brown, brightest over ears, face, and rump; belly creamy white or pale buff; tail sharply bicolor, a narrow line of dark brownish above, creamy below; feet soiled white. *Young* (half-grown specimens): Duller and darker.

Cranial characters.—Skull similar to that of *unalascensis* in size and general appearance, but more heavily ridged, with deeper prezygomatic notches, larger, more quadrangular interparietal, shallower lateral pits of palate; slightly smaller and especially narrower audital bullæ; rather lighter dentition, with different molar pattern. m1 and m2 with base of posterior triangles broadly open; m3 shortened, with but 2 closed triangles, 3 outer, and 4 inner salient angles, the third triangle opening into short posterior loop; m1 with 5 completely closed triangles, and a well developed anterior trefoil, 4 outer, and 5 inner sharp, salient angles back of terminal loop. From the St. Matthew Island subspecies *fisheri*, it differs in molar pattern as from *unalascensis*, and also in slenderer skull and rostrum, slenderer zygomata, and wider interpterygoid fossa.

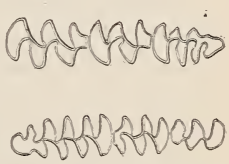


FIG. 5.—Molar enamel pattern of *Microtus abbreviatus* (× 5).

Measurements.—Average of 4 adult topotypes: Total length, 160; tail vertebræ, 25.7; hind foot, 23.3. *Skull* (of No. 97981, ♂ ad.): Basal length, 30.3; nasals, 8.8; zygomatic breadth, 18; mastoid breadth, 14; alveolar length of upper molar series, 7.

General remarks.—*Microtus abbreviatus* was described from an alcoholic specimen retaining none of the original colors. On the Harriman expedition 7 specimens were collected July 14 on Hall Island, and for the first time the natural appearance of the animal was made known. In external characters it strongly resembles a lemming on account of the short tail, long fur, and stout form, but the skull is that of a robust *Microtus*. It belongs to the subgenus *Microtus*, and in general character comes nearest to the *operarius* group, from which it is excluded, however, by its unique molar pattern—m3 having but 2 closed triangles, while m1 has 5.

Specimens examined.—Total number, 8, from the type locality.

MICROTUS ABBREVIATUS FISHERI Merriam. St. Matthew Island Vole.

Microtus abbreviatus fisheri Merriam, Proc. Wash. Acad. Sci., II, 23, March 14, 1900.

Type locality.—St. Matthew Island, Bering Sea, Alaska.

Geographic distribution.—Known only from St. Matthew Island.

General characters.—Similar to *abbreviatus*, but slightly larger and darker; rostrum longer and heavier; nasals anteriorly expanded and posteriorly notched.

Color.—Summer pelage (July specimens): Upperparts dark rich buff, brightest over ears, face, and rump, sprinkled with black hairs over back; belly strong clear buff; tail buff, with concealed dusky line above; feet pale buffy. *Young* (half-grown specimens): Duller and darker.

Cranial characters.—Skull larger than in *abbreviatus*, with relatively narrower braincase; rostrum longer and heavier on account of the longer, anteriorly spreading nasals; posterior tip of nasals distinctly notched; dentition slightly heavier than in *abbreviatus*, but with essentially the same molar enamel pattern.

Measurements.—Average of 7 adults, 1 male and 6 females, from St. Matthew Island: Total length, 166; tail vertebræ, 27; hind foot, 22.7. One adult ♂ : 178; 32; 24. *Skull* (No. 97976, ♂ ad.): Basal length, 31.3; nasals, 9.8; zygomatic breadth, 19; mastoid breadth, 14; alveolar length of upper molar series, 7.3.

General remarks.—*Microtus a. fisheri* needs comparison only with *abbreviatus*, from which it differs in well-marked subspecific characters. The external differences are less marked than the cranial, as a natural result of the very similar conditions on the neighboring islands occupied by the two forms. Hall Island, the home of *abbreviatus*, is separated from St. Matthew Island, the home of *fisheri*, by about 4 miles of deep sea.

Specimens examined.—Total number, 8, from the type locality.

MICROTUS TOWNSENDI (Bachman). Townsend Vole.

Arvicola townsendi Bachman, Journ. Acad. Nat. Sci. Phila., VIII, 60, Pl. I, 1839.
Arvicola occidentalis Peale, U. S. Expl. Expd., Mammalogy, 45, 1848. (Puget Sound.)

Type locality.—Lower Columbia River, near mouth of Willamette, on or near Wappatoo (or Sauvie) Island.

Geographic distribution.—Low country west of the Cascades, from Port Moody, British Columbia, south to the Willamette Valley and to Yaquina Bay, Oregon, in Transition zone.

Habitat.—Open grass land, pastures, fields, and dry meadows.

General characters.—Size large; fur thin and harsh; ears conspicuous above fur; color dark brownish; a pair of conspicuous glands on hips in adult males.

Color.—*Summer pelage:* Back vandyke brown, much darkened with long black hairs; sides dark buffy gray; belly grayish or dusky; tail blackish, scarcely lighter below; feet plumbeous gray. *Winter pelage* (imperfect in late October and April specimens): Slightly grayer above and lighter below. *Young:* Darker than adult, with dusky belly and blackish feet and tail.

Cranial characters.—Skull long and not much arched; angular and heavily ridged in old age; superciliary ridges conspicuous; incisive foramina long and narrow, constricted posteriorly; lateral pits of palate deep; bullæ medium in size and well rounded; dentition heavy; m2 with four closed sections; m3 with 3 closed triangles, 4 inner and 3 outer salient angles; m1 with 5 closed triangles, 5 inner and 4 outer salient angles. The long, narrow incisive foramina distinguish the skull most readily from that of *californicus*.

Measurements.—Adult male from Oregon City, Oreg.: Total length, 226; tail vertebræ, 66; hind foot, 26. Average of 10 adults, 5 ♂ and 5 ♀, from Avon, Wash.: 193; 64; 25.4. *Skull* (No. 56907, from Oregon City, Oreg.): Basal length, 29.2; nasals, 8.4; zygomatic breadth, 17.1; mastoid breadth, 13.5; alveolar length of upper molar series, 7.5.

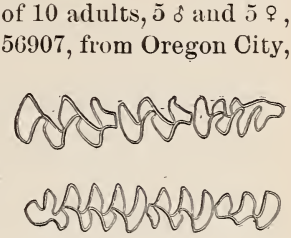


FIG. 6.—Molar enamel pattern of *Microtus townsendi* (× 5).

General remarks.—*Microtus townsendi* has no close affinities with any species except *tetramerus* of Vancouver Island. Except for the conspicuous hip glands, it comes nearest to the *longicaudus* and *mordax* group in combination of general characters. Almost no variation is shown throughout its rather limited range, and there are no characters by which to recognize *occidentalis* even as a subspecies.

Specimens examined.—Total number, 74, from the following localities:

Oregon: Oregon City, 1; Aumsville, 2; Yaquina Bay, 5; Newport, 6; Shelburn, 1 (im); Salem, 1.

Washington: Tenino, 2; Steilacoom, 3; Roy, 2; Kent, 1; Lake Washington, Seattle (south end), 3; Avon, 25; Mount Vernon, 4; Sauk, 1.

British Columbia: Port Moody, 16; Chilliwack, 1.

MICROTUS TETRAMERUS (Rhoads). Vancouver Vole.

Arvicola (*Tetramerodon*) *tetramerus* Rhoads, Proc. Acad. Nat. Sci. Phila., Oct., 1894, 283.

Type locality.—Beacon Hill Park, Victoria, British Columbia.

Geographic distribution.—Southern end of Vancouver Island.

General characters.—Like *townsendi*, but slightly smaller, with slenderer feet and tail and narrower, slenderer skull.

Color.—Indistinguishable from that of *townsendi*, in either winter or summer pelage.

Cranial characters.—Skull smaller, slenderer, and less arched than in *townsendi*, with superciliary ridges never quite meeting; nasals relatively shorter and more spreading anteriorly; incisors slenderer; molars smaller but with the same enamel pattern.

Measurements.—Average of 6 adult males from Goldstream (near Victoria), Vancouver Island: Total length, 177; tail vertebræ, 54.3; hind foot, 22. The largest of a series of 14: 190; 60; 23. *Skull* (No. 91901, ♂ ad.): Basal length, 27.3; nasals, 7.8; zygomatic breadth, 16; mastoid breadth, 12.4; alveolar length of upper molar series, 6.7.

General remarks.—The marked difference in size, together with slight cranial characters, separates this insular form as an easily recognizable species. Specimens of *townsendi* from the nearest localities on the mainland, Port Moody, British Columbia, and Avon, Wash., show no tendency toward *tetramerus*. The small series of specimens includes both summer and winter pelage.

Specimens examined.—Total number, 17, from near the type locality:

Vancouver Island, B. C.: Goldstream, 16; near Victoria, 1.

MICROTUS LONGICAUDUS (Merriam). Long-tailed Vole.

Arvicola (*Mynomes*) *longicaudus* Merriam, Am. Nat., XXII, 934–935, Oct., 1888.

Type locality.—Custer, S. Dak. (in the Black Hills at an altitude of about 5,500 feet).

Geographic distribution.—Boreal cap of the Black Hills and down some of the cold streams well into the Transition zone.

Habitat.—Banks of cold streams and in mountain meadows.

General characters.—Size of body about equal to that of *Microtus pennsylvanicus;* tail much longer; ears larger; colors grayer; skull flatter; braincase wider.

Color.—*Summer pelage:* Upperparts dull bister, darkened with numerous black-tipped hairs, becoming grayish on the sides and shading into dull, buffy gray on belly; feet plumbeous; tail dimly bicolor, blackish above, soiled whitish below. *Winter pelage* (old and faded in a June specimen from Sundance, Wyo.): Upperparts grayish bister, mixed with blackish-tipped hairs, shading gradually into slightly paler sides and dull whitish belly; tail distinctly bicolor; feet soiled whitish.

Cranial characters.—Skull long and not much arched; rostrum long; nasals reaching to anterior plane of incisors; bullæ large and rounded; molar pattern similar to that of *pennsylvanicus*, except for absence of posterior loop in middle upper molar; m3 with 3 closed triangles, 3 outer and 4 inner salient angles; m1 with anterior loop, 5 closed triangles, 4 outer and 5 inner salient angles. From *mordax* it differs in slightly shorter, heavier rostrum and wider nasals; narrower interpterygoid fossa; wider expansion of jugal; shorter and wider condyloid ramus of mandible.

Measurements.—Type, ♀ ad.: Total length, 185; tail vertebræ, 65; hind foot, 21. Topotype, ♀ ad.: 184; 61; 22. *Skull* (of type): Basal length, 25; nasals, 7.8; zygomatic breadth, 15.2; mastoid breadth, 11.6; alveolar length of upper molar series, 6.3.

General remarks.—*Microtus longicaudus* stands as one of the few outlying and isolated forms, though the first-described species of its widely distributed group. Its nearest neighbor is *M. mordax* of the Bighorn Mountains, Wyoming, between which range and the Black Hills neither species is known to occur.

Specimens examined.—Total number, 6, from the following localities:

South Dakota: Custer, 2.
Wyoming: Sundance (in the western edge of the Black Hills), 4.

MICROTUS MORDAX (Merriam). Cantankerous Vole.

Arvicola (*Mynomes*) *mordax* Merriam, North American Fauna No. 5, 61, July 30, 1891.
Microtus vellerosus Allen,[1] Bul. Am. Mus. Nat. Hist., XII, 7, March, 1899. (Liard River, Northwest Territory.)
Microtus cautus Allen,[1] Bul. Am. Mus. Nat. Hist., XII, 7, March, 1899. (Hell Gate, Liard River, Northwest Territory.)

[1] The types of *Microtus vellerosus* and *M. cautus,* kindly loaned me for comparison by Dr. Allen, agree in every character with specimens in corresponding pelage of *M. mordax* from its type locality. The type of *vellerosus,* collected May 4, shows the dark brownish-gray back of imperfect summer pelage, while the type of *cautus,* collected November 29, shows the light gray pelage of early winter.

Type locality.—Sawtooth (or Alturas) Lake, east foot of the Sawtooth Mountains, Idaho.

Geographic distribution.—Rocky Mountains and outlying ranges from latitude 60° to northern New Mexico, and south in the Cascades and Sierra Nevada as far as Kaweah and Kern rivers, California. In the Cascades mainly confined to the east slope, but extending west to the Siskiyous, in southern Oregon, and Salmon and Trinity mountains, in northern California. Found in most of the isolated ranges of eastern Oregon and northern and central Nevada. Common in Canadian and Hudsonian zones.

Habitat.—Marshes and wet woods, but more especially the banks of cold mountain streams, down which it often extends into the Transition zone.

General characters.—Size medium; tail long; ears large; feet small; no conspicuous side or hip glands in males. Very similar to *longicaudus*.

Color.—*Summer pelage:* Back grayish bister; sides olive gray; belly washed with whitish; nose dusky; feet plumbeous; tail dimly bicolor, dusky above, soiled whitish below. *Winter pelage:* Lighter colored than in summer; dorsal stripe of yellowish bister more sharply contrasted with the deeper gray of sides and face; belly heavily washed with pure white; tail sharply bicolor; feet whitish. *Young:* Darker, less sharply marked than the adults; feet and tail dusky.

Cranial characters.—Skull light and slender, similar to that of *longicaudus*, but with slightly longer, slenderer rostrum and nasals; slenderer zygomata, and longer condylar ramus of mandible; dentition essentially the same; m2 with 4 closed sections, the posterior open; m3 with anterior crescent, 3 closed triangles, and posterior loop with 2 inner salient angles; m1 with 5 closed triangles, 5 inner and 4 outer salient angles back of anterior loop; second and third lower molars each with 3 outer and 3 inner salient angles.

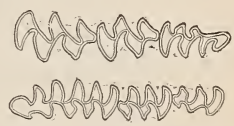


FIG. 7.—Molar enamel pattern of *Microtus mordax* (×5).

Measurements.—Type: Total length, 200; tail vertebræ, 77; hind foot, 22. Average of five adults from type locality, 182; 66; 22. *Skull* (of type): Basal length, 26.5; nasals, 8.6; zygomatic breadth, 16.2; mastoid breadth, 12.8; alveolar length of upper molar series, 6.6.

General remarks.—The species has a wide and frequently interrupted range, but shows remarkably slight variation of characters. Even from the southern extremities of the Rocky Mountains and Sierra Nevada the variation is too slight for subspecific recognition. Specimens from isolated ranges in Nevada are practically typical.

Specimens examined.—Total number, 708, from the following localities:

Idaho: Sawtooth Lake, 35; Lemhi, 4; Lost River Mountains, 2; Salmon River Mountains, 1; Three Creek, 1; Preuss Mountains, 1; Montpelier Creek, 3; Kingston, 1; Osborn, 1; Mullan, 10; Cœur d'Alene, 7; Craig Mountains, 1; Seven Devils Mountains, 3; Priest Lake (east side), 2.

Utah: Laketown, 6; Park City, 1; Barclay, 3; near Barclay, 4.

Colorado: Estes Park, 2; Ward, 4; Gold Hill, 2; Longs Peak, 10; Canyon City, 1; Lake City, 2; Silverton, 5; Fort Garland, 12.

New Mexico: Chama, 1; Martinez, 1; Agua de Lobo, 1 (no skull).

Wyoming: Bridger Pass, 14; Bighorn Mountains, 1; Lake Fork, near Bull Lake, 4; Clark Fork, mouth of Crandle Creek, 3; Tower Falls, Yellowstone Park, 2.

Montana: Red Lodge, 2; Pryor Mountains, 8; Fort Custer, 2; Big Snowy Mountains, 2; Jefferson River, 1; Blackfoot, 1; St. Marys Lake, 3; Java, 4; Summit, 5; Flathead Lake, 8; Tobacco Plains, 2; Horse Plains, 3; Upper Stillwater Lake, 6; Prospect Creek, 11; Thompson Falls, 2; Silver, 4.

Nevada: Reese River, 18; Arc Dome, 15; Indian Creek, 1; Shoshone Mountains, north of Cloverdale, 5; Pine Forest Range, 3; Granite Creek, 8; Mountain City, 15; Bull Run Mountains, 1; White Mountains, 6; Ruby Mountains, 14; Monitor Mountains, 2.

California: Near Mount Whitney, 31; Olancha Peak, 1; Mulkey Meadows (near Olancha Peak), 1; Soda Springs (on North Fork of Kern River), 1; Mineral King (on East Fork Kaweah River), 19; Upper San Joaquin River, 2; Lone Pine, 2; Bishop Creek, 2; Queen Station, 1; Sequoia National Park, 24; Yosemite Valley, 3; Pine City, 1; Mammoth, 7; White Mountains, 4; Donner, 3; Sierra Valley, 3; Hope Valley, 2; Carberry Ranch, 10; Emerald Bay, 5; Goose Lake, 2; Warner Creek, 1; Lassen Creek, 2; Lassen Peak, 19; Etna, 1; Trinity Mountains, 4; Canyon Creek, 16; Plumas County (20 miles southwest of Quincy), 2; Mount Shasta, 59; Sisson, 15; Goose Nest Mountain, 1; Bear Creek (Shasta County), 1.

Oregon: Siskiyou, 6; Fort Klamath, 18; Crater Lake, 5; Diamond Lake, 5; Sink Creek (east of Mount Thielson), 1; Upper Des Chutes River, Little Meadows (near head of Des Chutes River), 2; Farewell Bend (Des Chutes River, 30 miles southwest Prineville), 2; Swan Lake Valley, 2; head of Drews Creek, 1; Warner Mountains, 3; Steen Mountains, 6; Summit (east of Malheur Lake), 1; 10 miles north of Harney, 9; Maury Mountains, 5; Wallowa Mountains, 3; Lone Rock, 1.

Washington: Cleveland, 2; Wenatchee, 5; head of Lake Chelan, 12; Easton, 2; Conconully, 3.

British Columbia: Mount Richter, 2; Nelson, 1; Sicamous, 5; Hope, 2; Shuswap, 1; Glacier, 3; Okanagan, 2; Bennett City, 6.

Alberta: Henry House, 19; 15 miles south of Henry House, 4; south of Smoky River, 3; Banff, 1.

Northwest Territory: Liard River, 2; Rink Rapids (upper Yukon), 1; Lake Lebarge, 2; Lake Marsh, 1.

Alaska: Charlie Creek (Upper Yukon), 4; Circle, 1; White Pass, 5; Skagway, 1.

MICROTUS MACRURUS Merriam. Olympic Vole.

Microtus macrurus Merriam, Proc. Acad. Nat. Sci. Phila., Aug., 1898, 353.

Type locality.—Lake Cushman, Olympic Mountains, Washington.

Geographic distribution.—(The typical form) Olympic Mountains. (With slight variation) along the coast strip of British Columbia and Alaska north to Yakutat.

Habitat.—Marshes and borders of cold streams.

General characters.—Like *mordax*, but considerably larger, with conspicuously larger hind foot and darker coloration.

Color.—*Summer pelage:* Upperparts dark bister, shaded with numerous black hairs, becoming sooty gray in some specimens; sides slightly paler; belly washed with dull buffy or whitish; feet plumbeous; tail distinctly bicolor, blackish or brownish above, soiled whitish below,

usually white-tipped. (*Winter pelage* unknown.) *Young:* Darker than adult, with blackish feet and tail.

Cranial characters.—Skull averaging much larger than *mordax*, with wider interorbital region, heavier rostrum, smaller audital bullæ, and heavier dentition; molars especially wider; lower jaw conspicuously more massive, with wide, heavy molars.

Measurements.—Type: Total length, 220; tail vertebræ, 88; hind foot, 24. Average of five specimens from three localities in the Olympic Mountains: 204; 80; 24.3. *Skull* (of type, No. 66151, ♂ ad.): Basal length, 27.7; nasals, 8.2; zygomatic breadth, 16; mastoid breadth, 12.5; alveolar length of upper molar series, 7.

General remarks.—*Microtus macrurus* is the most conspicuously marked and easily recognizable form of the *longicaudus* group, though with less deeply seated characters than some forms that are externally scarcely distinguishable from each other. In the Olympic Mountains its range is completely isolated, being separated from that of *mordax* by the intervening low country, the habitat of the larger *townsendi*, and by the high Cascades, in which neither form occurs. To the northward it again occurs, in nearly typical form, on the coast at Lund, British Columbia (lat. 50°), and extends northward along the coast to Yakutat, Alaska, becoming slightly smaller and less markedly different from true *mordax*.

Specimens examined.—Total number, 84, from the following localities:

Washington: Lake Cushman, 7; head of Skokomish River, 1; head of Soleduc River, 1; Quineault Lake, 4; Granville, 1.

British Columbia: Lund, on Malaspina Inlet, 3; River Inlet (head), 14; Fort Simpson, 6.

Alaska: Loring, 3; Wrangell, 4; Juneau, 12; Yakutat, 7; Yakutat Bay (north shore), 10; Glacier Bay, 11.

MICROTUS ANGUSTICEPS Bailey. Coast Vole.

Microtus angusticeps Bailey, Proc. Biol. Soc. Wash., XII, 86, April 30, 1899.

Type locality.—Crescent City, California.

Geographic distribution.—Coast region of northwestern California and southwestern Oregon.

Habitat.—Damp pastures in the Sitka spruce belt.

General characters.—Smaller and darker colored than typical *mordax*, with very narrow, slender skull and small audital bullæ.

Color.—*Summer pelage:* Upperparts dark bister, lined with black hairs, darkest on face and nose; sides paler; belly washed with creamy white; feet plumbeous gray; tail distinctly bicolor, blackish above, soiled white below.

Cranial characters.—Skull small and very narrow, distinctly ridged in adults; nasals projecting in front of incisors; incisive foramina short; audital bullæ very small and constricted; coronoid notch of mandible narrow; incisors slender; molars small, with narrow, sharp angles; enamel pattern as in *mordax*.

Measurements.—Type, ♂ ad.: Total length, 170; tail vertebræ, 56; hind foot, 22. An adult ♀ topotype: 170; 55; 22. *Skull* (of type): Basal length, 23.4; nasals, 7.6; zygomatic breadth, 13.5; mastoid breadth, 10.8; alveolar length of upper molar series, 6.

General remarks.—Externally this species is not very different from true *mordax*, but the skull shows such marked characters as to warrant full specific rank.

Specimens examined.—Total number, 45, from the following localities:

California: Crescent City, 31; Arcata (Humboldt Bay), 13.
Oregon: Gold Beach, 1.

MICROTUS ALTICOLUS (Merriam). Mountain Vole.

Arvicola (*Mynomes*) *alticolus* Merriam, North American Fauna No. 3, 67–69, Pl. V, figs. 1 and 2; Pl. VI, figs. 1, 2, 3, and 4; Sept. 11, 1890.

Type locality.—San Francisco Mountain, Arizona (Little Spring, on northwest side of mountain, altitude 8,200 feet).

Geographic range.—Boreal zone of San Francisco Mountain, from 8,200 feet altitude up to timberline at 11,000 feet.

Habitat.—Vicinity of springs and cold streams on the slopes of the mountain.

General characters.—Similar to *longicaudus*, but tail shorter, hind foot and ear smaller, and skull with truncate, instead of pointed, anterior end of frontal and deeper lateral pit of palate.

Color.—*Summer pelage:* Upperparts uniform sepia or dull bister, darkened with blackish-tipped hairs; sides scarcely lighter; belly pale buffy or whitish; feet dull grayish or dirty whitish; tail not sharply bicolor, blackish above, grayish below. *Young:* Similar to adults, but with woolly fur and long, scattered, black-tipped hairs. (*Winter pelage* unknown.)

Cranial characters.—Skull similar to that of *mordax*, but readily distinguished from it and those of all other forms of the group by truncate end of anterior arm of frontal. Other characters are, deeper lateral pits of the palate; wider interpterygoid fossa; slightly longer, more open, incisive foramina. Dentition similar to that of *longicaudus* and *mordax*.

Measurements.—Type, ♀ ad.: Total length, 170; tail vertebræ, 56; hind foot, 20. Average of 5 adults from type locality: 178; 56; 20. *Skull:* Basal length, 25; nasals, 7.5; zygomatic breadth, 14.8; mastoid breadth, 12.3; alveolar length of upper molar series, 6.5.

General remarks.—*Microtus alticolus*, with its subspecies *leucophæus*, is the most isolated form in the *longicaudus* group. Its geographically nearest neighbor and probably nearest relative is *mordax*, in the mountains of Colorado and northern New Mexico.

Specimens examined.—Total number, 13, from the type locality. One immature specimen from Springerville, in the White Mountains, may be either *alticolus* or *leucophæus*.

MICROTUS ALTICOLUS LEUCOPHÆUS (Allen). Graham Mountain Vole.

Arvicola leucophæus Allen, Bul. Am. Mus. Nat. Hist., VI, 320-321, Nov. 7, 1894.

Type locality.—Graham Mountains, Arizona.

Geographic distribution.—Known only from the type locality.

General characters.—Similar to *alticolus*, and of the same proportions, but slightly larger, color the same, skull wider interorbitally and with other slight differences.

Color.—*Summer pelage:* Upperparts sepia or dull bister, but little paler on sides and faintly lined with blackish hairs; belly washed with soiled whitish; feet dull grayish; tail distinctly bicolor, brown above, grayish below. (*Young* and *winter pelages* not represented.)

Cranial characters.—Skull wider interorbitally than in *mordax* or *alticolus;* anterior arm of frontal with triangular instead of truncate point; incisive foramina wider than in *alticolus*, slightly constricted posteriorly; lateral pits of palate wide and shallow; coronoid notch narrow and sharp. Dentition as in *alticolus* and *mordax.*

Measurements.—Type, ♀ ad.: Total length, 173; tail vertebræ, 50; hind foot, 22.5. Topotype, ♀ ad.: 183; 50; 23. *Skull* (of type): Basal length, 26.5; nasals, 8.3; zygomatic breadth, 15.2; mastoid breadth, 12.3; interorbital width, 4.2; alveolar length of upper molar series, 6.3.

General remarks.—*Microtus leucophæus* belongs to the *longicaudus* group. It is closely related to *alticolus*, from which size and slight cranial characters separate it as a fairly well-marked subspecies.

Through the kindness of Dr. J. A. Allen, of the American Museum of Natural History, I have the type and a topotype of *M. leucophæus* for comparison with the Biological Survey series of *alticolus, mordax*, and *longicaudus.*

Specimens examined.—Total number, 2, from the type locality.

MICROTUS MEXICANUS (De Saussure). Mexican Vole.

Arvicola (*Hemiotomys*) *mexicanus* De Saussure, Revue et Mag. de Zool., 2e sér., XIII, 3, Jan., 1861.

Type locality.—Mount Orizaba, Puebla, Mexico.

Geographic distribution.—Eastern Puebla and to the north and west, grading into its subspecies *phæus.*

Habitat.—Grassy places in open forests, in upper Austral and Transition zones.

General characters.—Size rather small; tail short; ears conspicuous; pelage coarse and lax; colors brownish; skull wide, with short, wide incisive foramina; m1 normally with 6 inner salient angles.

Color.—*Winter pelage:* Upperparts grizzled brown, from a mixture of dull cinnamon and black; sides paler; belly washed with cinnamon or buffy, or rarely with whitish; sides of nose and ear coverts usually a brighter shade of cinnamon; feet clear gray; tail dusky above, gray below. *Summer pelage* (imperfectly represented): Evidently darker and less ferruginous. *Young:* Duller and darker than adult.

Cranial characters.—Skull rather angular, with wide-spreading zygomatic arches, narrow interorbital constriction, and large, well-rounded audital bullæ; incisive foramina short and wide, truncate posteriorly; zygomata broadly flattened; palate with a median groove between the lateral pits where a spur or ridge appears in most species of *Microtus;* upper incisors abruptly decurved; molar pattern differing from that of *nanus* and *montanus*—mainly in extra angle of anterior trefoil of m1; most of the salient angles acute; m2 has 4 closed sections; m3 has 3 closed triangles, 3 outer and 4 inner salient angles; m1 has 5 closed triangles, 5 outer and 6 inner salient angles.[1]

Measurements.—Average of 10 adults from the type locality (5 ♂ 5 ♀): Total length, 138; tail vertebræ, 29; hind foot, 19.35; maximum: 148; 30; 20. *Skull* (of topotype, No. 54496, ♂ ad.): Basal length, 24.5; nasals, 7.4; zygomatic breadth, 15.3; mastoid breadth, 11.6; alveolar length of upper molar series, 6.6.

General remarks.—*Microtus mexicanus, phœus, fulviventer,* and *mogollonensis* form a well-marked and closely united group of small, short-tailed, brownish voles, distinguished by the arrangement of mammæ in two pairs, a pair of inguinal, and a pair of pectoral; by wide-spreading zygomatic arches and narrow interorbital constriction; by wide incisive foramina and grooved posterior ridge of palate; and by similar habits and habitat. They need comparison only among themselves. While *mogollonensis* and *fulviventer* are well-marked forms, occupying widely separated and probably disconnected areas, *mexicanus* and *phœus* merely show the extremes of differentiation found in one wide-ranging and somewhat variable form. As only those from the type localities are really typical, any line separating *mexicanus* and *phœus* is purely arbitrary.

Specimens examined.—Total number, 194, from the following localities in Mexico:

Puebla: Mount Orizaba, 27; Chalchicomula, 22.
Vera Cruz: Cofre de Perote, 29; Las Vegas, 11.
Tlaxcala: Mount Malinche, 1; Huamantla, 2.
Hidalgo: Sierra de Pachuca, 7; Tulancingo, 7; Real del Monte, 10.
Morelos: Huitzilac, 4.
Mexico: Ajusco, 6; Toluca Valley, 20; North slope Volcan de Toluca, 9; Mount Popocatepetl, 19; Amecameca, 1; Salazar, 19.

MICROTUS MEXICANUS PHÆUS (Merriam). Colima Vole.

Microtus phœus Merriam, Proc. Biol. Soc. Wash., VII, 171–172, Sept. 29, 1892.

Type locality.—North slope of Sierra Nevada de Colima, Jalisco, Mexico (altitude 10,000 feet).

Geographic distribution.—Southern Jalisco and northward to northwestern Chihuahua (to the eastward, grading into *mexicanus*), occupying Boreal and Transition zones.

[1] This extra number of angles is a weak character depending on the slightly unusual development of the anterior trefoil of m1, so that a pair of short points or angles may in most cases be counted on its inner and outer sides.

Habitat.—Grassy parks in open timber.

General characters.—Similar to *mexicanus*, but slightly larger and a shade darker, and with slight cranial differences.

Color.—*Winter pelage:* Upperparts uniform dark cinnamon brown mixed with blackish; belly a lighter shade of cinnamon or buffy, or sometimes whitish; feet brownish gray; tail brownish gray, paler below. *Summer pelage:* Not shown in specimens from near the type locality, but June specimens from El Salto, Durango, are brighter and darker ferruginous than topotypes in winter pelage. *Young:* Dull brownish.

Cranial characters.—Skull similar to that of *mexicanus*, but with less constricted interorbital region, slightly shorter incisive foramina, and shallower prezygomatic notches. Dentition essentially the same.

Measurements.—Average of 10 adult topotypes (5 ♂ and 5 ♀): Total length, 151; tail vertebræ, 35; hind foot, 20.5. *Skull* (topotype, ♂ ad., No. 45645): Basal length, 25.2; nasals, 7.3; zygomatic breadth, 15.5; mastoid breadth, 12; alveolar length of upper molar series, 6.08.

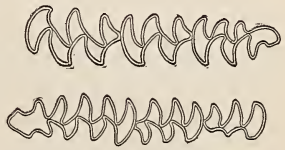


FIG. 8.—Molar enamel pattern of *Microtus phœus* (× 5).

General remarks.—*Microtus m. phœus* is not a strongly or sharply marked form of *mexicanus*, although apparently the more widespread form. Ajusco and Salazar specimens might as well be referred to it as to *mexicanus*. A large series from near Guadalupe, in southwestern Chihuahua, are indistinguishable from typical *phœus*, and those from Miquihuana, western Tamaulipas, are nearer to *phœus* than to *mexicanus*.

Specimens examined.—Total number, 136, from the following localities in Mexico:

Jalisco: Sierra Nevada de Colima, 17.
Michoacan: Nahuatzin, 23.
Queretaro: Pinal de Amoles, 9.
Tamaulipas: Miquihuana, 20.
Durango: El Salto, 25.
Chihuahua: Sierra Madre near Guadalupe y Calvo, 19; Colonia Garcia, 23.

MICROTUS FULVIVENTER Merriam. Oaxaca Vole.

Microtus fulriventer Merriam, Proc. Biol. Soc. Wash., XII, 106, April 30, 1898.

Type locality.—Cerro San Felipe, Oaxaca, Mexico.

Geographic distribution.—Central part of the State of Oaxaca.

Habitat.—Open grassy places and along edges of fields in the Boreal zone.

General characters.—Slightly larger than *mexicanus* and of nearly the same proportions; darker and richer in coloration; ears conspicuous above fur; tail a little more than one and a half times the length of hind foot.

Color.—*Summer pelage:* Upperparts umber brown, darkened by black hairs; under parts fulvous or dull chestnut brown; feet grayish brown;

tail dusky brown above, fulvous below, darker toward the end. *Winter pelage* (in October and March specimens): Less deeply colored. *Young:* Dull sooty, with scarcely a trace of fulvous.

Cranial characters.—Skull similar to that of *mexicanus*, but with smaller bullæ, longer incisive foramina; sharper posterior point of frontals; molars slightly heavier, enamel pattern almost the same; m1 has a more rounded anterior loop.

Measurements.—Average of 10 adult topotypes (5 ♂ and 5 ♀): Total length, 152; tail vertebræ, 35; hind foot, 20.5. Type (♂ ad.): 154; 38; 20. *Skull* (of type): Basal length, 25.4; nasals, 7.4; zygomatic breadth, 15.5; mastoid breadth, 12.4; alveolar length of upper molar series, 6.5.

General remarks.—*M. fulviventer* belongs to the *mexicanus* group, but is sharply separated in its distinguishing characters as well as in geographic range. But little variation is shown throughout its range and although specimens from the mountains near Ozolotepec show differences, these are slight and unimportant.

Specimens examined.—Total number, 126, from the following localities in Mexico:

Oaxaca: Cerro San Felipe, 32; Reyes, 23; 15 miles west of Oaxaca, 20; Mount Zempoaltepec, 28; near Cajones, 5; Guajamaloya, 1 (im.); mountains near Ozolotepec, 9; Totontepec, 8.

MICROTUS MOGOLLONENSIS (Mearns). Mogollon Mountain Vole.

Arvicola mogollonensis Mearns, Bul. Am. Mus. Nat. Hist., II, No. 4, 283–284, Feb., 1890.

Type locality.—Baker Buttes, Mogollon Mountains, Arizona.

Geographic distribution.—Plateau country of central Arizona.

Habitat.—Dry grassy parks among the yellow pines of the Transition zone.

General characters.—Size small; tail and feet short; color dull rusty brown; fur long and soft; ears not concealed; skull short, wide, and angular; lateral pits of palate very deep; an inner projecting point at base of posterior triangle of middle upper molar.

Color.—Upperparts dull rusty brown, brightest on tips of ears; sides slightly paler; belly cinnamon or buffy gray; feet grayish brown; tail brownish gray above, grayish below.

Cranial characters.—Skull short and well arched, with wide-spreading zygomata and sharply constricted interorbital region; zygomatic shield broad and flat; interparietal small and narrow; nasals notched posteriorly, falling considerably short of terminus of premaxillæ; bullæ full and rounded; incisive foramina short, wide, and open; incisors wider than in *nanus* and bent more abruptly downward; molar pattern as in *mexicanus*, except in m2, which has an inner point at base of posterior triangle, and in m1, which has 5 closed triangles and only 5 inner and 4 outer salient angles and an abbreviated terminal loop.

Measurements.—Average of 10 adults from San Francisco Mountain, Arizona: Total length, 131; tail vertebræ, 28.5; hind foot, 18. *Skull* (adult ♂, No. 24563): Basal length, 23.6; nasals, 7; zygomatic breadth, 15.2; mastoid breadth, 12; alveolar length of upper molar series, 6.3.

Remarks.—*M. mogollonensis* is widely separated, both geographically and specifically, from the other members of its group. Its nearest ally is *phœus* from Mexico.

Specimens examined.—Total number, 51; from the following localities:

Arizona: San Francisco Mountain (Little Spring on north side of mountain), 15; Springerville, 35.

New Mexico: Fort Wingate, 1.

MICROTUS XANTHOGNATHUS (Leach). Yellow-cheeked Vole.

Arvicola xanthognatha Leach, Zool. Miscel., I, 60, 1814.

Type locality.—Hudson Bay.

Geographic distribution.—Northwestern Canada and Alaska, from central Alberta north to the Arctic coast and west to central Alaska.

General characters.—Size large, almost equaling that of *richardsoni*, but tail shorter and ears larger; colors dull; nose and ear patch yellow; skull heavy, ridged, and angular. Side glands as in *richardsoni*, or a little farther back on flanks.

Color (March and May specimens).—Upperparts dark sepia to bister, heavily lined with coarse black hairs over the back; sides of nose and ear patch bright rusty yellowish, a tinge of the same around eyes and on cheeks; belly dusky gray; breast sooty; tail indistinctly bicolor, blackish above, dusky gray below; feet sooty.

Cranial characters.—Skull smaller than that of *richardsoni* and relatively longer and narrower, with less projecting incisors; nasals long and narrow; bullæ large; incisive foramina long and narrow; dentition heavy; molar pattern scarcely different from that of *townsendi;* anterior loop of $\overline{m.1}$ small and triangular; middle section of $\overline{m.3}$ frequently divided into two nearly closed triangles.

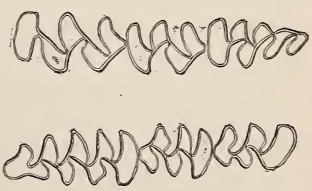


FIG. 9.—Molar enamel pattern of *Microtus xanthognathus* (× 5).

Measurements.—Two dry skins from Fort Resolution, Great Slave Lake, Canada, adult females, in U. S. Nat. Mus. No. 4504: Total length, 210; tail vertebræ, 50; hind foot, 27. No. 4502: 218; 45; 25. *Skull* (No. 4504): Basal length (approximately), 34.5; nasals, 10.3; zygomatic breadth, 20; mastoid breadth, 15.7; alveolar length of upper molar series, 8.5.

Remarks.—*Microtus xanthognathus* shows no close relationship to any other American species. In the position of side glands it resembles *richardsoni*, but in no other characters. It shows a strong superficial resemblance to *chrotorrhinus* in color, but the great difference in size prevents the possibility of one ever being mistaken for the other.

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

Canada: Nelson River, N. W. T., 1; Cache Apocotte (40 miles east of Henry House, Alberta), 1; Fort Resolution, 22; Great Slave Lake, 1; Fort Rae, 1; Liard River, 1; La Pierre House, 1; Anderson River, 1; Arctic coast (east of Fort Anderson), 2.

Alaska: Mouth of Porcupine River, 1; Yukon (200 miles southwest of mouth of Porcupine), 3; Charlie Creek (Upper Yukon), 9.

MICROTUS CHROTORRHINUS (Miller). Rock Vole.

Arvicola chrotorrhinus Miller, Proc. Boston Soc. Nat. Hist., XXVI, 189–193, pl. 3, 1894.

Type locality.—Mount Washington, New Hampshire, head of Tuckerman Ravine (altitude, 5,300 feet).

Geographic distribution.—Mount Washington, the Catskills, central Quebec, and northern New Brunswick, in the Hudsonian zone.

Habitat.—Rocky places near water on the mountains, and in deep spruce forests farther north.

General characters.—Size and proportions of *pennsylvanicus* except slightly smaller hind foot; ears larger; fur lax; conspicuously yellowish about nose, ears and rump; skull comparatively thin-walled and smooth; dentition unique.

Color.—*Summer pelage* (July 14): Upperparts bright glossy bister, lined with black hairs; nose to eyes dull orange rufus; hairs around ears and on rump yellowish; belly plumbeous; feet dark gray; tail grayish brown, slightly paler below. Worn, left-over *winter pelage:* Darker and more rusty above.

Cranial characters.—Skull light and smooth, somewhat flattened on top, superficially resembling that of *Evotomys;* bullæ large and rounded; incisive foramina short and wide; dentition rather light; incisors bent down at right angles to axis of skull, extending scarcely beyond tip of nasals; m2 with 4 closed sections; m3 normally with 5 closed triangles, 5 inner and 5 outer salient angles and a double-lobed posterior loop; m3 with outer salient angles prominent and reentrant angles deep.

Measurements.—Type: Total length, 165; tail vertebræ, 45; hind foot, 19.4. Average of 4 adult topotypes: 170; 48; 19.6. *Skull* (of ad. ♂, No. 2523, Bangs Coll.): Basal length, 25.4; nasals, 7.2; zygomatic breadth, 15; mastoid breadth, 12; alveolar length of upper molar series, 6.4.

Remarks.—*Microtus chrotorrhinus* shows a marked superficial resemblance to *M. xanthognathus*, but in cranial characters it differs widely from this and all other American species and is quite unique in the subgenus *Microtus*. In the specimens examined there is no trace of hip glands, but in two adult males (3845 and 3849) there appear to be rudiments of side glands on the flanks.

Specimens examined.[1]—Total number, 8, from the following localities:[2]

New Hampshire: Mount Washington, 3.
New York: Catskill Mountains, 1.
Quebec: Lake Edward, 4.

[1] Type in collection of G. S. Miller, jr.; other specimens in the collection of E. A. and O. Bangs.

[2] Mr. Miller records a specimen in the Am. Mus. Nat. Hist. from Trousers Lake, New Brunswick—Proc. Bost. Soc. Nat. Hist., XXVI, 193, 1894.

MICROTUS CHROTORRHINUS RAVUS Bangs. Gray Rock Vole.

Microtus chrotorrhinus ravus Bangs, Proc. Biol. Soc. Wash., XII, 187, Nov. 16, 1898.

Type locality.—Black Bay (north shore of Strait of Belle Isle), Labrador.

Geographic distribution.—Known only from the type locality.

General characters.—Similar to *chrotorrhinus*, but slightly grayer, and with noticeably more yellowish on nose and face. Skull slenderer, with lighter dentition.

Color.—*Summer pelage* (July specimens): Upperparts grayish bister, becoming yellowish on rump; whole face from behind ears suffused with yellowish, brighter on nose; belly thinly washed with white over the plumbeous; feet buffy gray; tail brownish above, slightly paler below.

Cranial characters.—*Skull*, compared with that of *chrotorrhinus*, slightly thinner, lighter, and slenderer throughout; interorbital constriction narrower; rostrum longer and narrower; incisive foramina longer; molar series shorter and narrower; tooth pattern as in *chrotorrhinus*.

Measurements.—Type,[1] ♂ ad.: Total length, 170; tail vertebræ, 50; hind foot, 22. Average of 4 adult topotypes: 159; 46; 21.25. *Skull* (No. 7952, ♀ ad.): Basal length, 25; nasals, 7; zygomatic breadth, 14.3; mastoid breadth, 11.3; alveolar length of upper molar series, 6.2.

General remarks.—July specimens from the type locality are in full, long pelage, with a freshness of appearance and brightness of color quite different from the type of *chrotorrhinus* of nearly the same date. There is a question as to whether the real summer pelage is shown.

Specimens examined.—Total number, 5, from the type locality.

Subgenus ARVICOLA[2] Lacépède.

Arvicola Lacépède, Nouv. Tableau Méthod. Mamm., in Mém. de l'Instit., Paris, III, 495, 1801. Type, *Mus terrestris* Linnæus (genus).
Arvicola Lataste, Le Naturaliste, II, 349, 1883 (subgenus).

Geographic distribution.—(In America) Boreal zone of the Cascades and Rocky Mountains of Canada and the northern United States.

Subgeneric characters.—(In American species) plantar tubercles, 5; side glands on flanks of males conspicuous; a musk-bearing anal gland; mammæ, 8; pectoral, 2–2; inguinal, 2–2; feet large; tail long; fur full and long; bullæ very small; incisors projecting far beyond premaxillæ; molars with constricted and tightly closed sections; m2 with 4 closed sections; m3 with 3 closed triangles; m1 with 5 closed

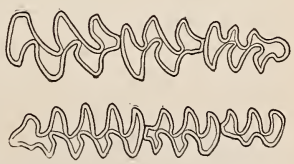


FIG. 10.—Molar enamel pattern of *Microtus* (*Arvicola*) *macropus* (×5).

[1] The measurements of type and 4 topotypes are from original description. In 3 adult topotypes the hind foot measures uniformly 20 mm. in dry skins with toes straight.

[2] For full synonymy of the subgenus *Arvicola*, see Miller, N. Am. Fauna No. 12, 66, 1896.

triangles, 5 inner and 4 outer salient angles; m3 with 3 transverse loops. (In the European section of the subgenus m3 has but 2 closed triangles, and m1 but 3.)

MICROTUS RICHARDSONI (De Kay). Richardson Vole.

Arvicola richardsoni De Kay, Zoology of New York, Mammalia, 91, 1842.

Type locality.—"Near the foot of the Rocky Mountains." (Type collected by Drummond in the vicinity of Jasper House, Alberta.)

Geographic distribution.—The typical form is known only from the vicinity of Jasper House and Henry House, Alberta, Canada. To the south it apparently grades into *macropus* in the Rocky Mountains, and *arvicoloides* in the Cascades.

General characters.—Size very large (probably not exceeded in America except by *alleni*); tail long; feet large; fur long and heavy: ears mostly concealed; colors dull; skull large and angular, with protruding incisors.

Color.—*Early winter pelage* (October 14 to 18): Upperparts uniformly grayish sepia, darkened by black-tipped hairs, becoming paler on the sides; belly washed with white over the plumbeous under-fur; feet silvery gray; tail bicolor, dusky above, soiled whitish below.

Cranial characters.—Skull large, with wide-spreading zygomatic arches, long rostrum, very long and protruding incisors; nasals rather short and wide, rounded at both ends, not reaching to base of incisors; audital bullæ small for a *Microtus*, but slightly larger and more rounded than in either of the subspecies; incisive foramina longer and less constricted posteriorly; superoccipital smooth without median ridge; terminal loop of third upper molar normally not recurved.

Measurements.—Young adult, No. 81381, from 25 miles west of Henry House: Total length, 208; tail vertebræ, 61; hind foot, 28. *Skull* (of same): Basal length, 32.5 (over incisors); nasals, 8.3; zygomatic breadth, 19.9; mastoid breadth, 14.6; alveolar length of upper molar series, 7.5.

General remarks.—Richardson's specimens, which he referred to *Arvicola riparius*, and which were later re-described by De Kay, were collected by Thomas Drummond in the foothills of the Rocky Mountains, probably west of Jasper House. In October, 1896, J. Alden Loring collected a series of 8 specimens at points 15 and 25 miles west of Henry House (40 or 50 miles southwest of Jasper House), Alberta, on the very trail by which Drummond crossed from Jasper House to the Columbia in 1826. Unfortunately, none of this series are fully adult, and but one condition of pelage is shown. By comparing specimens of the same age it becomes evident that the species equals the larger of its two southern forms, *arvicoloides*, though in color it agrees more nearly with the Rocky Mountain form, *macropus*. A single specimen from Glacier, British Columbia, is fairly intermediate between *richardsoni* and its two southern subspecies.

Specimens examined.—Total number, 8, from west of Henry House, Alberta, Canada.

MICROTUS RICHARDSONI MACROPUS (Merriam). Big-footed Vole.

Arvicola macropus Merriam, North American Fauna No. 5, 59–60, 1891.

Type locality.—Pahsimeroi Mountains, Idaho (altitude about 9,700 feet).

Geographic distribution.—Boreal zone of the Rocky Mountains from the Wasatch north to Canada, of the Wind River Mountains of Wyoming, the Blue Mountains of Oregon, and most of the intermediate ranges.

General characters.—Similar to *richardsoni*, but evidently somewhat smaller; colors the same in October specimens; distinguished by less projecting incisors and other cranial characters.

Color.—Summer pelage: Upperparts dark sepia, lined with long, black hairs; slightly paler on sides; belly washed with silvery white; feet dusky gray; tail distinctly bicolor throughout its length, sooty above, whitish below. *Winter pelage* (imperfect in October and May specimens): Lighter, clearer gray above, black hairs less conspicuous, more heavily washed with white below. *Young:* Like adult or slightly darker, with long, woolly fur and dusky feet and tail; during one stage of pelage with entirely dusky belly.

Cranial characters.—Skull similar to that of *richardsoni*, from which it differs in less projecting upper incisors, longer nasals with narrower posterior tips; supraoccipital with a median ridge; bullæ smaller, more compressed and angular; incisive foramina sharply constricted posteriorly; third upper molar with terminal loop recurved in about half of the specimens.

Measurements.—Type, ♀ ad.: Total length, 220; tail vertebræ, 71; hind foot, 26. Male from type locality (not fully adult): 202; 68; 28. *Skull* (of type): Basal length, 31.5; nasals, 9; zygomatic breadth, 19.7; mastoid breadth, 14.5; alveolar length of upper molar series, 7.5.

General remarks.—In a large series of specimens from numerous ranges of the Rocky Mountains the subspecies remains rather uniform. There is a slight increase in size toward the north, specimens from northern Montana averaging larger than from the type locality. Those from Strawberry Butte and the Wallowa Mountains of eastern Oregon are indistinguishable from the type series. Two half-grown specimens from the top of the Wasatch Mountains, near Park City, Utah, are too young to indicate reliable specific variation.

Specimens examined.—Total number, 113, from the following localities:

Idaho: Pahsimeroi Mountains, 8; Salmon River Mountains, 11; Sawtooth (or Alturas) Lake, 18; head of Wood River, 2; Summit, Alturas County, 1; Seven Devils Mountains, 2; head of Crow Creek, Preuss Mountains, 4; Thompson Pass, 3; Priest Lake, 1.

Utah: Park City, 2.

Wyoming: La Barge Creek, 5; South Pass City, 1; Lake Fork, Wind River Mountains, 10.

Montana: Beartooth Mountains, 17; Summit, Teton County, 2; St. Marys Lake, Teton County, 4.

Oregon: Strawberry Butte, 2; Wallowa Mountains, 20.

MICROTUS RICHARDSONI ARVICOLOIDES (Rhoads). Cascade Water-Vole.

Aulacomys arvicoloides Rhoads, Am. Nat., XXVIII, 182–185, Feb. 11, 1894.
Microtus principalis Rhoads, Am. Nat., XXIX, 940, Oct., 1895. (Mount Baker Range, British Columbia.)

Type locality.—Lake Keechelus, near Snoqualmie Pass, Kittitas County, Washington (altitude 8,000 feet).

Geographic distribution.—Boreal zone of the Cascade Mountains, in Washington and Oregon.

General characters.—Apparently equal to *richardsoni* in size, larger than *macropus*, and slightly darker than either. In cranial characters nearer *macropus* than *richardsoni*.

Color.—*Summer pelage:* Upperparts dark sepia, considerably darkened with coarse black hairs; belly thinly washed with pearl gray or silvery whitish; feet dusky gray; tail bicolor, blackish above, soiled whitish below. *Winter pelage:* Darker than summer, with an excess of black hairs above; belly strongly washed with white; feet and tail as in summer. *Young* not different from young *macropus*.

Cranial characters.—Skull like that of *macropus*, but larger; rostrum and incisors slightly heavier; nasals more broadly spreading anteriorly, with a slight constriction near the middle, narrow, and pointed posteriorly; audital bullæ, incisive foramina, and arc of upper incisors as in *macropus*.

Measurements.—Average of 6 adults, 3 males and 3 females, from Easton, Wash. (near the type locality): Total length, 234; tail vertebræ, 81; hind foot, 29.3. Largest specimen of the series: 253; 89; 29. *Skull* (No. 41578, ♂ ad., from Easton): Basal length, 36; nasals, 10.8; zygomatic breadth, 23; mastoid breadth, 16.3; alveolar length of upper molar series, 8.3.

General remarks.—I have before me a series of 13 specimens, collected at Easton, on the outlet of Lake Keechelus, about 12 miles from the type locality, and a large number of specimens from the upper slopes of Mount Rainier, as well as farther north and south in the Cascades. It is safe to assume that these Easton specimens are typical, especially as there is little variation shown throughout the Cascades of Washington. As at present known, the ranges of *arvicoloides* and *macropus* are widely separated, but no doubt they meet and coalesce in *richardsoni* of the Canadian Rockies.

Specimens examined.—Total number, 101, from the following localities:

Washington: Easton, 13; head of Cascade River, 2; Mount Rainier and vicinity, 34; Mount St. Helens, 4; Wenatchee, 1.

Oregon: Mount Hood, 11; Marmot, 1; Mount Jefferson, 2; Detroit, 1; Crater Lake, 22; Anna Creek, base of Mount Mazama, 10.

Subgenus PITYMYS[1] McMurtrie.

Psammomys Le Conte, Ann. Lyceum Nat. Hist. N. Y., III, 132, 1830. Type *Psammomys pinetorum* Le Conte. (Not *Psammomys* Cretzschmar, 1828).

Pitymys McMurtrie, Cuvier's Animal Kingdom, Am. edition, I, 434, 1831. Type *Psammomys pinetorum* Le Conte. (New name for *Psammomys* Le Conte.)

[1] For full synonymy of the subgenus *Pitymys*, see Miller, N. Am. Fauna No. 12, 58, 1896.

Geographic distribution (in America).—Southeastern United States, mainly in Upper Austral zone, and a small area in the Tropical zone of southeastern Mexico.

Subgeneric characters.—Plantar tubercles, 5; mammæ, 4, two pairs of inguinal; lateral glands on hips in adult males; ears very small; tail short; fur short, dense, and glossy. *Skull* flat and wide, with quadrate braincase; bullæ small; molars narrow; m3 with 2 closed triangles; m1 with 3 closed and 2 open triangles; m2 with anterior pair of triangles confluent; m3 with 3 transverse loops.

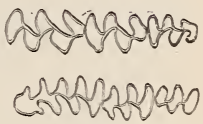


Fig. 11.—Molar enamel pattern of *Microtus* (*Pitymys*) *pinetorum* (×5).

MICROTUS PINETORUM (Le Conte). Pine Vole.

Psammomys pinetorum Le Conte, Ann. Lyc. Nat. Hist. N. Y., III, 133, Pl. II, 1830 (read Dec. 21, 1829).

Type locality.—Pine forests of Georgia. Probably the old Le Conte plantation at Riceboro.

Geographic distribution.—Georgia and the Carolinas.

Habitat.—Fields, open woods, and grassy uplands.

General characters.—Size small; ears very small; tail short; fur short and fine; colors bright.

Color.—Upperparts bright russet brown with a distinct gloss, becoming lighter on sides; belly dusky, lightly washed with color of back: tail brownish, darker above; feet grayish brown; ears concealed in the fur.

Cranial characters.—Skull short and wide with a quadrangular braincase and abruptly truncate occiput; interparietal wide and normally somewhat lozenge-shaped; mastoids and bullæ relatively small; interpterygoid fossa normally V-shaped. *Molar* series rather short and crowded; two middle triangles of m3 often confluent; first pair of reentrant angles in m1 usually not meeting between anterior loop and first pair of salient angles.

Measurements.—Average of 2 adult females from Georgetown, S. C.: Total length, 113; tail vertebræ, 18.5; hind foot, 15.5. *Skull* (No. 1523, Merriam Coll., ♂ ad., from Frogmore, S. C.): Basal length, 22.3; nasals, 7.3; zygomatic breadth, 15; mastoid breadth, 12.5; alveolar length of upper molar series, 6.

General remarks.—No definite type locality was given in the original description of *pinetorum*, but the species was said to inhabit the sandy soil of the pine barrens of Georgia. Very probably the type came from the vicinity of the old Le Conte plantation, near Riceboro, Ga. Thirteen specimens in the Merriam collection, from Beaufort County, S. C., about 60 miles from Riceboro, are probably fairly typical, and are taken for the basis of the above description. They represent the extreme development of the bright cinnamon brown and small-eared form of the Atlantic coast region. Northward through the Atlantic States the

specimens become darker and duller colored without other important modifications, except a slight average increase in size. The species described as *scalopsoides* from Long Island, and later as *apella* from Pennsylvania, includes this Northern form and seems worthy of recognition as a subspecies.

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

Georgia: Columbus, 2.
South Carolina: Beaufort County (Beaufort, Frogmore, and St. Helena Island), 13; Georgetown, 2; Society Hill, 1.
North Carolina: Old Richmond, 1; Raleigh, 11; Tarboro, 2.

MICROTUS PINETORUM SCALOPSOIDES (Aud. & Bach.). Mole like Vole.

Arvicola scalopsoides Aud. & Bach., Proc. Acad. Nat. Sci. Phila., I, 97, 1841.
Arvicola apella Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 405, 1853. Type from Pennsylvania.
Arvicola kennicotti Baird, Mamm. N. Am., 547, 1857. Type from Illinois.

Type locality.—Long Island, New York.

Geographic distribution.—Southern New York and westward to Illinois, southward along the coast, blending into true *pinetorum*.

Habitat.—Open grassy country, meadows, pastures, and waste places.

General characters.—Larger, darker, and duller than true *pinetorum*.

Color.—Upperparts dull brownish chestnut, slightly darkened by dusky-tipped hairs; sides paler; belly lightly washed with dull buff over plumbeous under-fur; feet brownish gray; tail indistinctly bicolor, sooty above, grayish below.

Cranial characters.—Skull similar to that of *pinetorum*, but larger, with heavier molars.

Measurements.—Average of three adults from Lake Grove, Long Island: Total length, 125; tail vertebræ, 20; hind foot, 16.3. *Skull* (No. 88732, same locality): Basal length, 23.5; nasals, 7.4; zygomatic breadth, 16; mastoid breadth, 12.6; alveolar length of upper molar series, 6.6.

Specimens examined.—Total number, 83, from the following localities:

New York: Lake Grove, Long Island, 4; Millers Place, Long Island, 2; Oyster Bay, Long Island, 1; Sing Sing, 4; Lake George, 1; Locust Grove, 1.
Pennsylvania: Philadelphia, 1.
New Jersey: Tuckerton, 3.
Maryland: Laurel, 2; Kensington, 1; Bladensburg, 2.
District of Columbia: Washington, 27.
Virginia: Falls Church, 4; Dunn Loring, 1; Fort Myer, 1; Clark County, 2; Cape Charles, 4; Bellehaven, 1; Wallaceton (Dismal Swamp), 4.
North Carolina: Currituck, 2; Magnetic City, 1.
West Virginia: White Sulphur Springs, 6.
Ohio: A specimen in the U. S. Nat. Mus., collected by Kennicott, is labeled 'Ohio.'
Indiana: Brookville, 2 (approaching *auricularis*); Terre Haute, 1.
Illinois: West Northfield, 2; Warsaw, 2.

MICROTUS PINETORUM AURICULARIS Bailey. Bluegrass Vole.

Microtus pinetorum auricularis Bailey, Proc. Biol. Soc. Wash., XII, 90, April 30, 1898.

Type locality.— Washington, Mississippi.

Geographic distribution.—Northern Mississippi, Tennessee, Kentucky, and southern Indiana, or in a general way the region between the Allegheny Mountains and the Mississippi River, mainly in the Lower Austral zone.

General characters.—Size small, about equaling that of *pinetorum*; ears very large for a *Pitymys* and conspicuous above fur; colors dark and rich, not always darker than *scalopsoides* but richer and more intense; fur short and dense like that of *pinetorum*.

Color.—Upperparts dark rich chestnut darkened by dusky-tipped hairs; belly washed with paler chestnut over dark under-fur; projecting tip of ear with scattered dusky hairs; tail not bicolor, scarcely darker above, like the back or slightly darker; feet dull brownish.

Cranial characters.—Skull like that of *pinetorum* in form and general characters; interpterygoid fossa normally U-shaped instead of V-shaped.

Measurements.—Type: Total length, 120; tail vertebræ, 22; hind foot, 16. Average of six adult specimens from the type locality, measured in the flesh by collector: 119; 22; 17. *Skull* (of type): Basal length, 22.3; nasals, 7; zygomatic breadth, 15.2; mastoid breadth, 12.3; alveolar length of upper molar series, 6.

General remarks.—A series of 31 specimens in the Merriam collection from Eubank, Ky., average darker and richer in coloration than the type series and have equally large ears. Specimens from Brookville, Ind., are dark and dull colored and might pass for either this species or *scalopsoides*. A single specimen from Hickman, Ky., is immature but apparently typical. A flat skin with crushed skull from Barron Springs, near Fredericksburg, Tex., has the large ear and small foot of *auricularis* but the dull color of *nemoralis*.

Specimens examined.—Total number, 45, from the following localities:

Mississippi: Washington, 10.
Kentucky: Hickman, 1; Eubank, 31.
Indiana: Brookville, 1.
Tennessee: Rogersville, 1.
Alabama: Greensboro, 1.

MICROTUS NEMORALIS Bailey. Woodland Vole.

Microtus nemoralis Bailey, Proc. Biol. Soc. Wash., XII, 89, April 30, 1898.

Type locality.—Stilwell (Boston Mountains), Indian Territory.

Habitat.—Open woods and brushland.

Geographic distribution.—West of the Mississippi River from central Arkansas north to Council Bluffs, Iowa.

General characters.—Size, larger than any other species of *Pitymys* in the United States; ears, relatively large; fur, comparatively long

and coarse; colors, duller than in *pinetorum*, not so dark as in *scalopsoides* or *auricularis*.

Color.—Upperparts dull chestnut, slightly lined with blackish-tipped hairs over the back and rump, becoming paler on the sides; belly washed with bright cinnamon; tail indistinctly bicolor; feet thinly clothed with pale buffy or sometimes dusky hairs. *Young:* Plumbeous or dark maltese, with a slight tinge of chestnut suffusing the back as maturity is approached.

Cranial characters.—Skull large and relatively elongated; supraoccipital sloping; interparietal short and wide; mastoids and audital bullæ large and projecting farther back than in *pinetorum;* palate often with a posterior point projecting into the U-shaped interpterygoid fossa.

Measurements.—Type: Total length, 130; tail vertebræ, 24; hind foot, 18. Average of five females and five males from the type locality: 135; 25; 18.1. *Skull* (of type): Basal length, 25.3; nasals, 7.7; zygomatic breadth, 16.5; mastoid breadth, 13.4; alveolar length of upper molar series, 7.

General remarks.—Specimens from London, Nebraska, and Council Bluffs, Iowa, are typical or slightly larger than those from the type locality. Those from central Arkansas and eastern Missouri are nearly or quite typical. So far as shown by the present series of specimens, the species stands distinct and apparently unconnected with the other forms of *Pitymys* east of the Mississippi River.

Specimens examined.—Total number, 46, from the following localities:

Indian Territory: Stilwell, Boston Mountains, 16.
Arkansas: Beebe, 5; Hardy, 1.
Missouri: Hunter, 3; Williamsville, 5; Kimswick, 5.
Iowa: Council Bluffs, 4.
Kansas: Neosho Falls, 1.
Nebraska: London, 6.

MICROTUS QUASIATER (Coues). Jalapa Vole.

Arvicola (Pitymys) pinetorum quasiater Coues. Proc. Acad. Nat. Sci. Phila., 1874, 191–192.

Type locality.—Jalapa, Vera Cruz, Mexico.

Geographic distribution.—Central Vera Cruz and eastern Puebla, on the east slope of the mountains (altitude 4,000 to 5,000 feet), in Humid Tropical and lower edge of Lower Austral zones.

Habitat.—Brushy woodland.

General characters.—Size of *pinetorum;* tail about as long as hind foot; ears large for a *Pitymys;* colors dark; fur glossy.

Color.—*Summer pelage:* Uniformly dark umber or seal brown, slightly paler on belly, feet, and tail; tail slightly paler below than above. *Winter pelage* (in January, specimens from Orizaba and Huauchinango): Darker, richer, and more glossy. *Young:* Darker and duller, inclining to sooty or plumbeous.

Cranial characters.—Skull similar to that of *pinetorum*, but with longer, more quadrate braincase, more prominent postorbital ridges, narrower interorbital space, and larger audital bullæ; dentition slightly heavier; molar pattern the same.

Measurements.—Average of 6 adult males and females from the type locality: Total length, 130; tail vertebræ, 23; hind foot, 17.7. *Skull* (No. 55048, ♀ adult): Basal length, 24; nasals, 7; zygomatic breadth, 12; alveolar length of upper molar series, 6.3.

General remarks.—*Microtus quasiater* is by far the most divergent form of *Pitymys* in America. Its range, so far as known, is restricted to a comparatively small area, 1,000 miles from that of its nearest relative, and reaches into a zone not known to be inhabited by any other species of *Microtus*.

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

Vera Cruz: Jalapa, 6; Jico, 8; Orizaba, 10.
Puebla: Huauchinango, 20.

Subgenus LAGURUS Gloger.

Lagurus Gloger, Gemeinnütz. Hand- u. Hilfsbuch d. Naturgesch., I, 98, 1841. Type *Lagurus migratorius* Gloger.
Lagurus Merriam, Am. Naturalist, XXIX, 758, Aug., 1895 (subgenus).

Geographic distribution (in America).—Transition zone of the semiarid parts of the northwestern United States, east of the Cascades and Sierra Nevada.

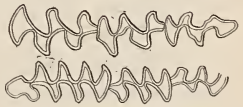


FIG. 12.—Molar enamel pattern of *Microtus* (*Lagurus*) *pallidus* (× 5).

Subgeneric characters.—(In American species) plantar tubercles, 5; mammæ, 8, inguinal 2–2, pectoral, 2–2; lateral glands on flanks; tail little little longer than hind foot; colors pale; fur lax. *Skull* low and wide; bullæ very large; mastoids reaching plane of exoccipital condyles; molars slender, with wide reentrant angles; m3 with 2 closed triangles and narrow posterior loop; m1 with 5 closed triangles, 4 inner and 4 outer salient angles; m3 with two terminal transverse loops and a pair of median triangles.

MICROTUS CURTATUS (Cope). Short-tailed Vole.

Arvicola curtata Cope, Proc. Acad. Nat. Sci. Phila., 1868, 2.
Arvicola decurtata Coues, Mon. N. Am. Rodentia, 215 (in text), 1877, nomen nudum.

Type locality.—Pigeon Spring, Mount Magruder, Nevada.

Geographic distribution.—Transition zone of the low mountain ranges in western Nevada and eastern California, east of the Sierra Nevada and north of Death Valley.

Habitat.—Dry, barren country, usually in sagebrush.

General characters.—Tail very short; feet hairy; fur long and lax; color pale buffy gray; skull wide and flat, with very large audital bullæ.

Color.—*Winter pelage:* Upperparts uniform pale buffy gray, or ashy gray becoming paler on the sides, and silvery white or soiled whitish

below; tail like belly, except an indistinct dusky dorsal line; ears slightly buffy, more noticeably so in young than in adults; feet soiled silvery whitish. *Summer pelage:* Slightly darker. *Young:* Darkened above by long, dusky-tipped hairs; ears distinctly buff tipped.

Cranial characters.—Skull wide and flat, with short rostrum, spreading zygomatic arches, and great mastoid breadth; audital bullæ and mastoids much inflated, and with thick, spongy walls; mastoids projecting back to plane of exoccipital condyles. Molar series rather light, with narrow, tightly closed triangles and wide reentrant angles.

Measurements.—Average of five adults from the type locality: Total length, 141; tail vertebræ, 27; hind foot, 17.6. *Skull* (No. 41019, ♀ ad.): Basal length, 24; nasals, 6.6; zygomatic breadth, 15; mastoid breadth, 13; alveolar length of upper molar series, 6.

General remarks.—This is the largest of the three species of *Lagurus* at present known in North America, size alone being sufficient to distinguish it from either *pauperrimus* or *pallidus*. It shows but slight variation throughout its somewhat restricted and probably interrupted range. Specimens from the head waters of Reese River, which is separated from the type locality by Sonoran valleys, show slightly larger audital bullæ and mastoids, but no characters of specific or subspecific value.

Specimens examined.—Total number, 54, from the following localities:

Nevada: Mount Magruder (near Pigeon Spring), 14; Reese River Valley, 7; Indian Creek (near head of Reese River), 2; head of Reese River, 10.
California: Inyo Mountains, 17; White Mountains, 4.

NOTE.—*Microtus* (*Lagurus*) *pumilus* Elliot (Field Columbian Museum, Zool. Series, Vol. I, No. II, p. 226, Feb. 1, 1899) from the Olympic Mountains, Washington, proves to be a young *Phenacomys*, as I have ascertained by examination of the type specimen, kindly loaned me by Mr. D. G. Elliot, curator of mammals in the Field Columbian Museum.

MICROTUS PALLIDUS (Merriam.) Pallid Vole.

Arvicola pallidus Merriam, Am. Nat., XXII, 702-705, Aug., 1888.

Type locality.—Fort Buford, N. Dak. The type was taken on a northeast slope, near the top of a high, barren hill, 2 miles east of the fort.

Geographic distribution.—Transition prairies of western North Dakota, Montana, and as far north as Calgary, Alberta.

Habitat.—High, semi-arid prairies, usually on shady slopes.

General characters.—Slightly paler than *curtatus;* smaller; with relatively much smaller audital bullæ. The palest species of *Microtus* found in America, and probably the shortest tailed.

Color.—Upperparts uniform pale buffy gray with an extra tinge of buff about ears and nose; belly white or soiled whitish; tail silvery whitish below, dusky above; feet silvery whitish or pale gray. The type series was taken in September and shows what is probably the darkest phase of summer pelage.

Cranial characters.—Skull like that of *curtatus* in general, but averaging slightly smaller and with decidedly smaller audital bullæ and narrower mastoid breadth. Teeth relatively heavy; incisors fully equaling those of larger skulls of *curtatus;* molar series heavy and actually longer in the smallest adults than in much larger specimens of *curtatus;* enamel pattern essentially the same.

Measurements.—Type, ♀ ad.: Total length, 121; tail vertebræ, 20; hind foot, 18 (measured dry). *Skull* (of type): Basal length, 22.3; nasals, 6.5; zygomatic breadth, 14.6; mastoid breadth, 11.6; alveolar length of upper molar series, 6.3.

General remarks.—In size *pallidus* falls between *curtatus* and *pauperrimus*, but in relative size of teeth *curtatus* comes in the middle, while in geographic position *pauperrimus* separates the other two. There is nothing in the material before me to indicate any intergradation between the forms or any subspecific relationship.

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

North Dakota: Fort Buford, 4.
Montana: Philbrook, 1.
Canada: Calgary, Alberta, 3.

MICROTUS PAUPERRIMUS (Cooper). Pigmy Vole.

Arvicola pauperrima Cooper, Am. Nat., II, 535–536, Dec., 1868.

Type locality.—Plains of the Columbia, near Snake River, Washington.

Geographic distribution.—Eastern Washington and Oregon, central Idaho, and the north slope of the Uinta Mountains, Utah, in Transition zone.

Habitat.—Open grassy ridges or high prairie, except in the Uinta Mountains, where they were found in grassy parks near the lower edge of pine timber.

General characters.—The smallest species of the subgenus *Lagurus*, with colors a shade darker than in *curtatus* or *pallidus;* skull small and very flat-topped, often concave postorbitally.

Color.—*Summer pelage:* Upperparts uniform buffy gray, slightly darkened with dusky-tipped hairs; ears and nose strongly tinged with buff; belly pale buffy; tail darkened above by a dusky line, buffy below; feet like belly. *Young:* Less buffy and slightly more dusky than adult.

Cranial and dental characters.—Skull small, relatively smooth, not ridged or angled, flat or concave on top; audital bullæ relatively as well as actually smaller than in *curtatus;* hamular process of mandible short and slender, inclosing a wide two-angled or rounded notch; incisors slender; molars differing from those of *curtatus* only in smaller size; enamel pattern essentially the same.

Measurements.—Average of 3 adults from the vicinity of Antelope, Oreg.: Total length, 115; tail vertebræ, 20; hind foot, 16. *Skull* (of

adult ♀, No. 78534, from Antelope, Oreg.): Basal length, 20; nasals, 5.5; zygomatic breadth, 13.4; mastoid breadth, 11.3; alveolar length of upper molar series, 5.2.

General remarks.—The above description is based mainly on a series of 6 specimens collected near Antelope, Oreg., on top of the high prairie ridge between the John Day and Des Chutes rivers, and not more than 150 miles from where Dr. J. G. Cooper collected his type of *pauperrimus* on the plains of the Columbia, near Snake River, October 9, 1860. Antelope is in reality on the south edge of the plains of the Columbia, and specimens from that point agree in every way with the somewhat mutilated type of *pauperrimus* still in the United States National Museum. Specimens from the Salmon River Mountains, Idaho, do not differ perceptibly from the type or from the Antelope series. A single specimen from the top of Steen Mountain is not typical, but the characters are not sufficient to warrant separating it on a single specimen, and they may prove only individual. Four specimens from the north slope of the Uinta Mountains, Utah, show but litttle deviation from the typical series.

Specimens examined.—Total number, 19, from the following localities:

Washington: Plains of the Columbia, 1 (the type).
Oregon: Antelope, 6; Bake Oven, 1 (im.); Steen Mountain, 1.
Idaho: Salmon River Mountains, 6.
Utah: Uinta Mountains, 4.

Subgenus CHILOTUS Baird.

Chilotus Baird, Mamm. N. Am., 516, 1857. Type, *Arvicola oregoni* Bachman.

Geographic distribution.—Pacific slope from northern California to southern British Columbia.

Subgeneric characters.—Plantar tubercles, 5; mammæ, 8, inguinal, 2–2; pectoral, 2–2; side glands obscure or wanting;[1] ears rather small; fur dense, without stiff hairs. *Skull* short, low, and with elliptical braincase; molars small; m3 with 2 or 3 closed triangles; m1 with 5 closed triangles; m2 with anterior pair of triangles usually confluent; m3 with 3 transverse loops.

MICROTUS OREGONI (Bachman). Oregon Vole.

Arvicola oregoni Bachman, Journ. Acad. Nat. Sci. Phila., VIII, Pl. 1, 60–61, 1839.
Microtus morosus Elliot, Field Columbian Mus., Zool. Series, Vol. I, No. II, 227, Feb. 1, 1899. (Olympic Mountains, Washington.)

Type locality.—Astoria, Oregon.

Geographic distribution.—Pacific coast region from northern California to Puget Sound.

[1] In a large number of skins of adult males, about a dozen show what appear to be ill-defined glands on the sides, midway between hips and shoulders; but before stating postively the presence and position of these glands it will be necessary to examine specimens in the flesh.

Habitat.—Dry open ground, under cover of grass and low vegetation, and under logs in the open redwood forest of California.

General characters.—Size rather small; tail long; colors dark; fur short, without long hairs.

Color.—Upperparts mixed bister and blackish, with a pepper-and-salt appearance; belly dusky, lightly washed with dull buffy; feet dusky gray; tail blackish, slightly lighter below; ears blackish, scantily haired, protruding from the fur.

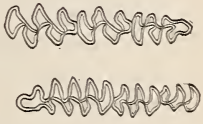


FIG. 13.—Molar enamel pattern of *Microtus* (*Chilotus*) *oregoni* (×5).

Cranial characters.—Skull, compared with those of other species ot the subgenus, long and slender, with narrower braincase, longer rostrum, more arched and less abruptly spreading zygomata, more quadrangular interparietal; superciliary ridges in adults well marked, approaching or meeting interorbitally; audital bullæ small and globose; dentition not peculiar.

Measurements.—Adult ♂, No. $\frac{17330}{2455}$, from Astoria: Total length, 140; tail vertebræ, 42; hind foot, 17. *Skull* (of same): Basal length, 22.2; nasals, 17; zygomatic breadth, 14.8; mastoid breadth, 11.8; alveolar length of molar series, 5.5.

General remarks.—The species shows some slight variation throughout its range, but all of the specimens examined from the low country south of Puget Sound are clearly referable to *oregoni*, and those from timberline in the Olympics do not vary sufficiently for even subspecific recognition.

Specimens examined.—Total number, 103, from the following localities:

Oregon: Astoria, 6; Oregon City, 6; Yaquina Bay, 1; Aumsville, 1; Elk Head, 1.

California: Crescent City, 12; Humboldt Bay, 1; Hoopa Valley, 2; Dyerville, 3.

Washington: Tenino, 9; Roy, 1; Skamania County (45 miles southeast of Toledo), 1; Kent, 2; Steilacoom, 1; Aberdeen, 3; Granville, 6; Quineault Lake, Chehalis County, 3; La Push, 3; Suez. 1; Neah Bay, 10; Olympic Mountains (near head of Soleduc River), 9; Lake Cushman, 21.

MICROTUS SERPENS Merriam. Creeping Vole.

Microtus serpens Merriam, Proc. Biol. Soc. Wash., XI, 75, 1897.

Type locality.—Agassiz, British Columbia.

Geographic distribution.—Low country of southern British Columbia and northern Washington between the Cascade Mountains and Puget Sound.

General characters.—Size, largest of the subgenus; tail short; colors dark.

Color.—*Winter pelage:* Upperparts uniformly sooty gray, becoming slightly lighter on sides; belly dusky, washed with dull buff; tail sooty above, silvery gray below; feet dusky gray; ears nearly naked, concealed in long fur. *Summer pelage:* Paler and more brownish above, belly lightly washed with buffy; ears projecting slightly from thinner, coarser fur.

Cranial characters.—Skull rather wide and short; superciliary ridges not well defined; interorbital width greater than in *oregoni;* zygomata abruptly spreading anteriorly, interparietal lozenge-shaped; audital bullæ full and globose; incisors larger and stronger and molars slightly larger than in *oregoni.*

Measurements.—Type: Total length, 130; tail vertebræ, 31; hind foot, 18. Average of 7 adults from type locality: 129; 32; 17.5. *Skull* (of type): Basal length, 22.4; nasals, 6.6; zygomatic breadth, 14; mastoid breadth, 11.2; alveolar length of upper molar series, 5.9.

General remarks.—The range of this northern, more robust form of *Chilotus,* as at present known, is rather limited, but future collections may show it to be continuous with that of *oregoni.*

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

British Columbia: Agassiz, 7; Port Moody, 10; Langley, 3; Sumas, 10; Mount Baker Range, 4.
Washington: Mount Vernon, 19; Hamilton, 2; Sauk, 1.

MICROTUS BAIRDI Merriam. Baird Vole.

Microtus bairdi Merriam, Proc. Biol. Soc. Wash., XI, 74, 1897.

Type locality.—Glacier Peak, Crater Lake, Oregon (altitude, 7,800 feet).

Geographic distribution.—Known only from the type locality, but probably restricted to the Hudsonian zone of the higher Cascades.

Habitat.—Beds of *Phyllodoce* and *Lutkea* at timberline.

General characters.—Slightly smaller than *M. oregoni;* color yellowish brown; fur short and glossy; tail short; ears almost concealed in the fur.

Color.—Upperparts glossy yellowish bister; sides paler; belly washed with whitish; tail indistinctly bicolor, dusky above, dark gray below; feet dusky gray; nose dusky.

Cranial characters.—Skull relatively short, wide, and flat, with short rostrum; braincase subquadrate; interparietal narrow; audital bullæ large; ascending arm of premaxillæ not extending beyond nasals; incisive foramina short and wide; dentition not peculiar.

Measurements.—Type, No. 79906, ♀ ad.: Total length, 131; tail vertebræ, 33; hind foot, 17.5. A young adult ♂ from type locality: 130; 32; 17. *Skull* (of type): Basal length, 22; nasals, 6.6; zygomatic breadth, 14; mastoid breadth, 11.5; alveolar length of upper molar series, 5.5.

General remarks.—This species of *Chilotus* is as yet known only from 2 specimens from the type locality. No doubt it will eventually be found to extend along the crest of the Cascade Range in Oregon.

Specimens examined.—Total number, 2, from the type locality.

Subgenus PEDOMYS Baird.

Pedomys Baird, Mamm. N. Am., 517, 1857. Type, *Arvicola austerus* Le Conte.

Geographic distribution.—Middle United States from southern Louisiana to Plains of the Saskatchewan.

Subgeneric characters.—Plantar tubercles, 5; side glands obscure or wanting,[1] rarely discernible; mammæ, 6, inguinal, 2–2, pectoral, 1–1; ears medium; fur long and coarse. *Skull* high and narrow; molars with wide reentrant angles; m3 with 2 closed triangles; m1 with 3 closed and 2 open triangles; m2 with anterior pair of triangles confluent; m3 with 3 transverse loops, the middle loop sometimes constricted, or even divided into 2 triangles.

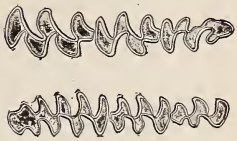


FIG. 14.—Molar enamel pattern of *Microtus (Pedomys) austerus* (×5).

MICROTUS AUSTERUS (Le Conte). Prairie Vole.

Arvicola austerus Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 405–406, 1853.
Arvicola (Pedomys) cinnamonea Baird, Mamm. N. Am., 541, 1857. (Type from Pembina, N. Dak.)

Type locality.—Racine, Wisconsin.

Geographic distribution.—Central part of Mississippi Valley from southern Wisconsin to southern Missouri and Fort Reno, Oklahoma, and west into eastern Nebraska and Kansas.

Habitat.—Dry upland prairie under low grass, and in rose and hazel thickets.

General characters.—Size of *Microtus pennsylvanicus*, but with slightly shorter tail and apparently coarser pelage. Color, dark peppery gray above, dull fulvous below.

Color.—*Winter pelage:* Upperparts dark gray, with a peppery appearance from the mixture of black and pale fulvous tips of long hairs, black tips predominating; sides paler; belly washed with pale cinnamon or fulvous; tail sharply bicolor, feet dusky; a tuft of fulvous hairs in front of ear. *Summer pelage:* Darker throughout, with fewer light-tipped hairs and thinner fulvous wash below. *Young:* Slightly paler than adult.

Cranial characters.—Skull high, narrow, and well arched; interparietal small, lozenge shaped; premaxillæ extending well back of nasals; audital bullæ small and narrow; incisive foramina wide posteriorly; molar pattern, that of the subgenus.

Measurements.—No. 2928, ♂ ad., from Racine, Wis., (measured from alcohol by Baird)[2]: Total length, 127; tail vertebræ, 32; No. 2897: hind foot, 19. *Skull* (No. 1999, ad., from Racine): Basal length, 27; nasals, 7.9; zygomatic breadth, 15.5; mastoid breadth, 12.6; alveolar length of upper molar series, 6.8. *Skull* (No. 948—not fully adult—from Racine): 25; 7.9; 15.4; 11.8; 6.

[1] A large number of skins of males show no trace of side glands, but a few show what appear to be very small glandular areas on the middle of the sides. It will be necessary to examine fresh specimens of old males before the presence or position of the glands is fully determined.

[2] Mamm. N. Am., 541, 1857.

Considerable variation is shown throughout the range of the species. To the southwest, at Orlando and Fort Reno, Okla., the individuals show slightly deeper coloration and slight modifications of cranial characters. Except for a slightly abnormal tooth pattern Baird's type of *cinnamonea* is a large specimen of typical *austerus*. I cannot believe that it ever came from Pembina.

Specimens examined.—Total, 211, from the following localities:

Wisconsin: Racine, 4.
Illinois: West Northfield, 14; Warsaw, 1.
Indiana: Wheatland, 4.
Iowa: Fairfield, 1; Knoxville, 93.
Nebraska: Blair, 1 (im.) Columbus, 7; London, 13; Norfolk, 1.
Kansas: Cairo, 4; Onaga, 13; Burlington, 1; Doniphan County, 1; Fort Leavenworth, 21.
Missouri: Golden City, 2; Piedmont, 10; Bismark, 6; Kimswick, 6.
Oklahoma: Orlando, 1; Fort Reno, 7.

MICROTUS LUDOVICIANUS sp. nov. Louisiana Vole.

Type from Iowa, Calcasieu Parish, Louisiana. No. 96624, ♂ ad., U. S. Nat. Mus., Biological Survey Collection. Collected April 7, 1899, by Vernon Bailey. Collector's number, 6767.

Geographic distribution.—Coast prairie of southwestern Louisiana, in Lower Austral zone.

Habitat.—Dry grassy mounds on the flat, half-marshy coast prairie.

General characters.—Size and proportions about as in *M. austerus*, color similar; rostrum and nasals slenderer and audital bullæ larger.

Color.—*Winter pelage* (in April specimens): Upperparts dark gray, with a coarse, peppery appearance, produced by the mixture of black-, brown-, and whitish-tipped hairs, and varying in color as these different colored hairs predominate; below dull fulvous or dark buffy; tail indistinctly bicolor, dusky above, buffy below; feet dusky. *Young* (quarter to half grown): Darker, more dusky, and less brownish than adult.

Cranial characters.—Skull like that of *austerus* with larger, more rounded audital bullæ, larger molars, and slenderer nasals. Middle section of $\overline{m3}$ often constricted or separated into two closed triangles. (This may occur in any species of *Pedomys*.)

Measurements.—Average of 10 adults (5 males and 5 females) from type locality: Total length, 164; tail vertebræ, 33; hind foot, 18.5. Average of hind foot of males, 19; of females, 18. Type: 146; 36; 19. *Skull* (of type): Basal length, 25.8; nasals, 8; zygomatic breadth, 15; mastoid breadth, 11.5; alveolar length of upper molar series, 6.3.

Remarks.—A single imperfect skull in the United States National Museum collection from Calcasieu Parish, La., showed such pronounced characters as to suggest the collection of the present series of specimens. Some of the characters in the old skull prove to be abnormal, and the actual differences between this southern form and true *austerus* are not strongly marked. There is no known and probably no actual intergradation or continuity of range between the two forms, and per-

haps subspecific rank would show better the close relationship of *ludovicianus* to *austerus*.

Specimens examined.—Total number, 26, from Calcasieu Parish, La.

MICROTUS HAYDENI (Baird). Hayden Vole.

Arvicola haydeni Baird, Mamm. N. Am., 543–544, 1857.

Type locality.—Fort Pierre, South Dakota.

Geographic distribution.—Plains region of western South Dakota, Nebraska, and Kansas, eastern Colorado and Wyoming, and southern Montana, in Transition zone.

Habitat.—Dry prairies. At the type locality, in sagebrush on badland hills.

General characters.—Considerably larger and lighter colored than *M. austerus*, with little or none of the fulvous or cinnamon wash below; fur very long and lax in winter and spring pelages; skull heavy and angular.

Color.—(May specimens from Fort Pierre): Upperparts uniform light gray, the color formed by a combination of whitish- and blackish-tipped hairs, with the white-tipped predominating; belly washed with silvery white, or sometimes soiled white, over plumbeous under-fur; feet dusky gray; tail bicolor. *Summer pelage:* Somewhat darker, with sometimes a slight wash of buff below. *Young* (one-fourth to one-half grown): Very woolly and slightly darker than adult.

Cranial characters.—Skull larger, more angular, and more heavily ridged than in *austerus;* anterior part of zygomatic arches more abruptly spreading; prezygomatic notch deeper; interparietal larger; palate higher, with more prominent median ridge.

Measurements.—Adult ♀ from type locality (No. 4239, Merriam Coll.): Total length, 180; tail vertebræ, 47; hind foot, 22. *Skull* (No. 4971 from Fort Pierre): Basal length, 28; nasals, 8; zygomatic breadth, 17.6; mastoid breadth, 12.6; alveolar length of upper molar series, 7.4.

General remarks.—Probably *haydeni* intergrades with true *austerus*, and is merely a more robust and paler northwestern form. The ranges of the two almost meet, if they are not continuous.

Specimens examined.—Total number, 110, from the following localities:

South Dakota: Fort Pierre, 4; Pierre, 3; Buffalo Gap, 4; Rapid City, 4.
Nebraska: Valentine, 10; Kennedy, 11; Sidney, 2; Callaway, 4; Alliance, 2.
Kansas: Pendennis, 10; Banner, 11.
Colorado: Loveland, 1; Canyon City, 1.
Wyoming: Beaver, 1; Newcastle, 1; Sundance, 1; Dayton, 1; Pass, 4.
Montana: Little Bighorn Valley, 8; Fort Custer, 24; Custer Station, 1; Lake Basin, 2.

MICROTUS MINOR (Merriam). Least Upland Vole.

Arvicola austerus minor Merriam, Am. Nat., XXII, 598–601, July, 1888.

Type locality.—Bottineau, at base of Turtle Mountains, North Dakota.

Geographic distribution.—Northern border of the Great Plains from northeastern North Dakota to Edmonton, Alberta, and southeastward to Minneapolis, Minn.

Habitat.—Dry upland prairie.

General characters.—Size very small, scarcely as large as *Evotomys gapperi* and of about the same proportions; color peppery gray; pelage long, lax, and coarse; sixth tubercle on hind foot usually present, though small; skull small and slender.

Color.—*Winter pelage:* Upperparts uniform, clear peppery gray, from a combination of black- and whitish-tipped hairs; belly washed with soiled white or pale buffy; tail sharply bicolor, dusky above, buffy below; feet gray. *Summer pelage:* With a mixture of fulvous above; belly with thinner wash of light-tipped hairs over dark under-fur. *Young:* Slightly darker than adult with less peppery appearance of fur.

Cranial characters.—Skull very small, not much arched, slender and narrow, with relatively heavy rostrum, narrow strap-shaped interparietal and slender zygomata; audital bullæ small and laterally compressed; molars with enamel pattern of the subgenus.

Measurements.—Type: Total length, 133; tail vertebræ, 36; hind foot, 16.5. Average of four adults from Sherbrook, N. Dak.: 128; 30; 16.7. *Skull* (No. 49230, ♀ ad., from Sherbrook): Basal length, 22.3; nasals, 6.4; zygomatic breadth, 12.2; mastoid breadth, 10; alveolar length of upper molar series, 5.

General remarks.—A mere glance at the skulls shows *minor* to be widely separated from any other species of the subgenus, differing from *austerus* in much smaller size, narrower braincase, and relatively smaller and narrower audital bullæ. The species shows little variation throughout its range over the prairie region, but those occupying the half-timbered region of south-central Minnesota show a marked intensity of color.

Specimens examined.—Total number, 94, from the following localities:

North Dakota: Bottineau, 3; Sherbrook, 4; Devils Lake, 1.
South Dakota: Traverse, 7.
Minnesota: Ortonville, 6; Elk River, 40; Fort Snelling, 7; Hamlington, 1.
Canada: Carberry, Manitoba, 1; Indian Head, Assinaboia, 11; Wingard, Saskatchewan, 10; Red Deer, Alberta, 1; Edmonton, Alberta, 2.

Subgenus ORTHRIOMYS Merriam.

Orthriomys Merriam, Proc. Biol. Soc. Wash., XII, 107, April 30, 1898. Type, *Microtus umbrosus* Merriam.

Geographic distribution.—That of its only known species.

Subgeneric characters.—Plantar tubercles, 5 (a rudiment of 6th); side glands wanting or very rudimentary; mammæ, 4, pectoral, 2–2; ears large and almost naked; feet large; tail long and scantily haired. *Skull* long and narrow; bullæ very small; posterior median ridge of palate sloping and grooved; m3 with 2 closed rounded triangles, and a third open one; $\overline{m1}$ with 3 closed triangles, 4 inner and 3 outer salient angles; $\overline{m2}$ with the anterior pair of triangles confluent; $\overline{m3}$ with 4 closed sections including 2 median triangles.

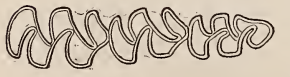


Fig. 15.—Molar enamel pattern of *Microtus (Orthriomys) umbrosus* (x 5).

MICROTUS UMBROSUS Merriam. Zempoaltepec Vole.

Microtus umbrosus Merriam, Proc. Biol. Soc. Wash., XII, 108, Apr. 30, 1898.

Type locality.—Mount Zempoaltepec, Oaxaca, Mexico (altitude 8,200 feet).

Geographic distribution.—Known only from the east slope of Mount Zempoaltepec, in the humid Upper Austral zone.

Habitat.—Dense oak forests, living in burrows and long underground tunnels.

General characters.—Size rather large; tail long; ears large; fur long and lax; colors dark; skull long and flat, with small bullæ and peculiar dentition.

Color.—Upperparts uniform dusky, with brown-tipped hairs; below dark plumbeous thinly washed with fulvous; feet and tail thinly haired, concolor, dark brown.

Cranial characters.—Skull long, narrow, and but little arched, with smooth outlines, and slender zygomatic arches; bullæ very small; palate low, with slender or incomplete lateral bridges, shallow lateral pits and grooved posterior ridge; interpterygoid fossa wide and quadrate; incisive foramina short and widest in the middle. Dentition heavy; incisors abruptly decurved; inner salient 'angles' of upper and posterior lower molars rounded instead of acute; m3 with a small outer and a large inner closed triangle and a posterior trefoil with large inner and small outer lobe; m3 with 2 median closed triangles, an outer and inner, and broad terminal loops.

Measurements.—Average of 7 specimens from type locality: Total length, 184; tail vertebræ, 65; hind foot, 23. Type: 177; 61; 23.5.

Skull (of type): Basal length, 26.5; nasals, 7.3; zygomatic breadth, 16; mastoid breadth, 12; alveolar length of upper molar series, 7.

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

Oaxaca: Mount Zempoaltepec (above Totontepec), 8; Totontepec, 7.

Subgenus HERPETOMYS Merriam.

Herpetomys Merriam, Proc. Biol. Soc. Wash., XII, 107, April 30, 1898. Type, *Microtus guatemalensis* Merriam, from Todos Santos, Guatemala.

Geographic distribution.—That of the type species.

Subgeneric characters.—Plantar tubercles, 5; side glands[1] on flanks of males small and obscure or sometimes wanting; mammæ, 6, pectoral, 2–2, inguinal, 1–1 (the latter apparently rudimentary and functionless); ears large; pelage long and soft; colors dark brownish. *Skull* with smooth outlines and large globose audital bullæ; m3 with 3 closed triangles; m1 with 3 closed triangles and an interior confluent

[1] In some specimens no side glands can be discovered, and in others they are marked by a pencil of white hairs. There is some doubt as to whether the white hairs are a product of the glands or occur there accidentally or from injury, as they sometimes do over other parts of the body.

pair of triangles opening into terminal loop, and with 5 inner and 4 outer salient angles; m3 with 4 closed sections including a pair of subequal median triangles.

MICROTUS GUATEMALENSIS Merriam. Guatemalan Vole.

Microtus guatemalensis Merriam, Proc. Biol. Soc. Wash., XII, 107, April 30, 1898.

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

Geographic distribution.—Known only from type locality.

Habitat.—Open ground on damp north slopes under rank growth of brush and weeds in the Boreal zone (altitude 9,800–11,000 feet).

General characters.—Size medium; tail less than twice the length of hind foot; ears large but nearly concealed in the long fur; colors dark.

FIG. 16.—Molar enamel pattern of *Microtus (Herpetomys) guatemalensis* (× 5).

Color.—*Winter pelage:* Upperparts dark umber brown; nose blackish; lips white; belly clear plumbeous or lightly washed with dull ochraceous; feet and tail dusky brown, concolor, and thinly haired. (*Summer pelage* not seen.) *Young* (half-grown individuals in December): Slightly duller than adult.

Cranial characters.—Skull rather long and but little arched, without conspicuous ridges and angles; interorbital space wide; braincase long; bullæ large and globose (larger than those of any other Mexican species); palate with steep and lightly grooved posterior median ridge; incisive foramina wide and short. *Dentition* heavy; most of the salient angles of molars acute; prisms deltoid; m3 with anterior crescent, 3 closed triangles, and a posterior crescent with two inner horns; m3 with posterior and anterior transverse crescents and a pair of subequal median triangles.

Measurements.—Average of 20 specimens from the type locality: Total length, 150; tail vertebræ, 37; hind foot, 21. Type (♂ ad.): 155; 40; 21. *Skull* (of type): Basal length, 25.6; nasals, 7.6; zygomatic breadth, 15; mastoid breadth, 12.3; alveolar length of upper molar series, 7.

General remarks.—So far as at present known, this is the southernmost species of *Microtus* in America. Its nearest relatives are *umbrosus* and *mexicanus*, with both of which it has some characters in common, but from which it differs so widely as to require subgeneric separation.

Specimens examined: Total number, 34, from the type locality.

Subgenus NEOFIBER True.

Neofiber True, Science, IV, 34, July 11, 1884 (genus). Type, *Neofiber alleni* True.

Neofiber Merriam, North American Fauna No. 5, 59, July, 1891 (subgenus).

Geographic distribution.—That of the type species.

Subgeneric characters.—Plantar tubercles, 5; side glands conspicuous in both sexes and in young, situated half-way between hips and shoulders, the glandular area marked by brownish base of fur and half-encircled above by a semilunar area of fur with white base; mammæ, 6, inguinal, 2–2, pectoral, 1–1; feet and fur modified for aquatic life; soles naked; a dorsal keel of long hair on rump. *Skull* massive; palate long with incomplete lateral bridges; pterygoids wing-like; m3 with 2 closed triangles; m1 with 5 closed triangles; m3 with 2 median triangles and 2 transverse terminal loops.

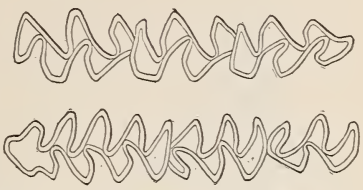


FIG. 17.—Molar enamel pattern of *Microtus* (*Neofiber*) *alleni* (× 5).

MICROTUS ALLENI (True). Florida Water-Rat.

Neofiber alleni True, Science, IV, 34, July 11, 1884.
Microtus (*Neofiber*) *alleni* Miller, North American Fauna No. 12, 70, July 23, 1896.

Type locality.—Georgiana, Brevard County, Florida.

Geographic distribution.—Eastern and central Florida.

Habitat.—Marshes, shallow lakes, and banks of streams.

General characters.—In appearance very similar to a small muskrat, but with a round tail, a tuft of long hair above the tail, hind feet less modified for aquatic life; fur dense, with color and texture of muskrat fur; skull resembling that of the muskrat, but with the rootless molars of *Microtus*.

Color.—Upperparts dark brown, darkened on head and along back by coarse blackish hairs; nose black; chin dusky; belly pale buff or soiled silvery whitish; tail dark brown or blackish, darker toward the tip; feet dark brown. *Young:* Dark maltese, with sooty backs.

Cranial characters.—Skull high and short, with heavy ridges and sharp angles; prezygomatic notches deep; postorbital shelf projecting; palate bone longer than in any other *Microtus*, shorter than in *Fiber;* lateral bridges of palate interrupted; pterygoids wing-like (as in *Fiber*); dentition heavy; upper incisors bent abruptly downward.

Measurements.—Average of 3 adult specimens from Canaveral, Fla.: Total length, 320; tail vertebræ, 121; hind foot, 44. Largest adult, ♂ : 330; 130; 44. *Skull* (No. 23450, ♀ ad.): Basal length, 44.6; nasals, 12.5; zygomatic breadth, 26; mastoid breadth, 20.5; alveolar length of upper molar series, 12.

General remarks.—The striking resemblance between *M. alleni* of Florida and *M. amphibius* of England proves on comparison of cranial characters to be only superficial; the differences are subgeneric.

Specimens examined: Total number, 17, from the following localities:

Florida: Georgiana, 3; Titusville, 1; Eden, 3; Canaveral, 5; Geneva, 3; Lake Harney, 1; Oaklodge (on peninsula opposite Micco), 1.

PLATE II.

Skulls of 9 subgenera, upper view.

[Enlarged one and one-half times.]

FIG. 1. *Microtus* (*Microtus*) *pennsylvanicus*. Hyattsville, Md.
(No. 87163, ♀ ad., U. S. Nat. Mus.)

2. *Microtus* (*Arvicola*) *macropus*. Sawtooth Lake, Idaho.
(No. 31451, ♀ ad., U. S. Nat. Mus.)

3. *Microtus* (*Neofiber*) *alleni*. Eden, Fla.
(No. 24112, ♀ ad., U. S. Nat. Mus.)

4. *Microtus* (*Pedomys*) *austerus*. Racine, Wis.
(No. 92851, ♂ ad., U. S. Nat. Mus.)

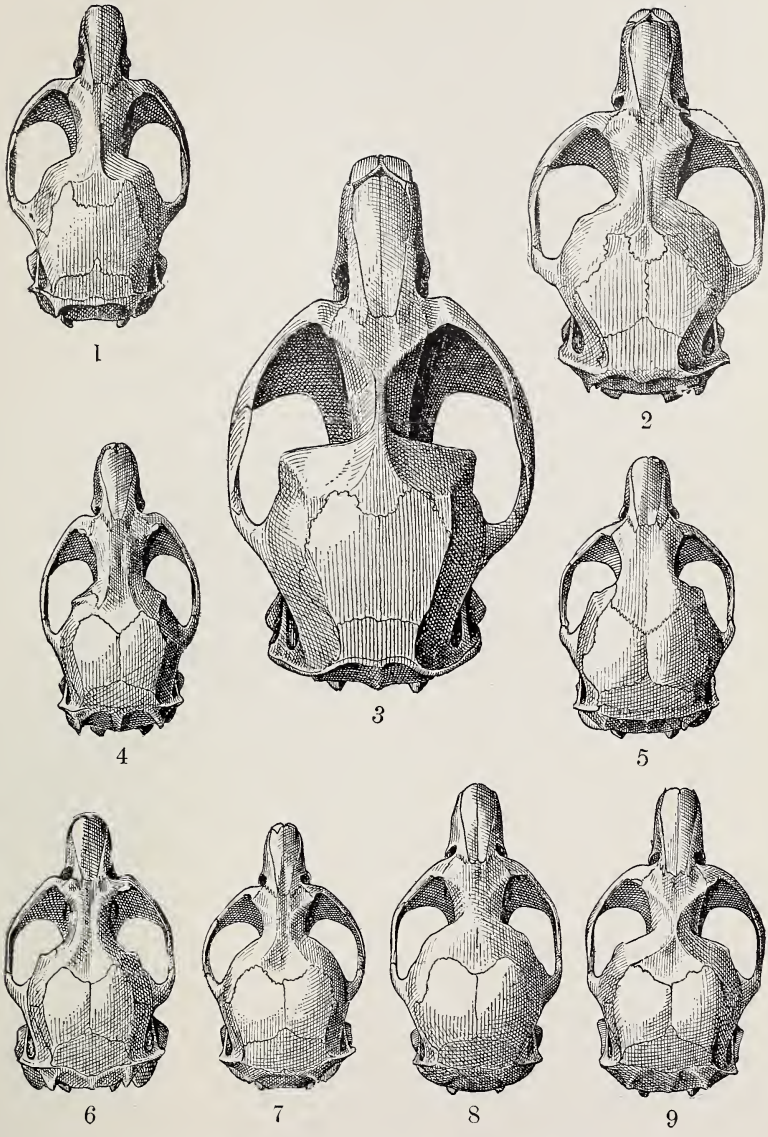
5. *Microtus* (*Pitymys*) *pinetorum*. Frogmore, S. C.
(No. 1523, ♂ ad., Merriam collection.)

6. *Microtus* (*Lagurus*) *curtatus*. Mount Magruder, Nev.
(No. 41017, ♂ ad., U. S. Nat. Mus.)

7. *Microtus* (*Chilotus*) *oregoni*. Astoria, Oreg.
(No. 24255, ♂ ad., U. S. Nat. Mus.)

8. *Microtus* (*Orthriomys*) *umbrosus*. Mount Zempoaltepec, Oaxaca, Mexico.
(No. 68469, ♀ ad., U. S. Nat. Mus.)

9. *Microtus* (*Herpetomys*) *guatemalensis*. Todos Santos, Guatemala.
(No. 76776, ♂ ad., U. S. Nat. Mus.)



SKULLS OF REPRESENTATIVE SPECIES OF THE NINE SUBGENERA OF *Microtus* (top view).

1. *Microtus* (*Microtus*) *pennsylvanicus.*
2. *Microtus* (*Arvicola*) *macropus.*
3. *Microtus* (*Neofiber*) *alleni.*
4. *Microtus* (*Pedomys*) *austerus.*
5. *Microtus* (*Pitymys*) *pinetorum.*
6. *Microtus* (*Lagurus*) *curtatus.*
7. *Microtus* (*Chilotus*) *oregoni.*
8. *Microtus* (*Orthriomys*) *umbrosus.*
9. *Microtus* (*Herpetomys*) *guatemalensis.*

PLATE III.

Skulls of 9 subgenera, lower view.

[Enlarged one and one-half times.]

FIG. 1. *Microtus* (*Microtus*) *pennsylvanicus*. Hyattsville, Md.
(No. 87163, ♀ ad., U. S. Nat. Mus.)

2. *Microtus* (*Arvicola*) *macropus*. Sawtooth Lake, Idaho.
(No. 31451, ♀ ad., U. S. Nat. Mus.)

3. *Microtus* (*Neofiber*) *alleni*. Eden, Fla.
(No. 24112, ♀ ad., U. S. Nat. Mus.)

4. *Microtus* (*Pedomys*) *austerus*. Racine, Wis.
(No. 92851, ♂ ad., U. S. Nat. Mus.)

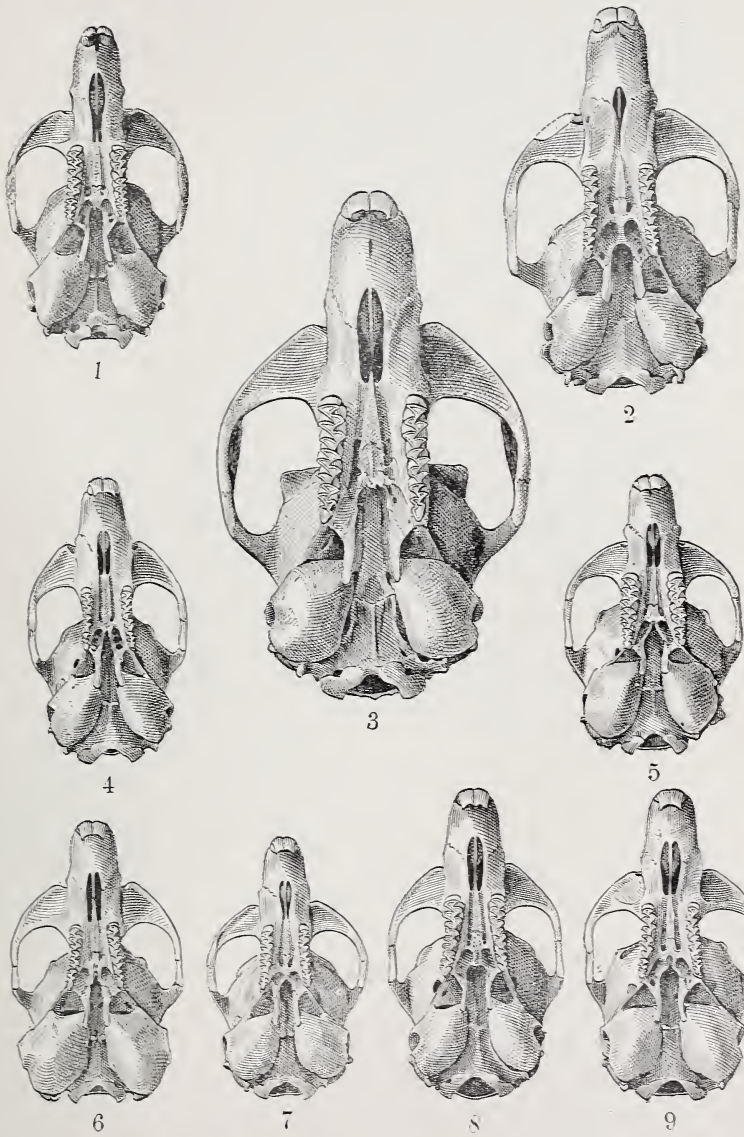
5. *Microtus* (*Pitymys*) *pinetorum*. Frogmore, S. C.
(No. 1523, ♂ ad., Merriam Collection.)

6. *Microtus* (*Lagurus*) *curtatus*. Mount Magruder, Nev.
(No. 41017, ♂ ad., U. S. Nat. Mus.)

7. *Microtus* (*Chilotus*) *oregoni*. Astoria, Oreg.
(No. 24255, ♂ ad., U. S. Nat. Mus.)

8. *Microtus* (*Orthriomys*) *umbrosus*. Mt. Zempoaltepec, Oaxaca, Mexico.
(No. 68469, ♀ ad., U. S. Nat. Mus.)

9. *Microtus* (*Herpetomys*) *guatemalensis*. Todos Santos, Guatemala.
(No. 76776, ♂ ad., U. S. Nat. Mus.)



SKULLS OF REPRESENTATIVE SPECIES OF THE NINE SUBGENERA OF *Microtus* (bottom view).

1. *Microtus* (*Microtus*) *pennsylvanicus*.
2. *Microtus* (*Arvicola*) *macropus*.
3. *Microtus* (*Neofiber*) *alleni*.
4. *Microtus* (*Pedomys*) *austerus*.
5. *Microtus* (*Pitymys*) *pinetorum*.
6. *Microtus* (*Lagurus*) *curtatus*.
7. *Microtus* (*Chilotus*) *oregoni*.
8. *Microtus* (*Orthriomys*) *umbrosus*.
9. *Microtus* (*Herpetomys*) *guatemalensis*.

PLATE IV.

Skulls of 7 groups in subgenus *Microtus*, upper view.

[Enlarged one and one-half times.]

FIG. 1. *Microtus mordax*. Red Lodge, Mont.
(No. 67305, ♀ ad., U. S. Nat. Mus.)

2. *Microtus nevadensis*. Ash Meadows, Nev.
(No. 39663, ♂ ad., U. S. Nat. Mus.)

3. *Microtus nanus*. Sawtooth Lake, Idaho.
(No. 75181, ♂ ad., U. S. Nat. Mus.)

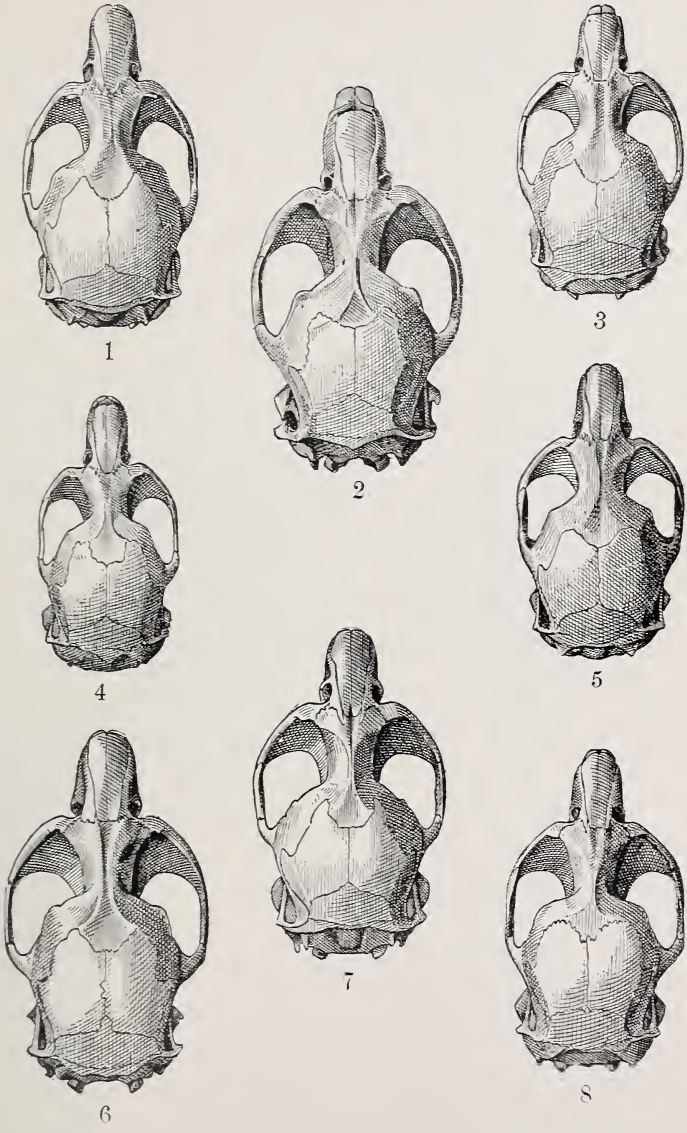
4. *Microtus operarius*. St. Michael, Alaska.
(No. 22214, ♂ ad., U. S. Nat. Mus.)

5. *Microtus chrotorrhinus*. Mount Washington, N. H.
(No. 1501, ♂ ad., Bangs Collection.)

6. *Microtus townsendi*. Steilacoom, Wash.
(No. 42921, ♂ ad., U. S. Nat. Mus.)

7. *Microtus californicus*. Walnut Creek, Cal.
(No. 44678, ♂ ad., U. S. Nat. Mus.)

8. *Microtus mexicanus*. Orizaba, Puebla, Mexico.
(No. 53406, ♀ ad., U. S. Nat. Mus.)



SKULLS OF REPRESENTATIVE SPECIES OF SEVEN OF THE GROUPS IN THE SUBGENUS *Microtus* (top view).

1. *Microtus mordax.*
2. *Microtus meadensis.*
3. *Microtus nanus.*
4. *Microtus operarius.*
5. *Microtus chrotorrhinus.*
6. *Microtus townsendi.*
7. *Microtus californicus.*
8. *Microtus mexicanus.*

PLATE V.

Skulls of 7 groups in subgenus *Microtus*, lower view.

[Enlarged one and one-half times.]

FIG. 1. *Microtus mordax*. Red Lodge, Mont.
(No. 67305, ♀ ad., U. S. Nat. Mus.)

2. *Microtus neradensis*. Ash Meadows, Nev.
(No. 39663, ♂ ad., U. S. Nat. Mus.)

3. *Microtus nanus*. Sawtooth Lake, Idaho.
(No. 75181, ♂ ad., U. S. Nat. Mus.)

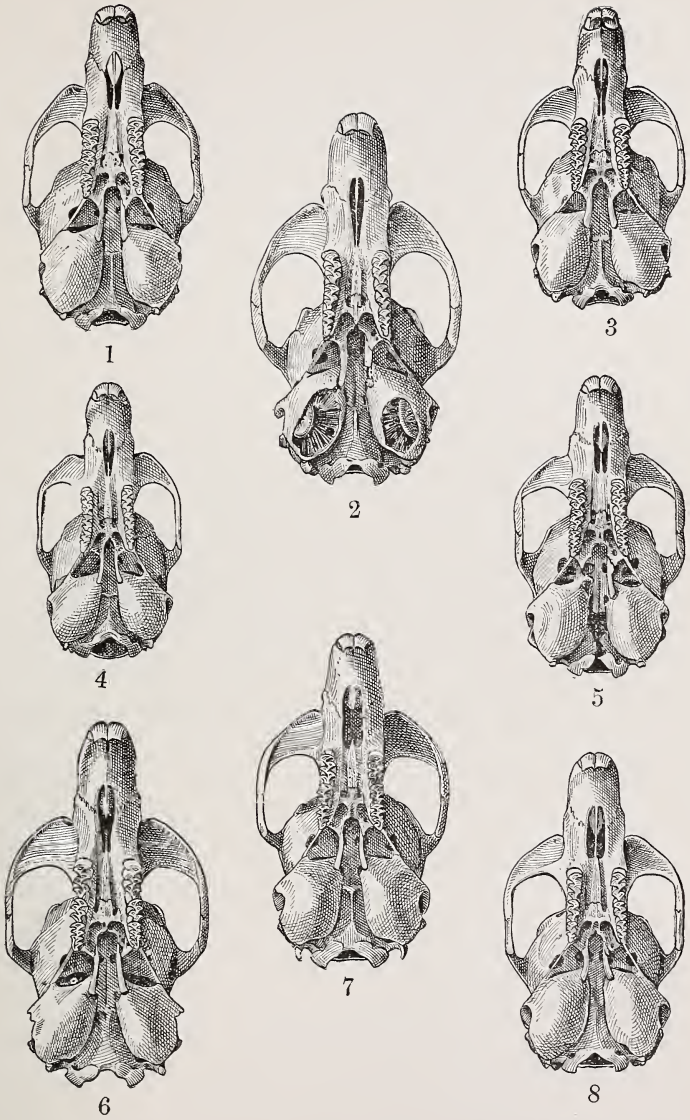
4. *Microtus operarius*. St. Michael, Alaska.
(No. 22214, ♂ ad., U. S. Nat. Mus.)

5. *Microtus chrotorrhinus*. Mount Washington, N. H.
(No. 1501, ♂ ad., Bangs Collection.)

6. *Microtus townsendi*. Steilacoom, Wash.
(No. 42921, ♂ ad., U. S. Nat. Mus.)

7. *Microtus californicus*. Walnut Creek, Cal.
(No. 44678, ♂ ad., U. S. Nat. Mus.)

8. *Microtus mexicanus*. Orizaba, Puebla, Mexico.
(No. 53406, ♀ ad., U. S. Nat. Mus.)



SKULLS OF REPRESENTATIVE SPECIES OF SEVEN OF THE GROUPS IN THE SUBGENUS *Microtus* (bottom view).

1. *Microtus mordax.*
2. *Microtus neradensis.*
3. *Microtus nanus.*
4. *Microtus operarius.*
5. *Microtus chrotorrhinus.*
6. *Microtus townsendi.*
7. *Microtus californicus.*
8. *Microtus mexicanus.*

INDEX.

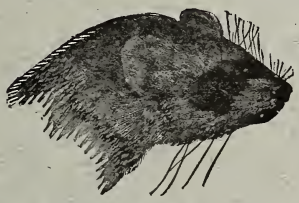
[Names of new species in black-face type, synonyms in *italics*.]

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 18

[Actual date of publication, September 20, 1900]



REVISION OF THE POCKET MICE OF THE GENUS PEROGNATHUS

BY

WILFRED H. OSGOOD
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

Prepared under the direction of

Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1900

U. S. DEPARTMENT OF AGRICULTURE
DIVISION OF BIOLOGICAL SURVEY

NORTH AMERICAN FAUNA

No. 18

[Actual date of publication, September 20, 1900]

REVISION OF THE POCKET MICE OF THE GENUS PEROGNATHUS

BY

WILFRED H. OSGOOD
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

Prepared under the direction of

Dr. C. HART MERRIAM
CHIEF OF DIVISION OF BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1900

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Biological Survey,
Washington, D. C., July 13, 1900.

Sir: I have the honor to transmit for publication, as No. 18 of North American Fauna, a 'Revision of the Pocket Mice of the Genus Perognathus,' by Wilfred H. Osgood, assistant in the Biological Survey. A preliminary revision of this group, based on the study of about 170 specimens, was published by me in 1889 as the first number of North American Fauna. In this early paper certain fundamental points in the history and synonym of the group were for the first time cleared up and the number of known forms was increased from 6 to 21. Five years later the rapid growth of the Biological Survey's collections enabled me to publish descriptions of a dozen additional species and to undertake a new revision of the group, which was brought down to date in 1896. The publication of this revision, with its accompanying illustrations, and colored maps showing the distribution of the various species, was deferred in order to obtain additional material still needed to settle a few remaining questions of distribution and relationship. This material was subsequently obtained, bringing the total number of specimens available up to 3,000; and my assistant, Mr. Osgood, to whom I had referred certain unsolved problems, undertook to bring the study of the whole group down to date. The result is here offered for publication.

Respectfully,

C. Hart Merriam,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

No. 18. NORTH AMERICAN FAUNA. September, 1900.

REVISION OF THE POCKET MICE OF THE GENUS PEROGNATHUS.

By Wilfred H. Osgood.
Assistant Biologist, Biological Survey.

INTRODUCTION.

HISTORY AND MATERIAL.

Pocket mice were first discovered by Maximilian, Prince of Wied, during his journey up the Missouri River. In 1839 he described and figured *Perognathus fasciatus* from specimens taken on the Missouri, near the mouth of the Yellowstone, in the present State of North Dakota. During the following half century several additional species were discovered; and in 1889 Dr. Merriam tentatively revised the group,[1] added many new species, and established the subgenus *Chætodipus* to include the large coarse-haired species. He also reviewed the history of the genus, so that it is now necessary to consider only events subsequent to 1889. Since then hardly a year has passed without the publication of additional species. In 1890 *fuliginosus* was proposed by Merriam;[2] in 1891 *femoralis*, by Allen;[3] in 1892 *merriami*, by Allen;[4] in 1893 *alticola* and *copei*, by Rhoads,[5] and *infraluteus*, by Thomas.[6] During 1894 two papers by Merriam greatly increased the knowledge of the group. The first[7] added *baileyi*, *canescens*, *columbianus*, *mexicanus*, *nelsoni*, *nevadensis*, *panamintinus*, and *stephensi;* the second,[8] *arenarius*, *bryanti*, *margaritæ*, and *peninsulæ*. In 1894 also, *conditi* and *pricei* were published by Allen[9] and

[1] North Am. Fauna, No. 1, 1889.
[2] Ibid., No. 3, 74, 1890.
[3] Bull. Am. Mus. Nat. Hist., N. Y., III, 281, 1891.
[4] Ibid., IV, 45, 1892.
[5] Proc. Acad. Nat. Sci. Phila., 1893, 404.
[6] Ann. and Mag. Nat. Hist., 6th ser., XI, 406, 1893.
[7] Proc. Acad. Nat. Sci. Phila., September, 1894, 262–268.
[8] Proc. Calif. Acad. Sci., 2d ser., IV, 460, 1894.
[9] Bull. Am. Mus. Nat. Hist., N. Y., VI, 318, 1894.

latirostris, by Rhoads;[1] in 1896 *mearnsi*, by Allen,[2] and in 1898 *pernix*, by Allen,[3] and *bangsi*, *eremicus*, and *pacificus*, by Mearns.[4]

The preliminary revision of the genus *Perognathus* by Dr. Merriam in 1889 was based on less than 200 specimens, practically all that were available in this country at that time. Nearly 3,000 specimens, all accumulated in the past decade, have been used in the present revision. This large collection, like those recently studied in other groups, proves the existence of many new forms,[5] shows the true status of doubtful ones, and clears up troublesome questions of relationship, nomenclature, and geographic distribution.

Most of the names of doubtful application in 1889 may now be disposed of definitely. In the case of *longimembris*, the name is found applicable to the species inhabiting the San Joaquin Valley, California, and a new name, *brevinasus*, is given to the San Bernardino form heretofore assumed to be true *longimembris*. The acquisition of topotypes settles previous questions regarding *flavus* and *mollipilosus*, and the possession of large series of specimens from Washington and Oregon makes it possible to fix the types of *lordi*, *parvus*, and *monticola*, though a slight uncertainty still attaches to the last. Abundance of material also makes available the name *hispidus*, under which *paradoxus* is placed as a subspecies, and of which *conditi* and *spilotus* become synonyms.

This material embraces all the specimens of *Perognathus* in the collections of the United States Biological Survey, the United States National Museum, the American Museum of Natural History, New York, and the private collections of Messrs. E. A. and O. Bangs and Dr. C. Hart Merriam. Besides these, various important specimens from other sources have been examined. All the types known to exist have been seen except those of *lordi*, *infraluteus*, and *pernix*, which are in the British Museum. In making acknowledgments, I wish first to express my obligations to Dr. C. Hart Merriam for the privilege of using his private collection and that of the Biological Survey, and also for much generous criticism and advice. For the privilege of using the collections in their charge, thanks are also due Dr. F. W. True, executive curator, and Mr. G. S. Miller, jr., assistant curator of mammals, in the United States National Museum; to Dr. J. A. Allen, curator of mammals and birds in the American Museum of Natural History; to Mr. Witmer Stone, curator of birds, Academy of Natural Sciences, Philadelphia; and to Mr. Outram Bangs, Mr. S. N. Rhoads, and Mr. W. W. Price.

[1] Am. Nat., XXVII, 185, 1894.

[2] Bull. Am. Mus. Nat. Hist., N. Y., VIII, 237, 1896.

[3] Ibid., X, 149, 1898.

[4] Ibid., X, 299, 1898.

[5] Five new species and eight new subspecies are described in the present revision.

The illustrations of skulls in Plates I and II and a few of the text figures were drawn by Dr. James E. McConnell; the outline figures of skulls in the text are republished from the plates in North American Fauna No. 1.

DISTRIBUTION.

The genus *Perognathus* is confined to North America and is restricted to the region west of the Mississippi River. Its northern limit is Ashcroft, British Columbia; its southern, Tlalpam, in the valley of Mexico. On the east its limits coincide approximately with those of the arid divisions of the Austral and Transition zones; on the west it extends to the Pacific coast. It may be said in a general way that the subgenus *Perognathus* inhabits the Sonoran and the lower part of the Transition zones (see Pl. III), while *Chætodipus* is seldom found outside of the Lower Sonoran zone except on the Great Plains (see Pl. IV). A curious exception to this distribution is found in central California, where *Perognathus* (*Chætodipus*) *californicus* is found in the Upper Sonoran zone and *Perognathus* (*Perognathus*) *longimembris* in the Lower Sonoran. Pocket mice usually choose plains and deserts for their habitat, and one or more species may be found in nearly all the desert and semi-desert country in the western part of the United States. As a rule, they are not found in mountainous regions, except where the aridity is considerable and the conditions are otherwise favorable. They abound in southern California, Lower California, and the Great Basin region, and in Mexico large areas are well populated with them.

COLOR AND PELAGES.

The general pattern of marking and coloration found in the genus is subject to little variation. The upperparts show varying shades of buff with greater or less admixture of black; the underparts are nearly always white. Most species have a distinct side stripe or lateral line and a minute white subauricular spot. Among the desert forms are numerous examples of protective coloration and adaptation to environment. A peculiar rump armature found in some species of the subgenus *Chætodipus* consists of grooved spiny bristles which extend beyond the rest of the pelage. What its function may be is little more than conjecture.

So far as known no species has more than one molt. This usually occurs in late summer after the breeding season, but is somewhat irregular, as specimens in entirely different pelages may be taken at the same place and date. The pelage acquired by the molt continues throughout the year, becoming more or less worn and patchy in early summer, just before its renewal;[1] hence in most species the seasonal

[1] Unless otherwise stated, the specimens described in this paper are in the new, unworn, or post-breeding pelage.

differences are not very great, the winter and spring pelage being simply paler than that of late summer and fall. The young invariably pass through a stage in which the pelage is soft and plumbeous.

HABITS.

The habits of pocket mice, as of most other small mammals, are not very well known. Most species are strictly nocturnal and very shy, and many of them are difficult to trap, as they do not readily take such bait as rolled oats or meat. They live in small burrows, from the entrances of which they throw out miniature mounds of earth like those of the pocket gopher. These burrows usually have two or more entrances, which often open under small bushes, and are closed with earth during the day, so that a casual observer might easily overlook them, particularly in the case of the smaller species. The food consists of seeds, which are carried in the cheek pouches and stored in chambers in the burrows. No species is known to hibernate, but it is possible that some of the more northern ones may do so.

CLASSIFICATION.

The genus *Perognathus* is a member of the family Heteromyidæ, one of the most peculiar groups of New World mammals. The other genera of this family are *Heteromys*, *Dipodomys*, *Perodipus*, and *Microdipodops*. Of these, *Heteromys* may be readily separated from the others by its very hispid pelage, which consists almost entirely of grooved spines, and by its rather murine skull, smooth upper incisors, and small mastoids and audital bullæ.

The genus *Perognathus* is commonly divided into two subgenera—*Perognathus* proper, including the small soft-haired species, and *Chætodipus*, containing the large coarse-haired and long-tailed forms. All the species except three fall naturally into one or the other of the two subgenera. One of these (*formosus*) is a *Perognathus* with strong inclination toward *Chætodipus;* another (*baileyi*) presents the reverse case; and the third (*hispidus*) must be classed as a *Chætodipus*, though it is aberrant in some ways. *P. femoralis* and *P. flavus* represent the extremes of the two subgenera and would certainly be placed in different genera if no other species were known, but between them may be found species showing almost every degree of differentiation. For convenience the genus has been divided into groups (see pp. 17–18) in order to show the affinities of the species and, to a certain extent, of the groups themselves.

In distinguishing species, dental peculiarities are of some service and cranial characters indispensable, showing relationship when external characters do not, and demonstrating intergradation to a degree of nicety otherwise almost unattainable. The best characters for com-

parison are the relative sizes of the mastoids and consequent dimensions of the interparietal. The shape of the interparietal varies somewhat, but its proportions and dimensions are generally reliable. The rostrum and interorbital space also furnish good characters. The hairiness of the feet is important, but of value only for separating species or groups in which other good differences are not apparent. The size and shape of the ears are also occasionally of use. In most species the males are slightly larger than the females, and in some the young adults are slightly different from fully mature individuals. Slight local variations are abundant; in some species it seems almost impossible to find two local series which are absolutely alike. But after making allowance for variation due to age and sex, individual variation will not be found very great; although so far as size is concerned it is greater in the *parvus* and *hispidus* groups than in the others.

NEW SPECIES.

Thirteen forms here characterized have not heretofore been described. These include five species and eight subspecies, as follows:

Perognathus merriami gilvus
apache melanotis
callistus
panamintinus brevinasus
amplus
parvus magruderensis
hispidus zacatecæ

Perognathus penicillatus angustirostris
pernix rostratus
goldmani
artus
anthonyi
californicus dispar

All measurements in the present paper are in millimeters.

Genus PEROGNATHUS Maximilian, 1839.

Perognathus Maximilian, Nova Acta Acad. Cæs. Leop.-Carol., XIX, I, 369–373, Pl. XXXIV, 1839; Reise Nord-Am., I, 449, 1839. Type, *Perognathus fasciatus* Maximilian, 1839, from the Upper Missouri River.
Cricetodipus Peale, U. S. Expl. Exp'd., VIII, 52–54, 1848.
Abromys Gray, Proc. Zool. Soc. London, 1868, 202.
Otognosis Coues, Proc. Acad. Nat. Sci. Phila., 1875, 305.
Chætodipus Merriam, N. Am. Fauna No. 1, 5, 1889.

Characters.—Size medium or small; form murine, rather slender; tail nearly as long as or longer than head and body; ears small; hind legs and feet rather long; external cheek pouches lined with hair. Skull rather small and light, flattened above; mastoids very large; audital bullæ inflated, more or less triangular in outline, anteriorly apposed to pterygoids; jugals light and thread-like; rostrum attenuate, nasals somewhat tubular anteriorly; infraorbital foramen reduced to a lateral opening in the maxillary. Teeth 20; molars rooted and tuberculate; upper incisors strongly sulcate.

Characters of subgenera.

I. Perognathus.

Size medium or small; pelage soft, no spines or bristles. Soles of hind feet more or less hairy (except in *formosus*).

Mastoids greatly developed, projecting beyond plane of occiput; mastoid side of parietal longest. Interparietal width less than interorbital width (rarely equal in *longimembris*).

Audital bullæ meeting or nearly meeting anteriorly. Supraoccipital without lateral indentations by mastoids (except in *formosus*); ascending branches of supraoccipital slender and thread-like.

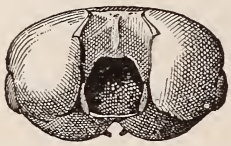


Fig. 1.—Posterior view of skull of *Perognathus* (*Perognathus*) *bimaculatus*.

II. Chætodipus.

Size medium or large; pelage harsh, often with spiny bristles on rump. Soles of hind feet naked.

Mastoids relatively small, not projecting beyond plane of occiput; mastoid side of parietal equal to or shorter than other sides. Interparietal width equal to or greater than interorbital width.

Audital bullæ separated by nearly full width of basisphenoid. Supraoccipital with deep lateral indentations by mastoids (except in *hispidus*); ascending branches of supraoccipital heavy and laminate.

Fig. 2.—Posterior view of skull of *Perognathus* (*Chætodipus*) *intermedius*.

Key to species and subspecies.

[Based on typical adults.]

I. Subgenus Perognathus.

Antitragus lobed; hind foot more than 20.
- Tail long and heavily crested; soles naked ..... *formosus* (p. 40)
- Tail moderate; soles of hind feet somewhat hairy.
  - Interparietal narrow, ratio of its width to basilar length of Hensel[1] about 25; color grayish; size large.
    - Mastoids moderate ..... *lordi* (p. 39)
    - Mastoids larger ..... *columbianus* (p. 40)
  - Interparietal wide, ratio of its width to basilar length of Hensel about 27.
    - Ears white; upper side of tail faintly dusky at tip ..... *alticola* (p. 39)
    - Ears buff or dusky; upper side of tail dusky throughout entire length.
      - Size large, hind foot 23 to 26 ..... *magruderensis* (p. 38)
      - Size medium, hind foot 21 to 23.
        - Audital bullæ meeting anteriorly in a strong symphysis; color usually slaty buff ..... *parvus* (p. 34)
        - Audital bullæ meeting anteriorly in a weak symphysis or not meeting; color cinnamon or ochraceous buff.
          - Premaxillæ exceeding nasals; color cinnamon buff; ears medium. *olivaceus* (p. 37)
          - Premaxillæ not exceeding nasals; color ochraceous buff; ears large. *mollipilosus* (p. 36)

[1] The basilar length of Hensel is measured from the anterior margin of the foramen magnum to the posterior rim of alveolus of the middle incisor.

Antitragus not lobed; hind foot 20 or less.
Tail longer than head and body.
Total length more than 150; mastoids very large ..... *amplus* (p. 32)
Total length less than 150; mastoids moderate.
Interorbital space narrow (less than 5); basilar length of Hensel about 17 ..... *longimembris* (p. 33)
Interorbital space wide (5 or more); basilar length of Hensel 15 or less.
Hairs of belly plumbeous at base ..... *nevadensis* (p. 31)
Hairs of belly white to roots.
Nasals short (about 7); tail 70 or less ..... *brevinasus* (p. 30)
Nasals long (about 8); tail more than 70.
Color pale vinaceous buff ..... *bangsi* (p. 29)
Color grayish buff ..... *panamintinus* (p. 28)
Tail about equal to or shorter than head and body.
Size rather large; interparietal width 4 or more; hind foot 18 or more.
Inside of ears chiefly black ..... *melanotis* (p. 27)
Inside of ears chiefly buff.
Color grayish olive buff ..... *callistus* (p. 28)
Color buff or ochraceous buff ..... *apache* (p. 26)
Size medium or small; hind foot less than 18.
Tail about 60.
Color olivaceous.
Hairs of belly white to roots ..... *fasciatus* (p. 18)
Hairs of belly plumbeous at base ..... *infraluteus* (p. 19)
Color not olivaceous.
Total length about 130; lower premolar smaller than last molar. *flavescens* (p. 20)
Total length 120 or less; lower premolar about equal to last molar.
Rostrum heavy; mastoids small ..... *merriami* (p. 21)
Rostrum light; mastoids larger ..... *gilvus* (p. 23)
Tail about 50.
Lower premolar larger than last molar ..... *pacificus* (p. 31)
Lower premolar smaller than last molar.
Hind foot about 15; color salmon buff ..... *flavus* (p. 23)
Hind foot about 17.
Upper parts sooty or black ..... *fuliginosus* (p. 25)
Upper parts salmon buff. (Northern Arizona) ..... *bimaculatus* (p. 24)
Upper parts buff, strongly mixed with black. (Central Mexico.) *mexicanus* (p. 26)

II. Subgenus Chætodipus.

Rump with more or less distinct spines or bristles.
Lateral line well marked; pelage not very hispid; bristles moderate, usually confined to rump.
Ears elongate (length 10 to 12); mastoids quite small; ratio of mastoid breadth to basilar length of Hensel about 70.
Size medium; total length less than 200; hind foot about 24 .. *californicus* (p. 58)
Size very large; length more than 200; hind foot about 26.
Interorbital space moderate; mastoids relatively small ..... *dispar* (p. 58)
Interorbital space wider; mastoids larger ..... *femoralis* (p. 57)
Ears rounded.
Ears large and orbicular (length about 10); color dark; rostrum heavy. (Mexico.)

Mastoids large ..... *goldmani* (p. 54)
Mastoids small ..... *artus* (p. 55)
Ears medium (length about 8); rostrum light.
Color of upperparts drab gray ..... *canescens* (p. 54)
Color of upperparts not drab gray.
Pelage rather hispid; color dark; rostrum relatively heavy. (Central Mexico) ..... *nelsoni* (p. 53)
Pelage softer; color lighter; rostrum slender.
Rump spines weak; interparietal strap-shaped; mastoids large. *intermedius* (p. 52)
Rump spines stronger; interparietal somewhat produced anteriorly.
Mastoids large ..... *fallax* (p. 55)
Mastoids smaller. (Cerros Island, Lower California) *anthonyi* (p. 56)
Lateral line very faint or not evident; pelage very hispid; bristles strong, extending to sides.
Size large; tail 120 or more. (San Jose Island, Lower California) *bryanti* (p. 61)
Size smaller; tail less than 110; hind foot about 24 ..... *peninsulæ* (p. 60)
Size smaller; hind foot about 22.
Mastoids moderate. (Southern California) ..... *spinatus* (p. 59)
Mastoids very small ..... *margaritæ* (p. 61)
Rump without spines or bristles.
Tail not crested, shorter than head and body; skull in adults with a supraorbital bead.
Size very large; hind foot about 26; color pale ochraceous. (Kansas and Nebraska) ..... *paradoxus* (p. 44)
Size smaller; hind foot about 24; color bright ochraceous. (Texas.) *hispidus* (p. 42)
Size large; hind foot about 26; color olive brown. (Zacatecas, Mexico.) *zacatecæ* (p. 45)
Tail crested, longer than head and body; skull without supraorbital bead.
Size very large; tail much longer than head and body; interparietal width about equal to interorbital width ..... *baileyi* (p. 41)
Size medium or large; tail slightly longer than head and body; interparietal width exceeding interorbital width.
Interorbital width less than 6; color of upperparts hair-brown. (West coast of Mexico.)
Skull narrow and elongate; rostrum slender ..... *pernix* (p. 50)
Skull short; rostrum heavy ..... *rostratus* (p. 51)
Interorbital width more than 6; color of upperparts pale vinaceous buff to broccoli brown.
Hind foot 20 to 21.
Size small; tail short, less than 80; hind foot 20. (Lower California) ..... *arenarius* (p. 50)
Size larger; tail 90 or more; hind foot 21 ..... *stephensi* (p. 49)
Hind foot 22 to 26.
Hind foot 23 to 26; color vinaceous buff.
Large; rostrum very heavy ..... *penicillatus* (p. 45)
Smaller; rostrum slender ..... *angustirostris* (p. 47)
Color blackish brown ..... *artus* (p. 55)
Hind foot 22 to 24; color broccoli brown.
Dark; rostrum heavy ..... *pricei* (p. 47)
Paler; rostrum slender ..... *eremicus* (p. 48)

List of species and subspecies, with type localities.

Subgenus PEROGNATHUS.

Species and subspecies.	Type locality.
Fasciatus group:	
Perognathus fasciatus Maximilian	Near junction of Missouri and Yellowstone rivers, N. Dak.
fasciatus infraluteus (Thomas)	Loveland, Colo.
flavescens (Merriam)	Kennedy, Nebr.
merriami Allen	Brownsville, Tex.
merriami gilvus nobis	Eddy, N. Mex.
flavus Baird	El Paso, Tex.
flavus bimaculatus (Merriam)	Fort Whipple, Yavapai Co., Ariz.
flavus fuliginosus (Merriam)	San Francisco Mountain, Ariz.
flavus mexicanus Merriam	Tlalpam, Mexico, Mexico.
apache Merriam	Keam Canyon, Apache County, Ariz.
apache melanotis nobis	Casas Grandes, Chihuahua, Mexico.
callistus nobis	Kinney Ranch, Sweetwater Co., Wyo.
Panamintinus group:	
Perognathus panamintinus (Merriam)	Panamint Mountains, Cal.
panamintinus bangsi (Mearns)	Palm Springs, Cal.
panamintinus brevinasus nobis	San Bernardino, Cal.
nevadensis Merriam	Halleck, Nev.
pacificus Mearns	Mexican boundary, shore of Pacific Ocean.
amplus nobis	Fort Verde, Ariz.
longimembris (Coues)	Fort Tejon, Kern Co., Cal.
Parvus group:	
Perognathus parvus (Peale)	Oregon [The Dalles?].
parvus mollipilosus (Coues)	Fort Crook, Shasta Co., Cal.
parvus olivaceus (Merriam)	Kelton, Utah.
parvus magruderensis nobis	Mount Magruder, Nev.
alticola Rhoads	Squirrel Inn, San Bernardino Mountains, Cal.
lordi (Gray)	British Columbia.
lordi columbianus (Merriam)	Pasco, Wash.
Formosus group:	
Perognathus formosus Merriam	St. George, Utah.

Subgenus CHÆTODIPUS.

Baileyi group:	
Perognathus baileyi Merriam	Magdalena, Sonora, Mexico.
Hispidus group:	
Perognathus hispidus Baird	Charco Escondido, Tamaulipas, Mexico.
hispidus paradoxus (Merriam)	Trego County, Kans.
hispidus zacatecæ nobis	Valparaiso, Zacatecas, Mexico.
Penicillatus group:	
Perognathus penicillatus Woodhouse	San Francisco Mountain, Ariz.
penicillatus angustirostris nobis	Carriso Creek, Colorado Desert, Cal.
penicillatus pricei (Allen)	Oposura, Sonora, Mexico.
penicillatus eremicus (Mearns)	Fort Hancock, El Paso Co., Tex.
stephensi Merriam	Mesquite Valley, Cal.
arenarius Merriam	San Jorge, Lower California.

Species and subspecies.	Type locality.
Pernix group:	
Perognathus pernix Allen	Rosario, Sinaloa, Mexico.
pernix rostratus nobis	Camoa, Sonora, Mexico.
Intermedius group:	
Perognathus intermedius Merriam	Mud Spring, Mohave Co., Ariz.
nelsoni Merriam	Hacienda La Parada, San Luis Potosi, Mexico.
nelsoni canescens (Merriam)	Jaral, Coahuila, Mexico.
goldmani nobis	Sinaloa, Sinaloa, Mexico.
artus nobis	Batopilas, Chihuahua, Mexico.
fallax Merriam	Reche Canyon, San Bernardino Co., Cal.
anthonyi nobis	Cerros Island, Lower California.
Californicus group:	
Perognathus femoralis Allen	Dulzura, San Diego Co., Cal.
californicus Merriam	Berkeley, Cal.
californicus dispar nobis	Carpenteria, Santa Barbara Co., Cal.
Spinatus group:	
Perognathus spinatus Merriam	Colorado River, Cal.
spinatus peninsulæ Merriam	San Jose del Cabo, Lower California.
bryanti Merriam	San Jose Island, Lower California.
margaritæ Merriam	Santa Margarita Island, Lower California.

Subgenus PEROGNATHUS Maximilian, 1839.

PEROGNATHUS FASCIATUS Maximilian. Maximilian Pocket Mouse.

Perognathus fasciatus Maximilian, Nova Acta Acad. Cæs. Leop.-Carol., XIX, I, 369–373, Pl. XXXIV, 1839; Reise Nord-Am., I, 449, 1839; Merriam, N. Am. Fauna No. 1, 10, 1889.

Type locality.—Upper Missouri River near its junction with the Yellowstone.

Distribution.—Upper Sonoran and Transition zones of eastern Montana and Wyoming, east into the adjoining parts of North and South Dakota.

General characters.—Size rather small, exceeding *P. flavus*, but not equaling *P. apache;* ears medium, antitragus not lobed; tail subterete, evenly haired, slightly shorter than head and body; proximal half of sole of hind foot hairy.

Color.—Upperparts grayish olivaceous, finely lined with black; hairs clear plumbeous basally, followed by a zone of black-tipped grayish buff; sides not noticeably paler than back; underparts pure white; lateral line bright buff (due to absence of black-tipped hairs), extending from nose to end of tail; tail indistinctly tricolor, dusky above, buffy on sides, and white below; orbital region and ill-defined ring around ears buff; subauricular spot present. *Spring pelage:* General color paler, more buffy and often lacking the olive tinge; contrast with lateral line not marked. *Young:* Dull plumbeous above with slight admixture of buffy.

Skull.—Size small; cranium somewhat arched; interparietal pentagonal, moderately wide; mastoids well developed, slightly project-

ing; audital bullæ scarcely meeting anteriorly; coronoid and angular processes of mandible long and slender; lower premolar about equal to or slightly smaller than last molar.

Measurements.—Average of four adults from Tilyou ranch, Montana (near junction of Missouri and Yellowstone): Total length, 134.7; tail vertebræ, 64.5; hind foot, 17. *Skull:* (See table, p. 62.)

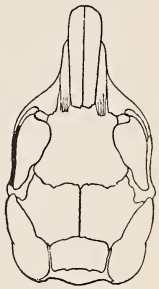


FIG. 3.—Skull of *Perognathus fasciatus.*

Remarks.—In bright new pelage *P. fasciatus* presents a very attractive appearance. Its diminutive size, peculiar greenish back, pure white underparts, and bright buff lateral line make a combination quite unusual among our small mammals. One specimen (No. 65017) from Rosebud Agency, S. Dak., collected May 13, 1894, is at the molting stage, and the incoming hairs show the extreme of this peculiar coloration. The head, back, and rump show small patches of bright, even iridescent, greenish, about which is the duller grayish of the old pelage. Another specimen (No. 65664) is further advanced, the only remains of the old pelage being slight traces on head and back and a large dark-buff rump patch. The species presents little geographic variation. Specimens from Bighorn Basin have somewhat peculiar skulls, but the aberrance is very slight.

Specimens examined.—Total number, 39, from localities as follows:

Montana: Calf Creek, 2; Clark Fork, 2; Big Porcupine Creek, 1; Frenchman River, 3; Lake Basin, Yellowstone County, 2; Powderville, 1; Sage Creek, Bighorn Basin, 1; Tilyou ranch, 27 miles above mouth of Yellowstone River, 6; Wolf Creek, 1; Mouth of Yellowstone, 1.

North Dakota: Forty miles north of Medora, 1.

South Dakota: Cheyenne River, Custer County, 1; Corral Draw, 4; Lugenbeel County, 2; Pine Ridge, 3; Rosebud Agency, 1; Quinn Draw, 3; Smithville, 1.

Wyoming: Kirby Creek, Bighorn Basin 2; Newcastle, 1.

PEROGNATHUS FASCIATUS INFRALUTEUS (Thomas). BUFF-BELLIED POCKET MOUSE.

Perognathus infraluteus Thomas, Ann. and Mag. Nat. Hist., 6th ser., XI, 406, May, 1893.

Type locality.—Loveland, Larimer County, Colo.

Distribution.—Known only from the type locality.

General characters.—Similar to *P. fasciatus*, but smaller and different in color of underparts, which are yellowish buff instead of white; pelage harsher.

Color.—Upperparts as in *P. fasciatus*, but more buffy; underparts buff with traces of white on inguinal and pectoral regions; eye-ring buff, more prominent than in *fasciatus*.

Skull.—Essentially as in *fasciatus*, but smaller and with slightly wider interparietal, as in *flavescens*.

Measurements.—Average of eight young adults from the type locality: Total length, 128; tail vertebræ, 59; hind foot, 17. *Skull:* (See table p. 62.)

Remarks.—The distinguishing character of this form is the buff color of its underparts. This, however, is not invariable, as one specimen in the series from the type locality is pure white below, and thus, but for minor characters, indistinguishable from *fasciatus*. The specimens examined are all young adults, which may partially account for their pecularities. In typical *fasciatus* the underparts are pure white in both young and old.

Specimens examined.—Total number, 10, all from the type locality, Loveland, Colo.

PEROGNATHUS FLAVESCENS (Merriam). Plains Pocket Mouse.

Perognathus fasciatus flavescens Merriam, N. Am. Fauna No. 1, 11, 1889; Allen, Bull. Am. Mus. Nat. Hist., N. Y., VIII, 247, 1896.
Perognathus copei Rhoads, Proc. Acad. Nat. Sci. Phila., 1893, 404.

Type locality.—Kennedy, Nebr.

Distribution.—Upper Austral plains of South Dakota, Nebraska, and Kansas; south possibly to northern Texas, and west to base of Rocky Mountains.

General characters.—Proportions much as in *P. fasciatus;* size slightly smaller; pelage harsher; color buff, lined with black, never showing the strong olivaceous appearance of *fasciatus.*

Color.—*April specimens:* Above, light-grayish buff mixed with dusky; below, white; lateral line, eye-ring, and postauricular spot, clear buff; subauricular spot prominent; large spot on inflexed part of ear white; tail indistinctly bicolor; feet and legs white.

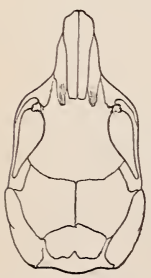


Fig. 4.—Skull of *Perognathus flavescens.*

Skull.—Similar to that of *fasciatus*, but a trifle smaller; interparietal wider; angular process of mandible shorter and broader; lower premolar smaller than last molar.

Measurements.—Average of six adults from Kennedy, Nebr.: Total length, 129.5; tail, 61.5; hind foot, 17.3. *Skull:* (See table, p. 62.)

Remarks.—This species is closely related to *P. fasciatus*, but is entirely distinct. Intergradation between the two is not probable, since typical examples of both have been taken at the same place, Rosebud Indian Agency, S. Dak. They doubtless occur together at other points, but in all cases color alone will be found sufficient to distinguish them.

P. copei from Mobeetie, Tex., was based on a single very imperfect specimen, and its status is accordingly doubtful. Its skull shows no tangible departure from that of true *flavescens.* Possibly it represents

a slight southern race of *flavescens*, or it may prove to be an intergrade between that species and *merriami*. Four distorted and desiccated individuals from Santa Fe, N. Mex., have also been doubtfully referred to *flavescens*.

Specimens examined.—Total number, 68, from localities as follows:

Colorado: Boulder County, 1; Greeley, 3; Pueblo, 4; Sterling, 5.
Kansas: Cairo, 4.
Nebraska: Cherry County, 10; Ewing, 1; Kennedy, 6; Lakeside, 1; Lincoln County, 1; Loup Fork, 1; Myrtle, 2; Perch, Rock County, 9; Pole Creek, 40 miles from Fort Riley, 1; Thomas County, 5; Verdigris, 1.
South Dakota: Rosebud Agency, 2; Vermilion, 2.
New Mexico: Santa Fe, 4.
Texas: Mobeetie, 1.

PEROGNATHUS MERRIAMI Allen. Merriam Pocket Mouse.

Perognathus flavus Baird, Mamm. N. Am., 423, 1857 (part); Merriam, N. Am. Fauna No. 1, 12, 1889; Allen, Bull. Am. Mus. Nat. Hist., N. Y., VIII, 58, 1896.
Cricetodipus flavus Thomas, Proc. Zool. Soc. London, 1888, 449.
Perognathus merriami Allen, Bull. Am. Mus. Nat. Hist., N. Y., IV, 45, Mar., 1892.
Perognathus mearnsi Allen, ibid., VIII, 237, Nov., 1896.

Type locality.—Brownsville, Tex.

Distribution.—Subtropical region of southern Texas and northeastern Mexico, and Lower Sonoran of central Texas. The known range extends from Alta Mira, Tamaulipas, northward to Washburn, Tex., and from this point southwestward to the vicinity of Roswell, N. Mex.; on the east it reaches San Antonio, and on the west follows up the Rio Grande as far as Comstock.

General characters.—Size smaller than *flavescens;* tail about equal to or slightly shorter than head and body, very scantily haired; pelage somewhat softer than in *flavescens* but not as in *flavus;* ears small and orbicular; colors bright; proximal half of sole of hind foot hairy.

Color.—Above, ochraceous buff densely mixed with black, forming an imperfectly defined dorsal stripe from the nose to the tail; below, pure white; sides bright buffy ochraceous, lateral line scarcely distinct; ears buff without, dusky within; spot behind ears clear buff; subauricular spot pure white, sharply contrasted with the surrounding black and ochraceous; light orbital area comparatively extensive; transverse nose stripes prominent, intensely black; tail slightly darker above than below; feet and forelegs white. *Late fall* and *winter pelage:* Heavier, softer, and lighter colored.

Skull.—General shape much as in *P. flavescens*, but smaller and slightly more angular; rostrum much heavier; maxillary branches of zygomata often squarely 'elbowed;' zygomata nearly parallel; interparietal more nearly quadrate than in *flavescens*, much wider than in *flavus;* lower premolar about equal to last molar.

Measurements.—Average of twenty adults from Brownsville, Tex.: Total length, 116.3; tail vertebræ, 57; hind foot, 16. *Skull:* (See table, p. 62.)

Remarks.—*P. merriami* is a very distinct species, more closely related to *P. flavescens* and *P. flavus* than to any other form. From *flavescens* it differs in size, color, hairiness of tail, and cranial characters. From *flavus*, to which it has some superficial resemblance, it is distinguishable by its slightly larger size, less hairy tail, smaller mastoids, heavier rostrum, wider interparietal, relatively larger lower premolar, and by other characters. In 1889 Dr. Merriam used a specimen of this species from Mason, Tex., as the basis of his description of *P. flavus*, of which no typical specimens were then extant. His prediction that this specimen would prove different from the El Paso animal was verified when actual topotypes of the latter were obtained. Subsequent authors, however, have continued to use the characters pointed out by Merriam on the basis of this specimen, and slight confusion has occasionally resulted.

The differences due to season are well shown by the large series examined. Early spring specimens (April) still wear the winter coat, which in June and early July often becomes so much worn that the plumbeous bases of the hairs are exposed. In late July and August the summer molt, the only one known, takes place. The new hair comes in rapidly and evenly, progressing from the head backward until the animals are in the bright post-breeding pelage, which is at its height in September and October. In winter there is but a slight change—a greater or less elimination of black and a general thickening of the pelage. The changes after this are evidently only those which result from wear.

Variations in this species are chiefly in size. Specimens from Padre Island, Texas, are smaller than typical ones, and those from some localities in Tamaulipas are abnormally large. *P. mearnsi* is not distinguishable, having been based on *merriami* in winter pelage.

Specimens examined.—Total number, 153, from localities as follows:

New Mexico: Forty miles west of Roswell, 1 (intermediate).
Texas: Austin, 1; Blocker Ranch, 1; Brownsville, 73; Comstock, 2; Kerrville, 6; Mason, 1; Padre Island, 3; Painted Cave, 1; Watson Ranch, San Antonio, 22; Santa Rosa, 10; San Diego, 3; Turtle Creek, Kerr County, 1; Washburn, 2 (intermediate).
Nuevo Leon: Aldama, 1; Doctor Cos, 1; Linares, 1.
Tamaulipas: Alta Mira, 1; Hidalgo, 7; Matamoras, 2; Mier, 5; Reynosa, 2; Victoria, 6.

PEROGNATHUS MERRIAMI GILVUS subsp. nov. Dutcher Pocket Mouse.

Type from Eddy, N. Mex. ♂ ad., No. $\frac{35}{48}\frac{939}{273}$, U. S. Nat. Mus., Biological Survey Coll. Collected September 18, 1892, by Dr. B. H. Dutcher. Orig. No., 329.

Distribution.—Western Texas and southeastern New Mexico. Lower Sonoran zone.

General characters.—Size and proportions about the same as those of *merriami*, slightly larger than *flavus;* color as in *merriami*, but

slightly paler; pelage softer. Skull superficially resembling that of *flavus*, but in detailed characters agreeing more closely with that of *merriami*.

Color.—Paler and more yellowish than *merriami;* back and sides well mixed with black; lateral line wide; postauricular spots rather prominent; tail whitish below, slightly dusky above.

Skull.—Like that of *merriami;* rostrum more slender; maxillary branches of zygomata lighter; mastoids larger. Contrasted with that of *flavus*, it has smaller mastoids, wider interparietal, larger lower premolar, and slightly wider interorbital space.

Measurements.—Type: Total length, 118; tail vertebræ, 58; hind foot, 16.5. One topotype: Total length, 122; tail vertebræ, 60; hind foot, 16.5. *Skull:* (See table, p. 62.)

Remarks.—This subspecies combines to some extent the characters of *flavus* and *merriami*. Nevertheless, careful study makes it perfectly evident that these are two distinct species, between which no real connection exists. All the evidence tends to show that *gilvus* has been derived from *merriami*. That its differentiation has been in the direction of *flavus* is probably an accidental circumstance, and does not indicate close relationship. The fact that typical *flavus* occurs with *gilvus* at its type locality (Eddy, N. Mex.), is interesting in this connection. Intergradation of *gilvus* with *merriami* is indicated by specimens from Comstock and Washburn, Tex., and also by a single individual taken 40 miles west of Roswell, N. Mex.

Specimens examined.—Total number, 7, from localities as follows:

New Mexico: Eddy, 4.
Texas: Big Spring, 1; Presidio County, 1; Stanton, 1.

PEROGNATHUS FLAVUS Baird. Baird Pocket Mouse.

Perognathus flavus Baird, Proc. Acad. Nat. Sci. Phila., 1855, 332; Mamm. N. Am., 423, 1857 (part); Allen, Bull. Am. Mus. Nat. Hist., N. Y., VII, 215, 1894.

Type locality.—El Paso, Tex.

Distribution.—Upper and Lower Sonoran zones from northeastern Colorado and western Nebraska to northern Mexico, extending westward into central Arizona and eastward to western Texas. In central Arizona its range meets that of the subspecies *bimaculatus* and in north-central Mexico it merges with that of *mexicanus*.

General characters.—Size very small; ears medium; pelage very soft; tail moderately haired, shorter than head and body; proximal half of hind sole hairy.

Color.—Above, pinkish buff, lightly mixed with black; below, pure white; black-tipped hairs most numerous in median dorsal region, produced anteriorly beneath ears to cheeks; face and orbital region more or less free from dusky; lateral line not sharply contrasted; postauricular spot clear buff, very prominent; subauricular spot present,

but inconspicuous; ears light buff outside, blackish inside; tail pale buffy, almost concolor, very faintly dusky above.

Skull.—Mastoid and audital bullæ greatly developed, interparietal very small, pentagonal or subquadrate, nearly as long as wide; rostrum quite slender; maxillary branches of zygomata angular; interorbital space well constricted; lower premolar noticeably smaller than last molar.

Measurements.—Average of ten adults from Fort Huachuca, Ariz.: Total length, 112.5; tail vertebræ, 50; hind foot, 15.8. *Skull:* (See table, p. 62.)

Remarks.—This species exhibits quite a departure from those preceding. Its small size, short tail, and conspicuous postauricular spots serve to mark it externally, while its short, broad skull, with full bulging mastoids and small interparietal distinguish it cranially. In its wide range some local differentiations might well be expected, but none of importance have been found. Its subspecies are not very strongly characterized and perfect intergradation with each is plainly evident.

Specimens examined.—Total number, 131, from localities as follows:

Arizona: Calabasas, 1; Chiricahua Mountains, 2; Dos Cabezos, 4; Fairbank, 2; Fort Grant, 5; Fort Huachuca, 41; Fort Lowell, 2; Mammoth, 1; Tanner Canyon, Huachuca Mountains, 4; Willcox, 15.

Colorado: Burlington, 1; Canyon City, 1; Fort Garland, 2; Greeley, 6; Loveland, 11.

Nebraska: Alliance, 1.

New Mexico: Chico Springs, 1; Deming, 2; Eddy, 1; Dog Spring, Grant County, 1; Taos, 1.

Oklahoma: Beaver River, Beaver County, 1.

Texas: El Paso, 8; Sierra Blanca, 1.

Chihuahua, Mexico: Chihuahua, 10; Escalon, 3; Gallego, 3.

PEROGNATHUS FLAVUS BIMACULATUS (Merriam). Yavapai Pocket Mouse.

Perognathus bimaculatus Merriam, N. Am. Fauna No. 1, 12, 1889; Allen, Bull. Am. Mus. Nat. Hist., N. Y., VII, 216, 1895.
Perognathus apache Allen, ibid, V, 71, 1893 (part).

Type locality.—Fort Whipple, Yavapai County, Ariz.

Distribution.—Central and northeastern Arizona and southeastern Utah.

General characters.—Similar to *P. flavus*, but larger.

Color.—As in *flavus*, but with a greater abundance of black-tipped hairs on dorsum; underparts white with occasional traces of buff; lateral line quite distinct; ears clear buff outside, blackish inside.

Skull.—Much larger than in *flavus;* interparietal relatively smaller; mastoids very large; lower premolar smaller than last molar as in *flavus.*

Measurements.—Average of ten adults from the type locality: Total length, 118; tail vertebræ, 53; hind foot, 17. *Skull:* (See table, p. 62.)

Remarks.—Typical adult specimens of *bimaculatus* are so much larger than *flavus* as to be very easily distinguishable, but immature or undersized examples are apt to give trouble. The average difference in size, however, is considerable and fully warrants recognition. When specimens of equal age are compared, the subspecies may be easily separated from the typical form by its larger ears and feet.

Specimens examined.—Total number, 82, from localities as follows:

Arizona: Fort Whipple, 23; Holbrook, 8; Keam Canyon, 1; Walnut, 1; Winslow, 21.

New Mexico: Fort Wingate, 4.

Utah: Noland Ranch, San Juan River, 9; Riverview, 25.

PEROGNATHUS FLAVUS FULIGINOSUS (Merriam). Dusky Pocket Mouse.

Perognathus fuliginosus Merriam, N. Am. Fauna No. 3, 74, 1890.

Type locality.—Cedar belt northeast of San Francisco Mountain, Arizona.

Distribution.—Lava beds in the vicinity of San Francisco Mountain, Arizona.

General characters.—Size and proportions those of *P. bimaculatus;* color very different.

Color.—Upperparts black or nearly black, except buff postauricular spots; lateral line and underparts ochraceous buff, except throat and breast, which are white.

Skull.—As in *bimaculatus.*

Measurements.—Type: Total length, 116; tail vertebræ, 58; hind foot, 18.

Remarks.—This form is doubtless a recent offshoot from *flavus* which has acquired dark colors to harmonize with the black lava rock which it inhabits. The fact that the conditions determining its differentiation are so plainly evident should be no reason for not recognizing the subspecies, even though its range be limited.

Specimens examined.—Total number, 3, from localities as follows:

Arizona: Cedar Belt, San Francisco Mountain, 1; Turkey Tanks, 1; Wolf Creek, 1.

PEROGNATHUS FLAVUS MEXICANUS Merriam. Mexican Pocket Mouse.

Perognathus flavus mexicanus Merriam, Proc. Acad. Nat. Sci., Phila., September 27, 1894, 265–266.

Type locality.—Tlalpam, Mexico, Mexico.

Distribution.—Upper and Lower Sonoran zones of the southern half of the table-land of Mexico.

General characters.—Similar to *P. flavus* but larger and darker.

Color.—Similar to that of *flavus*, but averaging much darker, the buff being richer and the fuliginous more extensive; postauricular spots and lateral line ochraceous, well contrasted; underparts white.

Skull.—As in *flavus*, but larger.

Measurements.—Average of 12 young adults from Tlalpam, Mexico: Total length, 115.7; tail, 53.7; hind foot, 17.4.

Remarks.—Some specimens of *mexicanus* are much like true *flavus*, but many are almost as dark as *fuliginosus*. In these the contrast of dusky back and sides with ochraceous lateral line and pure white underparts is very striking. In size *mexicanus* almost equals *bimaculatus*.

Specimens examined.—Total number, 29, from localities in Mexico, as follows:

Guanajuato: Celaya, 2; Guanajuato City, 2.
Hidalgo: Ixmiquilpan, 2.
Jalisco: Huejuquilla, 1.
Mexico: Tlalpam, 13.
San Luis Potosi: Ahualulco, 1; Hacienda La Parada, 3; Jesus Maria, 3.
Zacatecas: Berriozabal, 1; Valparaiso Mountains, 1.

PEROGNATHUS APACHE Merriam. Apache Pocket Mouse.

Perognathus apache Merriam, N. Am. Fauna No. 1, 14, 1889; ibid., No. 3, 73, 1890; Allen, Bull. Am. Mus. Nat. Hist., N. Y., V, 71, 1893 (part); ibid., VII, 216, 1895.
Perognathus flavus subsp. Merriam, N. Am. Fauna No. 3, 73, 1890.

Type locality.—Keam Canyon, Apache County, Ariz.

Distribution.—Eastern Arizona, western New Mexico, and southern Utah.

General characters.—Size large, about equaling *longimembris;* pelage rather soft; tail scantily haired; antitragus not lobed; posterior three-fifths of hind sole hairy.

Color.—Above, rich buff, with light admixture of black, effecting a suspicion of olivaceous; lateral line moderately well defined; below, pure white; ears buff, very faintly dusky within, a white spot on inflexed part and on inferior margin; tail white below, buff above with traces of dusky toward tip. In the early spring 'left-over' pelage the color is a beautiful clear buff with very few dusky-tipped hairs.

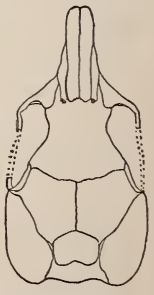


Fig. 5.—Skull of *Perognathus apache.*

Skull.—Size large, equaling *longimembris* and *parvus;* mastoids well developed; audital bullæ apposed anteriorly; interparietal pentagonal, of moderate size; angular process of mandible short and upturned, not long and widespread as in *longimembris;* lower premolar smaller than last molar. Compared with *longimembris* it has larger more bulging mastoids, heavier rostrum, wider interorbital space, shorter nasals, and smaller lower premolar.

Measurements.—Average of four adults from the type locality: Total length, 139.5; tail vertebræ, 67.5; hind foot, 18.5. *Skull:* (See table, p. 62.)

Remarks.—Apart from its subspecies, *P. a. melanotis*, *P. apache* is closely related to no other form except *P. callistus*. In color and size it bears some resemblance to *P. longimembris*, which is quite distant from it geographically. The only other similar form found within its range is *P. flavus bimaculatus*. From this it is distinguished by its larger size, heavy rostrum, and large wide interparietal. Specimens from Walnut, Ariz., are much deeper in color than usual.

Specimens examined.—Total number, 28, from localities as follows:

Arizona: Holbrook, 5; Keam Canyon, Navajo County, 8; Painted Desert, 2; Walnut, Coconino County, 4; Winslow, 1.

New Mexico: Deming, 3; Espanola, 1; Fort Wingate, 1; San Pedro, 1; Santa Fe, 3.

Utah: Noland Ranch, San Juan River, 1; Riverview, 1.

PEROGNATHUS APACHE MELANOTIS subsp. nov. BLACK-EARED POCKET MOUSE.

Type from Casas Grandes, Chihuahua, Mexico. ♀ ad., No. 97416, U. S. Nat. Mus., Biological Survey Coll. Collected May 21, 1899, by E. A. Goldman. Orig. No., 13750.

Distribution.—Known only from the type locality.

Characters.—Similar to *P. apache*, but darker; inside of ears black instead of buff; skull small and otherwise peculiar.

Color.—General color richer buff than that of *P. apache;* upperparts strongly mixed with black, particularly in median dorsal region; inside and inflexed parts of ears black, edges of ears and subauricular spot white; tail bicolor, dusky above, buffy white below; orbital region clear buff; underparts pure white.

Skull.—Similar to that of *P. apache*, but smaller; mastoids and audital bullæ much smaller; interparietal and interorbital space relatively wider.

Measurements.—Type: Total length, 133; tail vertebræ, 65; hind foot, 19.5. *Skull:* (See table, p. 62.)

Remarks.—The single specimen upon which this form is based is characterized by both external and cranial peculiarities which are much more than ordinary individual variation. A series of specimens from the type locality would doubtless show the majority of the peculiarities of the type to be constant.

PEROGNATHUS CALLISTUS sp. nov. Beautiful Pocket Mouse.

Type from Kinney Ranch, Green River basin, near Bitter Creek, Sweetwater County, Wyo. ♂ yg. ad., No. 88245, U. S. Nat. Mus., Biological Survey Coll. Collected May 14, 1897, by J. Alden Loring. Orig. No., 4122.

Distribution.—Known only from the type locality and vicinity.

General characters.—Size medium, smaller than *apache;* skull quite similar; color very different.

Color.—Above, grayish olive buff uniformly mixed with black; below, pure white; lateral line cream buff, well defined; ears whitish outside, dusky within; postauricular spot creamy buff, quite prominent; tail white below, dusky above.

Skull.—Similar to *apache*, but somewhat heavier and more arched; interparietal slightly wider (though mastoids are larger); audital bullæ scarcely meeting anteriorly.

Measurements.—Type: Total length, 135; tail vertebræ, 63; hind foot, 18. *Skull:* (See table, p. 62.)

Remarks.—This species is the most delicately colored of the genus. It has the attractive coloration of *fasciatus*, but softer and more delicate. Its position is evidently between *fasciatus* and *apache*, and its nearest relations are clearly with the latter. Its large size immediately separates it from *fasciatas*, which it resembles externally, especially before maturity.

Specimens examined.—Total number, 7; 6 from Kinney Ranch, Bitter Creek, and 1 from Green River, Wyoming.

PEROGNATHUS PANAMINTINUS (Merriam). Panamint Pocket Mouse.

Perognathus longimembris panamintinus Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, 265.

Type locality.—Perognathus Flat (altitude, 5,200 feet), Panamint Mountains, California.

Distribution.—Panamint Mountains, California, and eastward through southern Nevada to St. George, Utah.

General characters.—Size medium; tail long and moderately hairy; proximal third of hind sole hairy; pelage full, long, and silky; ears moderate.

Color.—Above, grayish buff, often with a pearly appearance caused by a pale buff ground color overlaid by dark-tipped hairs; lateral line pale buff, not sharply defined; subauricular spot small and inconspicuous; forelegs buffy or white; underparts white; tail, above dusky, strongly so distally, below buff or whitish.

Skull.—Size medium; nasals long and narrow; maxillary branches of zygomata gradually narrowing anteriorly; interorbital space wide; lower premolar larger than last molar. Compared with that of *flavus* the skull of *panamintinus* is more elongate, with smaller mastoids, and wider interparietal.

Measurements.—Average of 30 specimens from the type locality: Total length, 143; tail vertebræ, 78; hind foot, 19.7. *Skull:* (See p. 62.)

Remarks.—All the pocket mice without lobed antitragus found in California belong to the *panamintinus* group. *P. panamintinus* itself is easily recognizable by its proportions and dental peculiarities, as well as by its pearly gray color and long soft pelage. Its subspecies are closely related to it; *bangsi* inhabits the arid saline valleys southwest of the Panamint Mountains; *brevinasus* is also found to the southwest; and an incipient form not recognized by name is found in eastern Nevada. From this it appears that strictly typical *panamintinus* is confined to the Panamint Mountains.

Specimens examined.—Total number, 46, from localities as follows:

California: Panamint Mountains, 27.
Nevada: Ash Meadows, 1; Oasis Valley, 1; Oasis Valley (ten miles west), 1; Pahranagat Valley, 3; Pahroc Spring, 6; Panaca, 5; Vegas Valley, 1.
Utah: St. George, 1.

PEROGNATHUS PANAMINTINUS BANGSI[1] (Mearns). BANGS POCKET MOUSE.

Perognathus longimembris bangsi Mearns, Bull. Am. Mus. Nat. Hist., N. Y., X, 300, August 31, 1898.

Type locality.—Palm Springs, Colorado Desert, California.

Distribution.—Desert valleys of southern and southeastern California. Lower Sonoran zone.

General characters.—Similar to *panamintinus*, but smaller and paler.

Color.—Above, pale vinaceous buff, very lightly mixed with black, seldom showing the pearly effect of *panamintinus;* lateral line perfectly blended with sides; lower parts, including feet and fore legs, pure white; ears buffy white, thinly haired, a prominent white spot at the base of each and another on the inflexed portion; tail buff on upper side, rarely showing traces of dusky except at extreme tip, whitish on lower side; transverse nose spots nearly obsolete.

Skull.—Smaller than that of *panamintinus* with relatively smaller mastoids and wider interparietal; otherwise very similar.

Measurements.—*Type:* Length, 138; tail vertebræ, 80; hind foot, 19.

Remarks.—This pallid variety differs from *panamintinus* in color and size only. A convenient character for distinguishing it is the

[1] The following subspecies related to *P. panamintinus bangsi* has recently been described in the Proc. Biol. Soc. Wash., XIII, 153, June 13, 1900. Owing to absence in the field, the author has been unable to examine the type.—ED.

PEROGNATHUS PANAMINTINUS ARENICOLA Stephens.

"*Type* from San Felipe Narrows, San Diego County, California. No. 99828, ♂, U. S. Nat. Mus., Biological Survey Coll. Collected April 11, 1892.

"*Characters.*—Similar to *P. panamintinus bangsi* but paler and whiter; mastoids greatly swollen and projecting much further back than the occiput; interparietal very small. Total length, 141; tail vertebræ, 82; hind foot, 19."

color of the upper side of the tail, which is normally dusky in *panamintinus* and buffy in *bangsi*. The specimens from the more eastern localities are larger than those of the Colorado Desert and possibly should be considered intermediate between the latter and true *panamintinus*.

Specimens examined.—Total number, 56, from localities as follows:

California:[1] Argus Mountains (east base), 3; Ash Creek, Owens Lake, 5; Banning, 1; Bishop, Owens Valley, 1; Borax Flat, 4; Cabazon, 10; Hot Springs Valley, 7; Haway Meadows, 1; Little Owens Lake, 5; Moran, 2; Olancha, 1; Palm Springs, 2; Salt Wells Valley, 12; Whitewater, 2.

PEROGNATHUS PANAMINTINUS BREVINASUS subsp. nov. Short-nosed Pocket Mouse.

Type from San Bernardino, Cal. ♀ ad., No. $\frac{1109}{1661}$, Coll. of C. Hart Merriam. Collected May 2, 1885, by F. Stephens.

Distribution.—Known from a few scattered localities in extreme southwestern California. Upper Sonoran zone.

General characters.—Similar in general to *panamintinus* and *bangsi;* color darker; tail shorter; skull peculiar.

Color.—Above, pinkish buff, much varied with black; below, pure white; lateral line pinkish buff, not very sharply defined; postauricular spot buff, more prominent than in *bangsi;* hairs of back and especially of rump, clear buff nearly to roots, often showing no plumbeous whatever; ears dusky; subauricular spot small; orbital ring buffy; tail buff or buffy white, faintly dusky above; transverse nose stripes blackish, well defined. *Young:* Dull slaty; hairs of back dirty whitish, with plumbeous tips.

Skull.—Size medium, slightly smaller than in *panamintinus;* rather short, broad, and somewhat flattened; mastoids large and elevated from plane of cranium; interparietal moderate, smaller than in *panamintinus;* nasals much shorter than in *panamintinus;* zygomata more angular anteriorly; interorbital space relatively wide; audital bullæ not quite meeting in front; lower premolar larger than last molar.

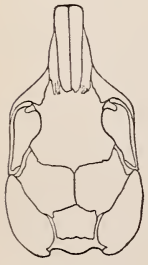


Fig. 6.—Skull of *Perognathus brevinasus.*

Measurements.—Type: Total length, 4.9 in. (124 mm.); tail vertebræ, 2.6 in. (66 mm.); hind foot (measured dry), 17.4 mm. Average of three adult males from Ferndale, San Bernardino County, Cal.: Total length, 130; tail, 68; hind foot (measured dry), 18.2.

Skull: (See table, p. 62.)

Remarks.—This is the *P. longimembris* of recent authors which requires a name, since *longimembris* applies only to the San Joaquin

[1] For details in regard to these localities, and others of the same general region mentioned in this paper, see N. Am. Fauna, No. 7, 361–384.

Valley animal. It ranges near *P. p. bangsi*, but is evidently confined to a higher zone. Whether it intergrades with *panamintinus* or *bangsi* is not satisfactorily shown by the present material. Possibly it should be considered a distinct species.

Specimens examined.—Total number, 61, from localities as follows:

California: Burbank, 1; Ferndale, San Bernardino County, 7; Jacumba, 7; San Bernardino, 44; Summit, Coast Range, San Diego County, 2.

PEROGNATHUS NEVADENSIS Merriam. Nevada Pocket Mouse.

Perognathus nevadensis Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, 264.

Type locality.—Halleck, Nev.

Distribution.—Upper Sonoran zone of central Nevada; northward to southern Oregon and northern Utah.

General characters.—Similar in general to *P. panamintinus;* differing in somewhat smaller size, color of underparts, and slight cranial characters.

Color.—Much as in *panamintinus* but darker, and with belly colored like sides.

Skull.—Very similar to that of *panamintinus;* nasals a trifle shorter; zygomata more angular anteriorly; interparietal shorter and broader, occipital side strongly concave; lower premolar larger than last molar.

Measurements.—Average of twenty-four adults from the type locality: Total length, 133; tail vertebræ, 72.4; hind foot, 18.7. *Skull:* (See table, p. 62.)

Remarks.—*P. nevadensis* and *P. panamintinus* are closely related. Whether they are directly connected at the present time remains to be seen. Specimens from Flowing Springs, Nev., are considerably larger than typical, and also interesting as showing a very worn pelage, which is pale grizzled cinnamon with all markings more or less obsolete.

Specimens examined.—Total number, 55, from localities as follows:

Nevada: Austin, 1; Battle Mountain, 5; Devil Gate (twelve miles west of Eureka), 1; Flowing Springs, 10; Golconda, 2; Halleck, 23; Monitor Valley, 2; Osobb Valley, 1; Pyramid Lake, 1; Reese River, 5; Stillwater, 2; Wadsworth, 2.
Oregon: Tumtum Lake, 3.
Utah: Kelton, 1.

PEROGNATHUS PACIFICUS Mearns. Pacific Pocket Mouse.

Perognathus pacificus Mearns, Bull. Am. Mus. Nat. Hist., N. Y., X, 299, August 31, 1898.

Type locality.—Mexican boundary monument No. 258, shore of Pacific Ocean.

Distribution.—Known only from the type locality.

General characters.—Size exceedingly small; similar in color and general characters to *P. p. brevinasus;* tail about equal to or slightly shorter than head and body; proximal third of hind sole hairy; pelage very soft but not long and full as in *panamintinus;* skull much as in the other members of the *panamintinus* group.

Color.—Similar to *P. p. brevinasus* but somewhat darker; sides about like back, between pinkish and salmon buff, very finely and thickly mixed with black; lateral line and slight postauricular spot pinkish buff; ears dusky; subauricular spot present; lower parts white; tail nearly concolor, faintly darker above than below.

Skull.—Size very small; cranium strongly arched; mastoids moderate, not bulging as in *brevinasus;* interparietal much wider than long; zygomata very slender and threadlike; nasals rather short; interorbital space moderately wide; lower premolar plainly larger than last molar.

Measurements.—Type: Total length, 113; tail vertebræ, 53; hind foot, 15.5. One adult topotype: Total length, 110; tail vertebræ, 54; hind foot, 15.3. *Skull:* (See table, p. 62.)

Remarks.—This species is by far the most diminutive member of the *panamintinus* group and of the genus. *P. flavus*, which has long been distinguished as the smallest pocket mouse, must now allow its title to pass to this tiny species. There is some superficial resemblance to *flavus*, but the skull is entirely in accord with the characters of the *panamintinus* group. Details which *pacificus* shares with the other members of the group, and which distinguish it from *flavus* and its forms, are small mastoids, wide interparietal, wide interorbital space, and large lower premolar.

Specimens examined.—Total number, 3, all from the type locality.

PEROGNATHUS AMPLUS sp. nov. Loring Pocket Mouse.

Type from Fort Verde, Ariz. ♂ ad., No. $\frac{34826}{49711}$, U. S. Nat. Mus., Biological Survey Coll. Collected June 26, 1892, by J. Alden Loring. Orig. No., 272.

Distribution.—Known only from the type locality.

General characters.—Size large; tail long, well haired, slightly penicillate; hind sole naked medially to posterior fifth, which is hairy; pelage soft, full, and long; antitragus not lobed; mastoids greatly developed.

Color.—Above, pinkish buff delicately lined with black; basal fifth of hairs plumbeous; underparts white; lateral line buff, rather wide, extending on forelegs nearly to wrist; orbital area pale; white spot present at base of ear above and below; tail buff, mixed with black above.

Skull.—Size large; mastoids excessively developed, bulging in all directions and reaching the maximum shown in the genus; audital bullæ relatively small, about as large as in *P. apache*, weakly apposed

anteriorly; interparietal relatively very small, pentagonal, about as long as broad; rostrum long and slender, nasals more slender than in *apache*, nasal branches of premaxillæ wider; zygomata narrowing anteriorly; interorbital width moderate; lower premolar about equal to or very slightly larger than last molar.

Measurements.—Type: Total length, 155; tail vertebræ, 80; hind foot, 20. *Skull:* (See table, p. 62.)

Remarks.—Both externally and cranially *P. amplus* is very peculiar and evidently has no close relation with any previously known species. In proportions (not in size) and character of pelage it is not very unlike *P. panamintinus*, and from some of the forms of this species it is but slightly dissimilar in color, but its remarkable skull and slightly haired hind foot are unique. The great development of mastoids which it shows is not at all correlated with an equal enlargement of the audital bullæ, as these are no larger than in *P. apache*. It has no important characters in common with *apache* and can not be closely related to it.

Specimens examined.—One, the type.

PEROGNATHUS LONGIMEMBRIS (Coues). San Joaquin Pocket Mouse.

Otognosis longimembris Coues, Proc. Acad. Nat. Sci. Phila., 1875, 305, under *Cricetodipus parvus*. (Type from Fort Tejon.)
Cricetodipus parvus True, Proc. U. S. Nat. Mus., IV, 474, 1882.
Perognathus inornatus Merriam, N. Am. Fauna No. 1, 15, 1889. (Type from Fresno.)

Type locality.—Fort Tejon, Cañada de las Uvas, Kern County, Cal.

Distribution.—Sonoran zone of the San Joaquin Valley, California, and its immediate extensions.

General characters.—Size large, equaling *P. apache;* color uniform, all markings reduced; antitragus not lobed; pelage rather harsh; proximal third of hind sole hairy.

Color.—Above, buff mixed with more or less black; below, white; bases of hairs on rump slightly or not plumbeous; lateral line poorly defined, concolor with upper sides; tail buff, paler on lower surface, faintly dusky above; upper side of forelegs generally buff to wrist; ears buffy outside, dusky within, a slight stripe of white on inflexed portion and the usual white spot at base. Young adults darker than adults, and showing a slight tinge of olivaceous.

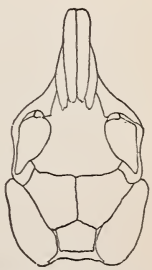


Fig. 7.—Skull of *Perognathus longimembris.*

Skull.—Size large, mastoids and audital bullæ moderate, not bulging as in *brevinasus;* interparietal subquadrate, relatively smaller than in *brevinasus;* interorbital space very narrow, often dorsally concave in old individuals; nasals long; lower premolar larger than last molar.

Measurements.—Average of 4 adult males from Fresno, Cal.: Total length, 145.2; tail vertebræ, 74.5; hind foot, 18.7. Of 4 adult females: Total length, 136; tail vertebræ, 71.5; hind foot, 18.3. *Skull:* (See table, p. 62.)

Remarks.—The above description is based mainly on specimens from Fresno, the type locality of '*inornatus.*' The type of *longimembris* is immature, but its skull shows the narrow interorbital space peculiar to the San Joaquin Valley form. The only available topotype is fortunately a young adult which agrees perfectly with specimens from Fresno and other points in the San Joaquin Valley. Two young specimens from San Emigdio and Rose Station, both very near Fort Tejon, are also clearly the same as those from Fresno, having the harsher pelage and slight olivaceous effect so different from the soft hairs and delicate pearly color of the young of *panamintinus* and subspecies. Thus it seems that the name *longimembris* should be applied to the animal recently called *inornatus* rather than to the San Bernardino form.

The species is very distinct, though its range is limited. It seems to be exclusively confined to the San Joaquin Valley, where it is the only representative of the genus. Young adults may be distinguished from old by their smaller size and darker color. Females are constantly smaller than males. Among adults two phases of color are apparent, one in which the hairs are grayish from the roots and another in which they are buffy.

Specimens examined.—Total number, 111, from localities as follows:

California: Alila, 2; Bakersfield, 5; Delano, 2; Fort Tejon, 2; Fresno, 54; Huron, 3; Livingston, 11; Lodi, 3; Oakdale, 2; Ripon, 2; Rose Station, Kern County, 1; San Emigdio, Kern County, 1; Three Rivers, 2; Tipton, 7; Walker Basin, Kern County, 14.

PEROGNATHUS PARVUS (Peale). Oregon Pocket Mouse.

Cricetodipus parvus Peale, U. S. Expl. Exp'd., VIII, Mamm. and Ornith., 52–54, 1848.
Perognathus parvus Cassin, U. S. Expl. Exp'd., Mamm. and Ornith., 48–49, 1858; Merriam, N. Am. Fauna No. 1, 28, 1889—Peale's description copied.
Perognathus monticola Baird, Mamm. N. Am., 422, 1857; Merriam, N. Am. Fauna No. 1, 17, 1889.

Type locality.—Oregon. Assumed to be The Dalles, Oreg.

Distribution.—Valley of the Yakima River, Washington, and thence southward to central and southeastern Oregon. Upper Sonoran zone.

General characters.—Size large; tail slightly penicillate, its vertebræ longer than head and body; ears moderate, well haired, antitragus prominently lobed; proximal fourth of hind sole hairy; color variable, presenting two extremes, a gray and a buff.[1]

[1] This species is certainly to some degree dichromatic, for the color variation is evidently not due to age, sex, or season. In one phase the buff is reduced to grayish

Color.—Gray phase: Above, pale slaty buff mixed with black, darkest in center of back; below, white, except belly, the hairs of which are normally plumbeous, with pale tips; sides like back, but paler; black-tipped hairs of back running forward across sides and reaching or nearly reaching forearm; lateral line buff; tail tricolor, dusky above, becoming black terminally, buff on sides, generally white below, but sometimes suffused with buffy; ears dusky, lighter on margins; subauricular spot moderate; feet white; inner side of hind legs dusky to heel. *Buff phase:* Everywhere as in gray phase, but general color buff or ochraceous buff instead of slaty. *Young:* Above, clear, light plumbeous, tips of hairs very pale buff, gradually intensifying with increasing age; below, as in adult. In late fall the high pelage which succeeds the breeding pelage becomes much paler as the black tips of the hairs wear off and expose the undercolor.

Skull.—Size large; cranium slightly arched; rostrum somewhat attenuate; audital bullæ and mastoids moderately developed; audital bullæ meeting anteriorly in a well-defined symphysis; interparietal wide, pentagonal, anterior angle strong; lower premolar smaller than last molar.

Measurements.—Average of five adults from Mabton, Wash.:[1] Total length, 171.8; tail vertebræ, 91.8; hind foot, 22.4. *Skull:* (See table, p. 62.)

Remarks.—The group for which *parvus* stands contains seven closely related forms. All are of relatively large size and have the antitragus distinctly lobed, thus requiring but slight comparison with the other members of the subgenus. *P. p. olivaceus* is the most centralized form. It occupies the main part of the Great Basin proper and the others, which are found in the various Great Basin extensions, have evidently been derived from it.

The name *parvus*, though one of the earliest proposed for a pocket mouse, has been usually incorrectly applied. Peale assigns the species to Oregon, and his original description and measurements indicate one of the larger members of the genus.[2] Since but one species is found in the part of Oregon traversed by the Wilkes expedition, and since this agrees in general with Peale's description, there seems to be no reason why the name *parvus* should not now be applied to it. The

drab, and in another it is developed into cinnamon, or even bright ochraceous. Between these extremes occur various intermediate stages. As might be expected, one phase is often much more numerous at a given locality than the other, though both are found together. The two are perfectly distinct in both adults and young.

[1] Although numerous specimens from The Dalles have been examined none are sufficiently adult to afford satisfactory measurements, so that it has been necessary to use the Mabton series for this purpose.

[2] The measurements alone are sufficient to prove that the name should never be used for a five-toed kangaroo rat. Cf. Rhoads, Proc. Acad. Nat. Sci. Phila., 1893, 407–410.

form found at The Dalles is here considered typical. The chances that the type was taken there are considerable since the species is very abundant there and members of the Wilkes expedition camped at or near that place on several different occasions.[1]

It is also not improbable that the type of Baird's '*monticola*' was also taken at The Dalles. Baird's queried statement that it came from St. Mary's Mission, Mont., is rendered much more doubtful by the unsuccessful efforts of recent collectors to obtain additional specimens from that locality. Dr. Suckley, who collected this type, stopped for some time at The Dalles and may have obtained it there, as pocket mice are probably more abundant there than at any other point at which he stopped. Its skull agrees more nearly with that of *parvus* than with that of any other form.

Specimens examined.—Total number, 103, from localities as follows:

Oregon: Antelope, 1; Burns, 5; Crown Rock, John Day River, 3; Harney, 1; Heppner, 2; Lost River, Klamath Basin, 5; Narrows, Malheur Lake, 6; North Dalles, 11; Prineville, 1; Rock Creek Sink, 2; Shirk, 5; The Dalles, 13; Tule Lake, 5; Tumtum Lake, 7; Twelve-mile Creek, 1; Umatilla, 2; Willows Junction, 2.

Washington: Mabton, 25; North Yakima, 6.

PEROGNATHUS PARVUS MOLLIPILOSUS (Coues). Coues Pocket Mouse.

Perognathus mollipilosus Coues, Proc. Acad. Nat. Sci. Phila., 1875, 296 (under *P. monticola*).

Perognathus monticola Townsend, Proc. U. S. Nat. Mus., X, 177, 1888.

Type locality.—Fort Crook, Shasta County, Cal.[2]

Distribution.—Great Basin extension of northeastern California, north to Klamath Basin, Oregon. Upper Sonoran zone, except on Mount Shasta, where it ascends to the Boreal.

General characters.—Size somewhat smaller than *parvus;* ears much larger, antitragal lobe prominent; coloration dark; markings intense.

Color.—Above, rich ochraceous buff, black-tipped hairs very abundant; lateral line prominent; white subauricular spot very faint or not evident; below, white, varying to tawny ochraceous on belly.

Skull.—Size relatively rather small; very similar to *P. olivaceus*, but with the ascending branches of the premaxillæ abruptly truncated, not exceeding the nasals.

Measurements.—Average of three adults from the type locality: Total length, 168.3; tail vertebræ, 88; hind foot, 22.3; ear from meatus (dry), 8.2. *Skull:* (See table, p. 62.)

Remarks.—The specimens from Fort Crook and Fall River Valley are the only ones that may be considered strictly typical. They are

[1] Wilkes, Narrative U. S. Expl. Exp'd, IV, 403–432, 1845.

[2] Fort Crook, now abandoned, was located about 2 miles northeast of the present site of Burgettville, or Swasey.

well characterized by large ears, rich color, obsolescent subauricular spots, and truncated premaxillæ. Nearly all the others here referred to *mollipilosus* show greater or less tendency toward *olivaceus*. The form seems to be one like *magruderensis*, which is rather ill defined, but of a type too strongly characterized to be left unrecognized. Specimens from the Boreal zone on Mount Shasta do not seem to be separable, notwithstanding their very anomalous distribution.[1]

Specimens examined.—Total number, 44, from localities as follows:

California: Alturas, 1; Cassel, 6; Edgewood, 3; Fall Lake, Fall River Valley, 1; Fort Crook, 5; Likely, 1; Madeline Plains, 2; Mount Shasta (head of Panther Creek, altitude 7,800 feet, 8; pine belt, south base 4), 12; Sisson, 2; Susanville, 2.

Oregon: Summer Lake, 2; Swan Lake Valley, 4; Williamson River, 3.

PEROGNATHUS PARVUS OLIVACEUS (Merriam). Great Basin Pocket Mouse.

Perognathus olivaceus Merriam, N. Am. Fauna No. 1, 15, 1889; ibid., No. 5, 71, 1891; Elliott, Field Columbian Mus., Zool. Ser., I, No. 10, 211, 1898.
Perognathus olivaceus amœnus Merriam, N. Am. Fauna No. 1, 16, 1889.

Type locality.—Kelton, Utah.

Distribution.—Upper Sonoran zone throughout the Great Basin, from northern Utah and southern Idaho southwest to Owens Valley, California, and west to southern Oregon and northeastern California.

General characters.—Similar to *P. parvus;* differing in softer pelage, lighter color, and slight cranial characters.

Color.—Similar to the buff phase of *P. parvus*, but with clearer, softer colors; above, bright cinnamon buff finely mixed with black; lateral line distinct; subauricular spot conspicuous; hairs of belly pure white or with plumbeous bases and buff tips; inner side of foreleg white or buff. Late fall pelage paler.

Skull.—Similar to that of *parvus* but slightly larger; mastoids more inflated; interparietal slightly smaller (ratio of interparietal width to basilar length of Hensel, 27.8); audital bullæ meeting anteriorly in a very weak symphysis or not meeting; ascending branches of premaxillæ generally exceeding nasals.

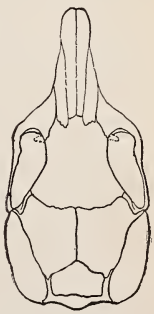


Fig. 8.—Skull of *Perognathus olivaceus.*

Measurements.—Type: Total length, 184; tail vertebræ, 101; hind foot, 23. Average of three males from Salt Lake City, Utah: Total length, 175.6; tail vertebræ, 95.6; hind foot, 22. Average of three females from Ogden, Utah: Total length, 167.7; tail vertebræ, 88; hind foot, 21.7. *Skull:* (See table, p. 62.)

Remarks.—In the wide range of this form are found numerous

[1] See N. Am. Fauna No. 16, 98, 1899.

more or less trivial deviations from the type. Most of these are of size only and probably represent nothing more than individual variation, which in this respect is often considerable. A difference in size between the sexes is also quite noticeable. The dark undercolor shown by the type of '*amœnus*' has been observed in many specimens from various localities, and in the series now available from Nephi are individuals with pure white belly hairs, as in the type of *olivaceus*.

Specimens examined.—Total number, 126, from localities as follows:

California: Benton, 1; Bishop Creek, 1; Long Valley, 4; Lower Alkali Lake, 1; Moran, 4.

Idaho: Bear Lake (east side), 10; Big Butte, 1; Birch Creek, 3; Blackfoot, 2; Lemhi, 1; Pahsimeroi Valley, 3.

Nevada: Anderson, 1; Bull Run Mountains, 3; Carson Valley, 1; Cottonwood Range, 5; Elko, 6; Golconda, 1; Granite Creek, 5; Halleck, 5; Monitor Valley, 5; Mountain City, 3; Pyramid Lake, 3; Reese River, 6; Ruby Valley, 9; Winnemucca, 1.

Utah: Blacksmith Fork, Cache County, 2; Kelton, 2; Laketown, 2; Nephi, 9; Ogden, 17; Otter Creek, 2; Salt Lake City, 4.

Wyoming: Fort Bridger, 1.

PEROGNATHUS PARVUS MAGRUDERENSIS subsp. nov. Mount Magruder Pocket Mouse.

Type from Mount Magruder, Nev. (altitude 8,000 feet). ♂ ad., No. $\frac{28427}{40531}$, U. S. Nat. Mus., Biological Survey Coll. Collected June 6, 1891, by Vernon Bailey. Orig. No., 2899.

Distribution.—Upper Sonoran and Transition zones of the desert ranges of southern Nevada and adjoining portion of California.

General characters.—Similar to *P. p. olivaceus*, but very much larger, being the largest member of the *parvus* group.

Color.—As in *P. p. olivaceus.*

Skull.—Very much as in *olivaceus*, but considerably larger and heavier; interparietal relatively narrower (ratio of interparietal width to basilar length of Hensel, 25.1).

Measurements.—Type: Total length, 198; tail vertebræ, 107; hind foot, 26. Average of five adult topotypes: Total length, 191; tail vertebræ, 102.2; hind foot, 24.2. *Skull:* (See table, p. 62.)

Remarks.—P. p. magruderensis is a large incompletely differentiated mountain form closely related to *olivaceus* which is found near it at a lower altitude. The form found on the Panamint Mountains shows trifling differences from typical *magruderensis*, but is here considered the same.

Specimens examined.—Total number, 27, from localities[1] as follows:

California: Coso, 8; Inyo Mountains, 2; Panamint Mountains, 7; White Mountains, 2.

Nevada: Mount Magruder, 7; Grapevine Mountains, 1.

[1]See N. Am. Fauna, No. 7, 361–384, 1893.

PEROGNATHUS ALTICOLA Rhoads. White-eared Pocket Mouse.

Perognathus alticolus Rhoads, Proc. Acad. Nat. Sci., Phila., December, 1893, 412.

Type locality.—Squirrel Inn, San Bernardino Mountains, California.

Distribution.—Known only from the type locality.

General characters.—Similar to *P. p. olivaceus*, from which it differs in somewhat smaller size, in color of ears and tail, and in slight cranial characters.

Color.—Above, as in *P. p. olivaceus;* sides like back, lateral line not prominent; below, white; ears clothed within and without with clear white hairs; tail faint buff above, terminal fourth slightly dusky, white below.

Skull.—Essentially as in *P. p. olivaceus;* ascending branches of supraoccipital very broad and heavy; interparietal rather narrow.

Measurements.—Average of two adult topotypes: Total length, 165; tail vertebræ, 83.5; hind foot, 22.2. *Skull:* (See table, p. 62.)

Remarks.—This isolated species may be immediately distinguished from the other members of the *parvus* group by its light ears and tail. The type agrees perfectly with the topotypes upon which the description is based.

Specimens examined.—Total number, 4, all from the type locality.

PEROGNATHUS LORDI (Gray). Northwest Pocket Mouse.

Abromys lordi Gray, Proc. Zool. Soc. London, 1868, 202.
Perognathus lordi Rhoads, Proc. Acad. Nat. Sci. Phila., 1893, 405.

Type locality.—British Columbia.

Distribution.—Upper Sonoran and Transition zones of the plains of the Columbia River, Washington, and suitable adjacent territory in southern British Columbia.

General characters.—Similar to *P. parvus;* size large (nearly equaling *magruderensis*); tail long; feet and ears moderate; antitragus lobed; color dark; interparietal narrow.

Color.—Above, pale slaty buff, strongly mixed with black; general color as in the gray phase of *P. parvus;* hairs of belly generally with plumbeous bases and buffy tips, leaving a small inguinal and a large pectoral patch pure white; subauricular spot small but distinct; tail tricolor, as in *parvus*.

Skull.—Size large; audital bullæ and mastoids inflated; audital bullæ always connected anteriorly; interparietal squarish pentagonal, deeply notched by occipital.

Measurements —Average of seven adults from Oroville, Wash.: Total length, 183, tail vertebræ, 97.7; hind foot, 23.2. *Skull:* (See table, p. 62.)

Remarks.—The numerous specimens examined from various parts of the country in which John Keast Lord collected leave little doubt

that this was the pocket mouse to which his name was given by Gray in 1868; but in order to remove all uncertainty, specimens were sent to Mr. Oldfield Thomas, curator of mammals in the British Museum, who kindly compared them with the type and found that they agreed in every essential particular. In color *lordi* is almost identical with the gray phase of *P. monticola*, but its large size and small interparietal show it to be a very different species. Apparently it does not occur on the west side of the Columbia at Wenatchee or south of that point. Specimens from Coulee City, Douglas, and vicinity are grading toward *columbianus*.

Specimens examined.—Total number, 131, from localities as follows:

British Columbia: Ashcroft,14; Kamloops, 6; Okanagan, 12; Vernon, 2.
Idaho: Lewiston, 1.
Washington: Almota, 16; Asotin, 11; Chelan, 2; Cheney, 3; Conconully, 3; Coulee City, 6; Douglas, 11; Fort Spokane, 7; Marcus, 1; Orondo, 7; Oroville, 9; Spokane Bridge, 11; Wenatchee (east bank of Columbia), 9.

PEROGANATHUS LORDI COLUMBIANUS (Merriam). Columbian Pocket Mouse.

Perognathus columbianus Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, 236.

Type locality.—Pasco, Wash.

Distribution.—Vicinity of type locality.

General characters.—Similar to *P. lordi*, from which it differs in slight cranial characters.

Color.—As in *P. lordi*.

Skull.—Audital bullæ and mastoids highly developed; interparietal width much reduced; otherwise as in *P. lordi*.

Measurements.—Average of five adults from Pasco, Wash.: Total length, 179.8; tail vertebræ, 92; hind foot, 22.8. *Skull:* (See table, p. 62.)

Remarks.—This form is found only on the hot plains about the Great Bend of the Columbia. The great development of audital bullæ and mastoids and consequent reduction of interparietal width exhibited by it is the extreme shown in the *parvus* group.

Specimens examined.—Total number, 26, from localities as follows:

Washington: Pasco, 12; Touchet, 14.

PEROGNATHUS FORMOSUS Merriam. Long-tailed Pocket Mouse.

Perognathus formosus Merriam, N. Am. Fauna No. 1, 17, October 25, 1889.

Type locality.—St. George, Utah.

Distribution.—Southwestern Utah, southern Nevada, and the adjoining portion of California. Lower Sonoran zone.

General characters.—Size large (about equal to *P. p. magruderensis*); tail much longer than head and body, heavily crested penicillate; ears

large, somewhat attenuate, scantily haired: antitragus prominently lobed; soles naked.

Color.—Above, grizzled sepia; below, white; sides not noticeably lighter than back; dark hairs generally extending down front leg to forearm; ears dusky black, tuft of bristly hairs at base mixed black and whitish; subauricular spot small, noticeable only in very high pelage; feet white; tail buff to pencil below, buff mixed with dusky above, intensifying toward pencil, which is brownish black. Worn pelage, drab instead of sepia. *Young:* Smoky gray above, white below.

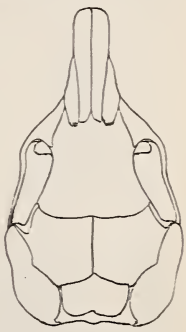


FIG. 9.—Skull of *Perognathus formosus.*

Skull.—Size medium; cranium slightly arched; mastoids well developed, bulging very slightly behind, rather smaller than in the *parvus* group; interorbital space wide; interparietal large and wide, pentagonal; nasals shorter than in *magruderensis;* audital bullæ slightly touching anteriorly; lower premolar larger than last molar.

Measurements.—Average of five adults from St. George, Utah: Total length, 189.6; tail vertebræ, 106.4; hind foot, 24. *Skull:* (See table, p. 62.)

Remarks.—This peculiar species is the only member of the subgenus *Perognathus* which has a heavily crested tail. In this respect it is like *Chætodipus*, but its skull shows the characters of true *Perognathus*. It inhabits remote western deserts little frequented by collectors. With the exception of the type, all the specimens known were taken by the Death Valley Expedition in 1891.

Specimens examined.—Total number, 136, from localities[1] as follows:

California: Argus Mountains, 6; Bennett Wells, 2; Emigrant Spring, 12; Funeral Mountains, 7; Furnace Creek, 4; Grapevine Springs, 11; Little Owens Lake, 3; Lone Pine, 2; Lone Willow Spring, 2; Panamint Mountains, 15; Resting Springs, 1; Saline Valley, 6; Saratoga Springs, 6.

Nevada: Ash Meadows, 4; bend of Colorado River near Callville, 12; Bunkerville, 2; Charleston Mountains, 1; Grapevine Mountains, 6; Oasis Valley, 2; Pahranagat Valley, 2; Pahroc Spring, 2; Pahrump Valley, 17; Thorp Mill, 2.

Utah: St. George, 9.

Subgenus CHÆTODIPUS Merriam, 1889 (see p. 14).

Chætodipus Merriam, N. Am. Fauna No. 1, 5, 1889. Type, *Perognathus spinatus* Merriam, 1889, from Colorado River, California.

PEROGNATHUS BAILEYI Merriam. BAILEY POCKET MOUSE.

Perognathus baileyi Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, 262.

Type locality.—Magdalena, Sonora, Mexico.

[1] See N. Am. Fauna No. 7, 361–384, 1893.

Distribution.—South central Arizona and thence south into Sonora and northern Lower California, Mexico.

General characters.—Size, very large; tail very long and penicillate; color similar to that of *P. formosus;* skull large and heavy.

Color.—As in *formosus*, but paler, being grayish rather than buffy; under side of tail whitish instead of buffy.

Skull.—Large and massive; mastoids relatively smaller than in *formosus;* mastoid side of parietal scarcely longest, about equaling other long sides; audital bullæ very weakly apposed in front; interparietal large, pentagonal, relatively wider than in *formosus*, interparietal width about equal to interorbital width; lower premolar smaller than or about equal to last molar.

Fig. 10.—Skull of *Perognathus baileyi.*

Measurements.—Average of five adults from the type locality: Total length, 214.6; tail vertebræ, 120.6; hind foot, 27. *Skull:* (See table, p. 62.)

Remarks.—*P. baileyi* stands somewhat alone. It seems most nearly related to *formosus*, although the sum of its characters places it in a different subgenus. The size and massiveness of its skull suggest relationship to some of the larger species of *Chætodipus*, like *paradoxus* or *femoralis*, but detailed characters indicate little affinity in this direction.

Specimens examined.—Total number, 17, from localities as follows:

Arizona: Mammoth, 1; New River, 5; Tucson (75 miles southwest), 1; Santa Catalina Mountains, near Tucson, 1.
Sonora: Magdalena, 8.
Lower California: Comondu, 1.

PEROGNATHUS HISPIDUS Baird. Hispid Pocket Mouse.

Perognathus fasciatus Baird, Mamm. N. Am., 420, 1857; Thomas, Proc. Zool. Soc. Lond., 1888, 449.
Perognathus hispidus Baird, Mamm. N. Am., 421, 1857; Merriam, N. Am. Fauna No. 1, 23, 1889.
Perognathus paradoxus spilotus Merriam, N. Am. Fauna No. 1, 25, 1889; Allen, Bull. Am. Mus. Nat. Hist., N. Y., VI, 172, 1894; ibid., VIII, 58, 1896.
Perognathus paradoxus Allen, Bull. Am. Mus. Nat. Hist., N. Y., VI, 172, 1894.

Type locality.—Charco Escondido, Tamaulipas, Mexico.

Distribution.—Southern and western Texas, north to Oklahoma and south into border States of Mexico. Lower Sonoran zone.

General characters.—Size large; tail equal to or slightly shorter than head and body, not crested or penicillate; pelage harsh, no spines or bristles anywhere; ear small, antitragus lobed, tragus quite evident; soles of hind feet naked in median line; skull heavy and somewhat ridged.

Color.—Above, ochraceous much mixed with black; sides scarcely paler than back; lateral line clear ochraceous, extending on fore and hind legs for half their length; face and orbital region light, lower cheeks continuous with lateral line; underparts white; ears dusky inside, buffy white on margins and on outer side, except an elliptical black spot on inflexed portion; feet white; tail whitish below, buffy on sides, sharply black above. *Spring pelage:* Much paler.

Skull.—Size large; rostrum heavy, somewhat arched; interorbital space wide; supraorbital bead very evident; mastoids relatively small, not bulging behind; mastoid side of parietal short; interparietal large, imperfectly pentagonal, all angles much rounded, anterior one sometimes entirely annihilated; ascending branches of supraoccipital short and heavy; audital bullæ normally separated anteriorly by breadth of basisphenoid, occasionally approaching each other; lower premolar about equal to last molar.

Measurements.—Average of six adults from Brownsville, Tex.: Total length, 204.5; tail vertebræ, 100.5; hind foot, 25. *Skull:* (See table, p. 62.)

Remarks.—This species typifies one of the most peculiar groups of the genus. It is characterized by its large size, short uncrested tail, and heavy ridged skull. Its skull, though peculiar, is plainly that of a *Chætodipus*, but external characters, excepting size, do not prohibit its being classed with restricted *Perognathus*, thus reversing the conditions presented by *formosus*. Baird's type agrees in essential characters with specimens from Brownsville, Tex., and other points near the type locality. In examining this type it was discovered that the broken skull supposed to belong to it is composite. The posterior section is the only part which may be safely assumed to have been originally within the skin. The anterior part and the mandible seem to have belonged with some other skin. Besides many differences of proportion which show this to be the case, there is a distinct difference in the texture and surface appearance of the bone in the two parts, indicating that they were cleaned and used differently. The skull of Baird's second specimen (No. 1695), which he figured, is nearly perfect and agrees in detail with many recently collected ones. The posterior section of the skull of the type agrees with this one, and also with the same parts of numerous others from the same vicinity. The skin of the type is also easily recognizable, so that when everything is considered there is no good excuse for allowing the name *Perognathus hispidus* to remain doubtful.

The form described as *P. p. spilotus* is here considered synonymous with *hispidus*, though there is some difference between the two. In a general way the southern animals are smaller, and with harsher pelage and higher color than the northern. The difference, which is chiefly of size, is fairly marked, and the increase quite gradual from

typical *hispidus* to typical *paradoxus*, leaving '*conditi*' and '*spilotus*' exactly intermediate, in character as well as geographic situation. Individual variation in size is often considerable, as is well shown by the Brownsville series, in which the length of the hind foot varies from 22 mm to 25 mm.

Specimens examined.—Total number, 175, from localities as follows:

Texas: Bee County, 5; Beeville, 2; Blocker Ranch, 1; Brazos, 1; Brownsville, 40; Chileipin Creek, San Patricio County, 1; Colorado, 1; Corpus Christi, 2; Cuero, 1; Gainesville, 6; Llano, 2; Lomita Ranch (near Rio Grande City), 3; Long Point, 1; Los Indios Ranch, Nueces County, 1; Nueces Bay, 5; Oconnorport, 1; Padre Island, 1; Rio Grande City, 3; Rockport, 30; Roma, 1; Saginaw, 1; San Antonio, 46; Santa Rosa, 1; San Thomas, 2; Sauz Ranch, Cameron County, 1; Sycamore Creek (mouth), 2.
Nuevo Leon: Linares, 2.
Tamaulipas: Matamoras, 1; Mier, 3; Victoria, 1.

PEROGNATHUS HISPIDUS PARADOXUS (Merriam). Kansas Pocket Mouse.

Perognathus paradoxus Merriam, N. Am. Fauna No. 1, 24, October 25, 1889.
Perognathus latirostris Rhoads, Am. Nat., XXVIII, 185, February, 1894.
Perognathus conditi Allen, Bull. Am. Mus. Nat. Hist., N. Y., VI, 318, November, 1894.

Type locality.—Trego County, Kans.

Distribution.—Upper Sonoran zone of the Great Plains from the Dakotas to Texas, westward to base of Rocky Mountains.

General characters.—Very similar to *P. hispidus*, but larger and with softer pelage; skull much heavier and more ridged.

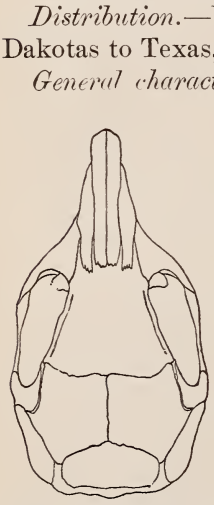


Fig. 11.—Skull of *Perognathus paradoxus.*

Color.—Much as in *hispidus*, but duller and paler.

Skull.—As in *hispidus*, but much larger, heavier, more angular and more ridged; otherwise not tangibly different.

Measurements.—Average of six adults from Kansas and Nebraska: Total length, 222.3; tail vertebræ, 108; hind foot, 26.5. *Skull:* (See table, p. 62.)

Remarks.—The average difference in size between *paradoxus* and typical *hispidus* is considerable, but apart from this there are no very important distinctive characters. The skull varies individually more than is usual in the genus and affords scarcely any reliable differences. *P. paradoxus* has few characters in common with *P. femoralis*, which it rivals in size. It is heavier and more robust than *femoralis* and different in many other ways. The type of '*P. latirostris*' Rhoads is slightly larger than any other specimen examined, but, in view of the variation shown in the group, the chances of its being even subspecifically distinct seem very slight. Specimens from Arizona and

western Texas are here referred to *paradoxus*, as they seem slightly nearer to that form than to *hispidus*.

Specimens examined.—Total number, 61, from localities as follows:

Arizona: Fort Huachuca, 1; San Bernardino Ranch, 2.
Colorado: Boulder County, 2; Sterling, 2.
Kansas: Colby, 1; Ellis, 2; Garden Plain, 1; Pendennis, 1; Trego County, 3.
Nebraska: Callaway, 1; Cherry County, 1; Myrtle, 2; Red Cloud, 1.
New Mexico: Las Vegas, 1; Roswell, 1.
Oklahoma: Alva, 11; Orlando, 3; Ponca, 1.
South Dakota: Corral Draw, Pine Ridge Indian Reservation, 8; Quinn Draw, Cheyenne River, 3; Smithville, 1.
Rocky Mountains: 1 (type of '*latirostris*').
Texas: Amarillo, 1; Marfa, 3; Presidio County, 1.
Chihuahua: Chihuahua, 1; Santa Rosalia, 2; Casas Grandes, 12.

PEROGNATHUS HISPIDUS ZACATECÆ subsp. nov. ZACATECAS POCKET MOUSE.

Type from Valparaiso, Zacatecas, Mexico. ♀ yg. ad., No. 91877, U. S. Nat. Mus., Biological Survey Coll. Collected December 16, 1897, by E. A. Goldman. Orig. No., 11968.

Distribution.—Upper Sonoran zone from Valparaiso, Zacatecas, to Celaya, Guanajuato, Mexico.

General characters.—Somewhat larger and darker-colored than *hispidus;* otherwise similar.

Color.—Much darker and more olivaceous than in *hispidus;* general color of upperparts between the hair-brown and olive of Ridgway; bases of hairs very dark plumbeous; lateral line pure ochraceous, well defined, slightly paler than in *hispidus;* spots at base of whiskers intensely black and very conspicuous; tail sharply black above; underparts white.

Skull.—As in *hispidus*, but somewhat larger.

Measurements.—Type: Total length, 211; tail vertebræ, 105; hind foot, 27.5. *Skull:* (See table, p. 62.)

Remarks.—This form seems to be related most nearly to *paradoxus* and, like it, inhabits the Upper Sonoran zone. Its dark olivaceous color makes it easily recognizable.

Specimens examined.—Total number, 10, from localities in Mexico, as follows:

Guanajuato: Celaya, 1.
Zacatecas: Valparaiso, 9.

PEROGNATHUS PENICILLATUS Woodhouse. DESERT POCKET MOUSE.

Perognathus penecillatus Woodhouse, Proc. Acad. Nat. Sci. Phila., 1852, 200.
Perognathus penicillatus Woodhouse, Sitgreaves Exp'd. Zuñi and Colorado River, 49, pl. 3, 1854; Merriam, N. Am. Fauna No. 1, 22, 1889.

Type locality.—San Francisco Mountain, Arizona.[1]

[1] Woodhouse does not specify exactly where the type was taken. It seems to have been between his camps 15 and 18, which were on the northeast side of the mountain. It is not unlikely that the type came from the Little Colorado Desert, a few miles farther to the northeast.

Distribution.—Vicinity of Colorado River, from Bunkerville, Nev., to Yuma, Ariz., where it meets the range of its subspecies *angustirostris*. The type is the only specimen known from the type locality. Lower Sonoran zone.

General characters.—Size rather large, about equal to *formosus;* tail long, heavily crested, penicillate; sole of hind foot naked to heel; ears scantily haired, shorter and rounder than in *formosus*, antitragus lobed; pelage rather soft; no spines on rump; color very uniform, markings almost obsolete.

Color.—Above, vinaceous buff very finely sprinkled with black; sides exactly like back; lateral line obsolete; subauricular spot present; face and cheeks like back except for a slight darkening under ears; no black spots at base of whiskers; ears outside like back, inside slightly dusky; tail white below to pencil, upper surface and pencil dusky brownish. In the 'left-over' winter pelage the general color is écru drab instead of vinaceous buff.

Skull.—Size medium or rather large; rostrum heavy and high; parietals somewhat flattened; mastoid side of parietal about equaling squamosal side, much exceeded by others; interparietal moderate, all angles rounded, especially posterior ones, anterior angle rounded but distinctly evident; ascending branches of supraoccipital quite heavy; audital bullæ widely separated anteriorly: lower premolar larger than last molar.

Measurements.—Average of four adults from bend of Colorado River, Nevada: Total length, 205; tail vertebræ, 109; hind foot, 25.5. *Skull:* (See table, p. 62.)

Remarks.—The members of the *penicillatus* group are true *Chætodipus*, but none of them have rump spines. Characters marking the typical form are large size, uniform color, subdued markings, and heavy skull. The skull of the type which is now available for examination does not agree perfectly with any of the series from the bend of the Colorado River. It is larger and heavier than these, the anterior part is much elevated, and the rostrum broad. These characters, however, are quite pronounced in the Colorado River specimens, and it seems safe to consider them *penicillatus*, even though no exact duplicates of the type are among them. Even the most northern of the Colorado River specimens is somewhat intermediate between true *penicillatus* and *angustirostris*.

Specimens examined.—Total number, 55, from localities as follows:

Arizona: Ehrenberg, 5; Harper Ferry, 3; Fort Mohave, 9; Norton, 4; San Francisco Mountain, 1 (type).

California: Mohave Mountains, 1.

Nevada: Bunkerville, 3; Colorado River, Lincoln County, 8; Colorado River, near Callville, 8; Vegas Valley, 13.

PEROGNATHUS PENICILLATUS ANGUSTIROSTRIS subsp. nov. California Desert Pocket Mouse.

Type from Carriso Creek, Colorado Desert, Cal. ♂ ad., No. 73881, U. S. Nat. Mus., Biological Survey Coll. Collected March 31, 1895, by A. W. Anthony. Orig. No., 22.

Distribution.—Colorado Desert; south to northern Lower California and east to the Colorado River and southwestern Arizona, where it meets the range of *penicillatus* and *pricei*. Lower Sonoran zone.

General characters.—Similar to *P. penicillatus*, but smaller; color about the same; skull lighter and with longer and more slender rostrum.

Color.—As in *P. penicillatus*.

Skull.—Similar in general to *P. penicillatus;* nasals and ascending premaxillæ long and narrow, much more slender than in *penicillatus;* interparietal averaging larger and more angular.

Measurements.—Type: Total length, 191; tail vertebræ, 105; hind foot (measured dry), 24.4. Average of five topotypes: Total length, 181; tail vertebræ, 103; hind foot, 24. *Skull:* (See table, p. 62.)

Remarks.—The numerous specimens of this subspecies which have been examined include many which are not strictly typical. This is true of the large series from the Colorado River at monument No. 204 and the several localities in the vicinity of Yuma, all of which tend in differing degrees toward true *penicillatus*. From Yuma eastward the tendency is toward *pricei*. The characters of small size and slender rostrum are very constant in the many specimens from the Colorado Desert, California.

Specimens examined.—Total number, 253, from localities as follows:

Arizona: Bradshaw City, 1; Gila City, 3; Yuma, 9.

California:[1] Agua Caliente, 3; Baregas Springs, 4; Carriso Creek, 15; Colorado Desert, 7; Coyote Wells, 3; Indian Wells, 1; Laguna, 5; Mexican Boundary monument No. 204, near Colorado River, 78; Palm Springs, 55; Salt Creek, 1; San Felipe Canyon, 6; Unlucky Lagoon, 9; Vallecitas, 10; Walters, 7; Whitewater, 2; Fort Yuma, 15.

Lower California: Gardner Lagoon, 5; Hardee River (head, near mouth of Colorado River), 2; Poso Vicente, 2; Seven Wells, 10.

PEROGNATHUS PENICILLATUS PRICEI (Allen). Price Pocket Mouse.

Perognathus pricei Allen, Bull. Am. Mus. Nat. Hist., N. Y., VI, 318, November, 1894.
Perognathus obscurus Allen, Bull. Am. Mus. Nat. Hist., N. Y., VII, 216, June, 1895.

Type locality.—Oposura, Sonora, Mexico.

Distribution.—South central Arizona and Northwestern Mexico, west of the Sierra Madre.

General characters.—Similar to *penicillatus*, but smaller; pelage

[1] Nearly all these localities are in the Colorado Desert.

harsher, no spines on rump; upperparts more strongly mixed with black; skull short and heavy.

Color.—Above, general effect drab or broccoli brown, produced by vinaceous buff strongly lined with black; sides like back, lateral line faintly evident; ears very scantily haired, same color as back; underparts white; tail bicolor, white below, dusky above.

Skull.—Size medium, much smaller than in *penicillatus;* rostrum short and heavy; nasal branches of premaxillæ barely exceeding nasals; interparietal moderately wide, anterior angle often obliterated; lower premolar larger than last molar. Contrasted with *penicillatus* the skull of *pricei* is much smaller, smoother, or less angular, and has very much shorter nasals. In comparison with *intermedius* it is heavier and less arched, the rostrum is broader, and the nasals are shorter, the mastoids are smaller, and the interparietal is narrower.

Measurements.—Average of seventeen adults from Hermosillo, Sonora, Mexico: Total length, 172.5; tail vertebræ, 92.8; hind foot, 22.3. *Skull:* (See table, p. 62.)

Remarks.—The type of *P. pricei* is very immature, but its skull shows characters amply sufficient to prove that it belongs to the *penicillatus* rather than the *intermedius* group. Although these groups inhabit the same general region and resemble each other so closely in superficial characters, the skulls are so markedly different as to indicate that they bear no close relation to one another. The only external difference is found in the rump spines. This is not to be relied upon absolutely, however, for though never present in *penicillatus* and its forms, they are sometimes, though very rarely, absent or undeveloped in *intermedius.* In local habitat the two also differ in an interesting way, *pricei* being found in sandy places, while *intermedius* prefers the rocks.

The extreme form of *pricei* is found in southern Sonora, where it is so different from typical *penicillatus* as to suggest full specific rank.

Specimens examined.—Total number, 187, from localities as follows:

Arizona: Calabasas, 6; Dos Cabezos, 1; Fairbank, 28; Fort Bowie, 2; Fort Huachuca, 1; Fort Lowell, 39; La Osa, 2; Mammoth, 12; New River, 5; Phœnix, 5; Santa Cruz River (west of Patayone Mountain), 3; Sentinel, 2; Tubac, 3; Tucson (twenty miles south), 3; Willcox, 6.

Sonora: Batomotal, 13; Hermosillo, 17; Magdalena, 6; Oposura, 8; Ortiz, 10; Quitobaquita, 10; Sonora, 1; Sonoyta, 4.

PEROGNATHUS PENICILLATUS EREMICUS (Mearns). Eastern Desert Pocket Mouse.

Perognathus (*Chætodipus*) *eremicus* Mearns, Bull. Am. Mus. Nat. Hist., N. Y., X, 300, August 31, 1898.

Type locality.—Fort Hancock, El Paso County, Tex.

Distribution.—Extreme western Texas, thence south into north

central Mexico east of the Sierra Madre at least to La Ventura, Coahuila.

General characters.—Size about equal to *pricei;* color slightly paler; pelage softer; nasals longer and more slender; skull otherwise peculiar.

Color.—Essentially as in *pricei*, but paler; general effect fawn lightly mixed with black; dark area below ears quite prominent; spot at base of whiskers faint.

Skull.—Similar to *pricei;* cranium somewhat arched; nasals long and slender; nasal branches of premaxillæ widened at extremities, extending much beyond nasals; supraoccipital slightly bulging behind.

Measurements.—Type: Total length, 163; tail vertebræ, 83; hind foot, 22.1. *Skull:* (See table, p. 62.)

Remarks.—The average difference between this eastern form of the *penicillatus* group and its western relative *pricei* is considerable. The long slender nasals and high arched skull of this form are never found in specimens from west of the Sierra Madre. Specimens from Chihuahua and Coahuila appear to be quite typical. *P. eremicus* differs from *pricei* much as *angustirostris* does from true *penicillatus.* In fact, its skull is not very unlike that of *angustirostris*, but the two are not likely to be confused, on account of the difference in size and color. Specimens from San Bernardino ranch, Arizona, are not typical, being dark-colored and otherwise intermediate.

Specimens examined.—Total number, 93, from localities as follows:

Arizona: San Bernardino Ranch, Cochise County, on Mexican boundary, 27.
Texas: El Paso, 5; Fort Hancock, 3.
Chihuahua: Ciudad Juarez, 2; Escalon, 1; Samalayuca, 3; Santa Rosalia, 24.
Coahuila: Jimulco, 1; La Ventura, 12; Torreon, 14.
Durango: Mapimi, 1.

PEROGNATHUS STEPHENSI Merriam. Stephens Pocket Mouse.

Perognathus stephensi Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, 267.

Type locality.—Mesquite Valley, northwest arm of Death Valley, Inyo County, Cal.

Distribution.—Known only from the type locality.

General characters.—Similar to *penicillatus;* size very much smaller; tail long, well crested; hind feet naked below; very little or no black in color.

Color.—'Left-over' winter pelage: Above, between pinkish buff and vinaceous buff; effect perfectly uniform, no traces of black anywhere; ears sparsely haired, same color as back; lateral line entirely obliterated; face slightly lighter than back and sides; below, white; tail below white, above like back. The post-breeding pelage is doubtless darker and may have more or less black in it.

Skull.—Size small; general form much like that of *penicillatus;*

cranium slightly arched; mastoids rather small; interparietal correspondingly large; ascending branches of supraoccipital relatively heavy; lower premolar very large, nearly twice as large as last molar.

Measurements.—Type: Total length, 177; tail vertebræ, 96; hind foot, 21. *Skull:* (See table, p. 62.)

Remarks.—P. stephensi is a miniature of *penicillatus* and but slightly larger than *arenarius.* It is at once separated from the former by its small size and from the latter by its cranial characters. Further collections from the desert region of California will doubtless yield more of this interesting species, but at present it is known only from the two specimens which Mr. Stephens caught in the extension of Death Valley known as Mesquite Valley.

Specimens examined.—Total number, 2, the type and one topotype.

PEROGNATHUS ARENARIUS Merriam. Little Desert Pocket Mouse.

Perognathus arenarius Merriam, Proc. Cal. Acad. Sci., 2d ser., IV, 461, September 25, 1894.

Type locality.—San Jorge, near Comondu, Lower California.

Distribution.—Known only from the type locality.

General characters.—Size very small; tail short, slightly exceeding head and body; pelage rather soft, no bristles anywhere; color plain and uniform, lateral line obsolete; skull short and broad.

Color.—Very similar to *penicillatus;* dorsum buffy drab, finely mixed with black; sides somewhat paler, lateral line not evident; ears dusky, a minute white spot on lower margins; underparts white; tail bicolor.

Skull.—Size very small; cranium slightly arched; interorbital and mastoid width relatively great; mastoids moderate, relatively larger than in *penicillatus;* interparietal broadly pentagonal; nasals rather slender, slightly emarginate at frontal endings; zygomata extremely frail and light; lower premolar larger than last molar.

Measurements.—Type (from dry skin): Total length, 136; tail vertebræ, 70; hind foot, 20. *Skull:* (See table, p. 62.)

Remarks.—P. arenarius is a very aberrant member of the *penicillatus* series. It is about the same color as *stephensi*, but differs from it in size and cranial details, such as more slender nasals, wider interorbital space, larger mastoids, and shorter premaxillæ. As far as known it is the smallest member of the subgenus *Chætodipus.*

Specimen examined.—The type.

PEROGNATHUS PERNIX Allen. Sinaloa Pocket Mouse.

Perognathus pernix Allen, Bull. Am. Mus. Nat. Hist., N. Y., X, 149, April, 1898.

Type locality.—Rosario, Sinaloa, Mexico.

Distribution.—Coast of western Mexico in the States of Sinaloa and Jalisco.

General characters.—Size small; tail rather long, thinly haired, slightly crested; colors dark; pelage slightly hispid, no spines or bristles anywhere; ears medium; feet naked below.

Color.—General color above, hair-brown, uniform over all parts above the lateral line; lateral line distinct, between pinkish buff and ochraceous buff; underparts soiled white; ears dusky, a minute white spot on inferior margins; tail brownish black above, whitish below.

Skull.—Size rather small; form narrow and elongate; mastoids quite small; interorbital space much constricted; nasals rather broad and flattened, of medium length; naso-frontal suture not emarginate; interparietal wide, somewhat produced anteriorly; posterior angles much rounded; molar teeth small and weak; lower premolar larger than last molar.

Measurements.—Average of four adult topotypes: Total length, 175; tail vertebræ, 97; hind foot, 22.3. *Skull:* (See table, p. 63.)

Remarks.—*Perognathus pernix* differs from other Mexican species in much smaller size. Its dark color, narrow interorbital space and long nasals distinguish it from all other *Chætodipus* not having rump spines.

Specimens examined.—Total number, 48, from localities in Mexico, as follows:

Sinaloa: Altata, 2; Culiacan, 17; Mazatlan, 11 (not typical); Rosario, 10.
Tepic: Acaponeta, 8.

PEROGNATHUS PERNIX ROSTRATUS subsp. nov. BROAD-NOSED POCKET MOUSE.

Type from Camoa, Rio Mayo, Sonora, Mexico. ♂ yg. ad., No. 95818, U. S. Nat. Mus., Biological Survey Coll. Collected October 28, 1898, by E. A. Goldman. Orig. No., 13167.

Distribution.—Coast plains of southern Sonora and northern Sinaloa, Mexico.

General characters.—Size, proportions, and general color about as in *P. pernix;* skull quite different.

Color.—Above, slightly lighter and grayer than *pernix;* general color oftener broccoli brown than hair-brown; facial area distinctly paler than back and sides; lateral line pinkish buff; lower parts soiled white.

Skull.—Similar to *pernix*, but shorter and broader; rostrum very heavy; nasals, premaxillæ, and premaxillary branches of zygomata all heavier than in *pernix;* nasals shorter; interorbital space wider; interparietal, mastoids, and audital bullæ not tangibly different.

Measurements.—*Type:* Total length, 162; tail vertebræ, 94; hind foot, 23.5. Average of four topotypes: Total length, 161; tail vertebræ, 88; hind foot, 22.5. *Skull:* (See table, p. 63.)

Remarks.—This form is quite a departure from *pernix*, but intergradation with that species is evidenced by a single specimen from

Sinaloa. The series of topotypes from Camoa are constant in their cranial differences from *pernix*, and though no external characters are evident the form seems well worth recognition.

Specimens examined.—Total number, 10, from localities in Mexico, as follows:

Sinaloa: Sinaloa, 1.
Sonora: Camoa, 9.

PEROGNATHUS INTERMEDIUS Merriam. Intermediate Pocket Mouse.

Perognathus intermedius Merriam, N. Am. Fauna No. 1, 18–19, 1889; ibid., No. 3, 74, 1890.
Perognathus obscurus Merriam, ibid., No. 1, 20–21, 1889.

Type locality.—Mud Spring, Mohave County, Ariz.

Distribution.—Known from several scattered localities in the Sonoran zone of Arizona, New Mexico, and northern Mexico.

General characters.—Size medium, smaller than *penicillatus;* color much darker, with well-defined markings; rump spines rather weak; skull rather small and light.

Color.—*Winter pelage:* Above, general effect drab, with a strong mixture of black on back and rump; sides paler than back; lateral line pale fawn, quite narrow; ears dusky; tail dusky above, becoming black toward pencil, whitish below, faintly buffy on sides; underparts white, with suggestions of buff.

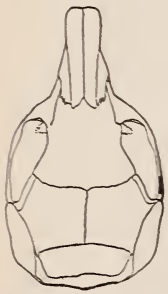


Fig. 12.—Skull of *Perognathus intermedius.*

Skull.—Size medium; cranium well arched; rostrum slender, somewhat depressed; interparietal very wide and strap-shaped, anterior angle normally obliterated, others but slightly rounded; lower premolar larger than last molar. Compared with *penicillatus* it is smaller and less angular; rostrum and nasals much more slender; zygomata more sloping; mastoids relatively larger and fuller; ascending branches of supraoccipital much lighter; interorbital space wider.

Measurements.—Average of four adults from the Grand Canyon of the Colorado, Arizona: Total length, 179.5; tail vertebræ, 102.7; hind foot, 22.7; ear from anterior base, 7. *Skull:* (See table, p. 62.)

Remarks.—Specimens of typical *intermedius* are not numerous at present, and the few that are available are in the winter pelage. This makes the determination of '*P. obscurus*' a little difficult. The latter is identical with *intermedius* in cranial characters, but slightly more ruddy in color.

P. intermedius is much rarer than *penicillatus*, some form of which is often found near it. In the vicinity of El Paso, Tex., Mr. Vernon Bailey collected both *intermedius* and *eremicus*, the one being found

in the rocks and the other in the sandy places. At other localities where both occur the same conditions seem to obtain.

Specimens examined.—Total number, 46, from localities as follows:

Arizona: Grand Canyon, 4; Harper Ferry, 1; Fort Bowie, 1; Fort Huachuca, 1; Little Colorado River, Painted Desert, 2; Mud Spring, 2; Willow Spring, 1.
New Mexico: Camp Apache, Grant County, 14.
Texas: Alpine, 1; El Paso, 2.
Chihuahua: Casas Grandes, 4; Chihuahua, 13.

PEROGNATHUS NELSONI Merriam. Nelson Pocket Mouse.

Perognathus nelsoni Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, 266.

Type locality.—Hacienda La Parada, San Luis Potosi, Mexico.

Distribution.—Upper and Lower Sonoran zone of central Mexico, covering the table-land from Inde, Durango, south to Lagos, Jalisco, and east to Jaumave, Tamaulipas.

General characters.—Similar to *intermedius*, but larger, darker, and harsher pelaged; tail heavily crested; rump bristled.

Color.—Above, general effect hair-brown; hairs dark plumbeous, basally followed by a narrow grayish fawn zone and a heavy black tip; sides like back, orbital region scarcely lighter; lateral line fawn, well defined; underparts dirty whitish; ears dusky, slightly hoary on margins; tail bicolor, black above, whitish below. Worn pelage much paler, becoming drab or ecru drab.

Skull.—Similar to *intermedius*, but larger and heavier, rostrum and nasals particularly so; interparietal smaller; nasal branches of premaxillæ exceeding nasals; ascending branches of supraoccipital heavy.

Measurements.—Average of ten adults from the type locality: Total length, 182; tail vertebræ, 104; hind foot, 23; ear from anterior base, 8. *Skull:* (See table, p. 62.)

Remarks.—This is the commonest pocket mouse of Mexico. It is found in suitable localities over the entire table-land. It is closely related to *intermedius* and possibly intergrades with it. There are some slight variations in the species, but none are marked enough to warrant separation.

Specimens examined.—Total number, 65, from localities in Mexico, as follows:

Aguas Calientes: Chicalote, 5.
Coahuila: Jimulco, 1; La Ventura, 1; Sierra Encarnacion, 1.
Durango: Durango City, 10; Inde, 3; Mapimi, 1.
Jalisco: Lagos, 9.
San Luis Potosi: Hacienda La Parada, 19; Jesus Maria, 3.
Zacatecas: Berriozabal, 9; Cañitas, 1; Hacienda San Juan Capistrano, 1; Valparaiso Mountains, 1.

PEROGNATHUS NELSONI CANESCENS (Merriam). Gray Pocket Mouse.

Perognathus intermedius canescens Merriam, Proc. Acad. Nat. Sci. Phila., September 27, 1894, 267.

Type locality.—Jaral, Coahuila, Mexico.

Distribution.—Known only from the type locality.

General characters.—Size larger than *intermedius;* color much paler and more grayish; skull similar to that of *P. nelsoni.*

Color.—General color of upperparts drab gray; lateral line pinkish buff, rather narrow; underparts pure white; tail bicolor, mouse gray above, white below.

Skull.—Similar to that of *nelsoni;* differs in more slender nasals, constricted interorbital space, and slightly smaller mastoids.

Measurements.—Type: Total length, 193; tail vertebræ, 117; hind foot, 22. One topotype: Total length, 184; tail vertebræ, 105; hind foot, 22. *Skull:* (See table, p. 63.)

Remarks.—This form seems to be quite localized. Its habitat is similar to that of the other members of the group. The type and cotypes were caught in the cliffs of a rocky canyon.

Specimens examined.—Total number, 3, from the type locality.

PEROGNATHUS GOLDMANI sp. nov. Goldman Pocket Mouse.

Type from Sinaloa, Sinaloa, Mexico. ♀ ad., No. 96673, U. S. Nat. Mus., Biological Survey Coll. Collected February 15, 1899, by E. A. Goldman. Orig. No., 13428.

Distribution.—Coast plains of northern Sinaloa and southern Sonora, Mexico.

General characters.—Size large; tail moderately long and heavily crested; pelage somewhat hispid, rump with a few short bristles; ears relatively large, much larger than those of *nelsoni;* antitragal lobe prominent, wider at base than at apex; in color and markings similar to *nelsoni;* skull relatively large and heavy.

Color.—Similar in general to *nelsoni;* general color across shoulders and anterior portion of upperparts, broccoli brown; posterior half of dorsum much darkened by admixture of black; lateral line pinkish buff; ears blackish with hoary margins, externally whitish for distal half; subauricular spot present; tail sharply bicolor, blackish above, white below.

Skull.—Size large, much heavier than in *nelsoni;* mastoids somewhat smaller and more ridged; nasals much larger and heavier; skull noticeably higher and not so wide posteriorly, thus making the zygomata more nearly parallel.

Measurements.—Type: Total length, 202; tail vertebræ, 108; hind foot, 28. Average of five topotypes: Total length, 202; tail vertebræ, 112; hind foot, 28; ear from anterior base, 11. *Skull:* (See table, p. 63.)

Remarks.—The large orbicular ears of this species easily distinguish

it from *nelsoni*, its nearest relative. It is one of the several forms peculiar to western Mexico, and, like the others, its known range is quite limited. Specimens from Camoa and Alamos are slightly smaller than those from Sinaloa.

Specimens examined.—Total number, 36, from localities in Mexico, as follows:

Sinaloa: Sinaloa, 7.
Sonora: Alamos, 18; Camoa, 11.

PEROGNATHUS ARTUS sp. nov. Batopilas Pocket Mouse.

Type from Batopilas, Chihuahua, Mexico. ♀ ad., No. 96298, U. S. Nat. Mus., Biological Survey Coll. Collected October 6, 1898, by E. A. Goldman. Orig. No., 13090.

Distribution.—Known only from a few scattered localities in western Mexico.

General characters.—Externally similar to *goldmani;* rump bristles weak or undeveloped; skull distinctive.

Color.—As in *goldmani*.

Skull.—Similar to that of *goldmani*, but smaller and narrower; mastoids much smaller with more strongly marked transverse ridges; audital bullæ smaller; nasals moderate, exceeded by ascending premaxillæ; interparietal nearly elliptical, slightly produced anteriorly; zygomata nearly parallel.

Measurements.—Average of five adult topotypes: Total length, 191; tail vertebræ, 106; hind foot, 24.6. *Skull:* (See table, p. 63.)

Remarks.—The large size of this species at once distinguishes it from *pernix* and *rostratus*, and its very small mastoids separate it from other Mexican species. Externally it is very similar to *goldmani*, but it has less prominent rump bristles; in fact, they are not at all evident in the majority of specimens. *P. pernix* was generally found by Mr. Goldman at the same localities as *P. goldmani*, but at Culiacan he found it in company with *P. artus*.

Specimens examined.—Total number, 15, from localities in Mexico, as follows:

Chihuahua: Batopilas, 8.
Durango: Chacala, 3.
Sinaloa: Culiacan, 4.

PEROGNATHUS FALLAX Merriam. Short-eared California Pocket Mouse.

Perognathus fallax Merriam, N. Am. Fauna No. 1, 19, 1889; Allen, Bull. Am. Mus. Nat. Hist., N. Y., V, 184, 1893.

Type locality.—Reche Canyon, 3 miles southeast of Colton, San Bernardino County, Cal.

Distribution.—Extreme southwestern California, occupying the region west of the San Bernardino and San Jacinto ranges and extending south into northern Lower California.

General characters.—Size medium, somewhat larger than *intermedius;* general color similar but darker; wider and brighter lateral line; rump bristles heavier; tail long and crested; ears moderate.

Color.—Above, general effect bister, middle of back and rump with a strong element of black; lateral line and subterminal zone of hairs of upperparts pinkish buff; underparts creamy white; ears dusky on inflexed portions, hoary on inner sides; tail bicolor.

Skull.—Similar to *intermedius;* cranium arched; nasals slender; mastoids rather large and full; interparietal wide, anterior angle slightly developed; naso-frontal suture slightly or not emarginate.

Measurements.—Average of six adults from the type locality: Total length, 192; tail vertebræ, 11; hind foot, 23; ear from anterior base, 9. *Skull:* (See table, p. 63.)

Remarks.—This species falls readily into the small group typified by *intermedius.* It differs from the other members in size, color, and shape of interparietal. It has been much confused with *femoralis* on account of its similar color, but its much smaller ear is a convenient external character for distinguishing it. Two specimens from Turtle Bay, Lower California, are similar in color to *anthonyi*, but cranially the same as *fallax*, to which they are here referred.

Specimens examined.—Total number, 120, from localities as follows:

California:[1] Ballenas, 1; Bergmann, Riverside County, 1; Carlsbad, 1; Chihuahua Mountains, 1; Dulzura, 24; El Nido, 3; Encinitas, 1; Herron, San Bernardino County, 5; Jacumba, 8; Lajolla, 1; Mountain Spring, 11; Radec, 5; Reche Canyon, Riverside County, 10; Riverside, Riverside County, 1; Rose Canyon, 10; San Felipe Valley, 4; San Pasqual Valley, 4; Santa Ysabel, 10; San Ygnacio Valley, 1; Summit (Coast Range), San Bernardino County, 4; Temescal, Riverside County, 1.

Lower California: Cape Colnett, 2; Ensenada, 1; Gato Creek, 1; Jamul Creek, 1; San Isidro Ranch, 2; Sanos Cedros, 1; San Quintin Bay, 1; Tia Juana, 2; Turtle or San Bartolome Bay, 2.

PEROGNATHUS ANTHONYI sp. nov. Cerros Island Pocket Mouse.

Type from South Bay, Cerros Island, Lower California. ♀ ad., No. 81058, U. S. Nat. Mus., Biological Survey Coll. Collected July 29, 1896, by A. W. Anthony. Orig. No., 71.

Distribution.—Known only from the type locality.

General characters.—Similar in general to *P. fallax;* differing in slightly smaller size, more ruddy color, and cranial characters.

Color.—Above, grayish fawn mixed with black; lateral line brownish fawn, poorly defined; ears dusky; white subauricular spot present; tail dusky above, whitish below.

Skull.—Similar to *P. fallax;* cranium less arched; rostrum heavier; mastoids smaller; interparietal smaller and shorter; zygomatic breadth greater anteriorly.

[1] Most of these localities, unless otherwise stated, are in San Diego County.

Measurements.—Type: Total length, 168; tail vertebræ, 92; hind foot, 23.5. *Skull:* (See table, p. 63.)

Specimens examined.—One, the type.

PEROGNATHUS FEMORALIS Allen. GREAT CALIFORNIA POCKET MOUSE.

Perognathus femoralis Allen, Bull. Am. Mus. Nat. Hist., N. Y., III, 281, June 30, 1891; Rhoads, Proc. Acad. Nat. Sci. Phila., 1893, 407.

Type locality.—Dulzura, San Diego County, Cal.

Distribution.—Known from a few localities in San Diego County, in extreme southern California, and the adjoining part of Lower California.

General characters.—Size very large; tail long, heavily crested penicillate; color dark; ears large and elongate; pelage harsh; rump and flanks furnished with strong bristles or spines; skull large and heavy.

Color.—Similar to *fallax*, but quite intensified; above, general color bister, hairs heavily tipped with intense black; lateral line rich pinkish buff; underparts dirty whitish, sometimes washed or flecked with buffy; tail bicolor.

Skull.—Large and heavy; less arched than in *fallax;* rostrum and nasals much heavier; mastoids relatively smaller; molar teeth relatively weaker; interparietal subquadrate, rarely developing a fifth angle; naso-frontal suture slightly emarginate.

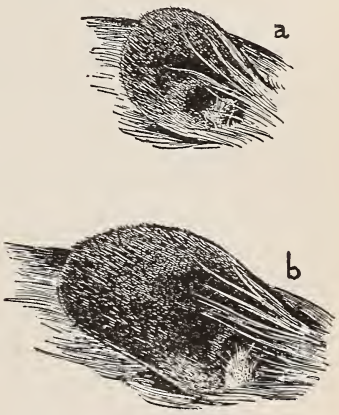


FIG. 13.—Ear of (a) *Perognathus fallax;* (b) *Perognathus femoralis.*

Measurements.—Average of six adults from the type locality: Total length, 223; tail vertebræ, 126; hind foot, 27.5; ear from anterior base, 12. *Skull:* (See table, p. 63.)

Remarks.—This species has the longest tail and largest hind foot found in the genus, but its body is light in comparison with that of *paradoxus.* In color it has a remarkable resemblance to *fallax*, which is found within its range, but its large size, long ears, and heavy skull are amply sufficient to distinguish it.

Specimens examined.—Total number, 60, from localities as follows:

California (**San Diego County**): Dulzura, 32; Santa Ysabel, 9; Twin Oaks, 16.

Lower California: Nachoguero Valley, 3.

PEROGNATHUS CALIFORNICUS Merriam. California Pocket Mouse.

Perognathus californicus Merriam, N. Am. Fauna No. 1, 26, 1889; Allen, Bull. Am. Mus. Nat. Hist., N. Y., 263, 1896; Elliott, Field Columbian Mus., Zool. Ser., I, No. 10, 211, 1898.

Perognathus armatus Merriam, l. c., 27.

Type locality.—Berkeley, Cal.

Distribution.—Vicinity of San Francisco Bay and south to Bear Valley, San Benito County, where it meets the range of its subspecies *dispar*.

General characters.—Similar to *P. femoralis*, but smaller; about equal in size to *fallax;* ears quite elongate; rump and flanks well supplied with bristles; skull very peculiar.

Color.—Nearly the same as *femoralis*, much darker than *fallax;* general effect of upperparts bister; hairs pale plumbeous basally, darkening distally; subterminal zone pinkish buff followed by heavy black tips; tail bicolor; underparts and feet yellowish white.

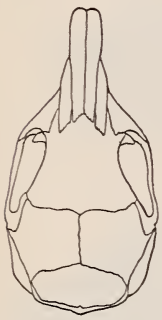


Fig. 14.—Skull of *Perognathus californicus.*

Skull.—Size medium; cranium considerably arched; mastoids exceedingly small; mastoid width greatly reduced; occiput bulging greatly; interparietal about twice as broad as long, anterior angle very slightly developed; naso-frontal suture deeply emarginate or V-shaped; lower premolar slightly larger than last molar.

Measurements.—Average of five adults from the type locality: Total length, 192; tail vertebræ, 103; hind foot, 24; ear from anterior base, 10.5. *Skull:* (See table, p. 63.)

Remarks.—*P. californicus* is remarkable for its very small mastoids. It has no close relation to *fallax*, with which it has sometimes been confused. Its long ears and its cranial characters indicate that its closest affinities are with *femoralis*. Even within its very limited range it is quite a rare animal, and but few specimens are in collections.

Specimens examined.—Total number, 18, from localities as follows:

California: Berkeley, 7; Bear Valley, San Benito County, 2; Gilroy, 3; Portola, San Mateo County, 2; Stanford University, 2.

PEROGNATHUS CALIFORNICUS DISPAR subsp. nov. Allen Pocket Mouse.

Type from Carpenteria, Santa Barbara County, Cal. ♂ ad., No. $\frac{32116}{43928}$, U. S. Nat. Mus., Biological Survey Coll. Collected December 19, 1891, by E. W. Nelson. Orig. No., 1655.

Distribution.—Coast valleys of California from San Bernardino to San Benito County and north along the foothills of the west slope of the Sierras to Placer County.

General characters.—Larger and paler colored than *californicus;* pelage somewhat softer; skull quite different.

Color.—Similar to *fallax*, paler than *californicus* or *femoralis;* above, general color bister; facial area slightly lightened; lateral line pinkish buff, sometimes approaching ochraceous buff; underparts buffy white; tail bicolor.

Skull.—Similar to that of *californicus*, but larger and heavier; in general form resembling that of *femoralis;* mastoids quite small; nasals heavy, somewhat elongate; interorbital space narrow.

Measurements.—Type: Total length, 218; tail vertebræ, 120; hind foot, 27. Average of six typical adults: Total length, 210; tail vertebræ. 117; hind foot, 26; ear from anterior base, 12. *Skull:* (See table, p. 63.)

Remarks.—Although this subspecies is somewhat intermediate in character between *californicus* and *femoralis* there seems to be no good evidence of any connection with the latter. It intergrades with *californicus* in the vicinity of Bear Valley, San Benito County. In typical form, its skull presents the characters of small mastoids and narrow interorbital space found in *californicus* at the same time almost attaining the large size of the skull of *femoralis.*

Specimens examined.—Total number, 56, from localities as follows:

California: Auburn, 1; Bitter Water, 3; Carpenteria, 4; Fort Tejon, 2; Hueneme (10 miles west), 1; Kern River (25 miles above Kernville), 1; Las Virgines Creek, Los Angeles County, 1; Milo, 1; Nordhoff, 4; Raymond, 1; San Bernardino Peak, 3; San Emigdio, 4; San Fernando, 3; San Luis Obispo, 8; San Simeon, 1; Santa Monica, 1; Santa Paula, 1; Three Rivers, 9; Ventura River, 7.

PEROGNATHUS SPINATUS Merriam. Spiny Pocket Mouse.

Perognathus spinatus Merriam, N. Am. Fauna No. 1, 21, October 25, 1889.

Type locality.—Twenty-five miles below the Needles, Colorado River, California.

Distribution.—Desert region of southern California and northern Lower California.

General characters.—Size medium, tail moderately long and crested; ears small and orbicular; pelage hispid, spines large and prominent on rump, scattered on flanks and sides and often extending to shoulders; lateral line very faint or wanting.

Color.—Above, general effect drab brown; hairs plumbeous basally, ecru drab subterminally and black-tipped; sides and orbital region slightly paler than back; underparts buffy white; lateral line generally faint, in very bright pelage showing as a slender line of ecru drab; ears dusky, subauricular spot small; tail hair-brown above, whitish below; spines white with dusky tips, except on sides where the tips are also white. Many of the hairs of the back often end with a

broad zone of ecru drab without the usual black tip. These, when combined with those having black tips, cause a peculiar mottled appearance. The 'left-over' winter pelage is much paler and grayer, the general effect being pale drab.

Skull.—Size medium; cranium rather slender and much flattened; parietals on nearly same plane as interparietal; mastoids small, not so full as in *fallax* and *intermedius;* interparietal broad but normally with slight evidence of an anterior or fifth angle; supraorbital ridge slightly trenchant; lower premolar about equal to last molar.

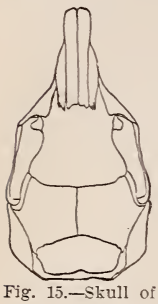


Fig. 15.—Skull of *Perognathus spinatus.*

Measurements.—Average of five adults from Palm Springs, Cal.: Total length, 181; tail vertebræ, 101; hind foot (measured dry), 21.5. *Skull:* (See table, p. 63.)

Remarks.—*Perognathus spinatus* has a limited range, and aside from the excellent series from Palm Springs in the Bangs collection but few specimens have found their way into collections. It is the type of the subgenus *Chætodipus* and the representative of a small group quite distinct from all others. Young adults of this group differ from old in being of a grayish color and in having weaker and less numerous spines. In juveniles the first pelage is soft and without spines, which do not appear until an entire new pelage is acquired. In this species, as in most others, the males average slightly larger than the females.

Specimens examined.—Total number, 46, from localities as follows:

California: Colorado River (twenty-five miles below Needles), 1 (type); Coast Range, San Diego County, 3; La Puerta, San Diego County, 6; Palm Springs, 21; San Felipe Canyon, 12; Vallecitas, San Diego County, 2.
Lower California: Cocopah Mountains, 1.

PEROGNATHUS SPINATUS PENINSULÆ Merriam. Cape St. Lucas Pocket Mouse.

Perognathus spinatus peninsulæ Merriam, Proc. Cal. Acad. Sci., 2d ser., IV, 460, September 25, 1894.

Type locality.—San Jose del Cabo, Lower California.

Distribution.—Cape region of Lower California.

General characters.—Similar to *P. spinatus,* but much larger; pelage a trifle more hispid; tail more scantily haired and relatively shorter; ears large and rounded.

Color.—As in *P. spinatus.*

Skull.—Similar to that of *P. spinatus,* but averaging much larger; supraorbital ridges flattened and shelf-like, with very trenchant edges, forming a nearly straight line from mastoids to lachrymals.

Measurements.—Average of five adults from San Jose del Cabo and Cape St. Lucas: Total length, 188; tail vertebræ, 101; hind foot, 24. *Skull:* (See table, p. 63.)

Specimens examined. Total number, 23, from localities as follows:

Lower California: Cape St. Lucas, 7; Comondu, 2 (intermediate); San Jose del Cabo, 5; Santa Anita, 9.

PEROGNATHUS BRYANTI Merriam. BRYANT POCKET MOUSE.

Perognathus bryanti Merriam, Proc. Cal. Acad. Sci., 2d ser., IV, 458, September 25, 1894.

Type locality.—San Jose Island, Lower California.

Distribution.—Known only from the type locality.

General characters.—Larger and longer-tailed than *peninsulæ;* skull slightly characterized; otherwise similar.

Color.—Apparently as in *peninsulæ.*

Skull.—Slightly larger and heavier than in *peninsulæ;* somewhat more elongate; nasals longer and more slender; interparietal wide and subquadrate; lower premolar equal to or slightly larger than last molar.

Measurements.—*Type:* Total length, 216; tail vertebræ, 127; hind foot, 25. One adult topotype: Total length, 225; tail vertebræ, 128; hind foot, 25. *Skull:* (See table, p. 63.)

Remarks.—This insular form is well characterized by its large size and long tail. In color it is probably the same as *peninsulæ,* though the material examined is not sufficient to determine with certainty.

Specimens examined.—Total number, 8, all from the type locality.

PEROGNATHUS MARGARITÆ Merriam. MARGARITA POCKET MOUSE.

Perognathus margaritæ Merriam, Proc. Cal. Acad. Sci., 2d ser., IV, 459, September 25, 1894.

Type locality.—Santa Margarita Island, Lower California.

Distribution.—Known only from the type locality.

General characters.—Size medium; tail longer than head and body; ears moderate; pelage rather harsh, rump and flanks with a few bristles; skull peculiar.

Color.—Above, much as in *spinatus,* pale fawn mottled and lined with hair-brown and black; lateral line scarcely evident; subauricular spot present, but very small; underparts and feet dirty white.

Skull.—Size rather small; cranium somewhat arched; mastoids exceedingly small, fully as small as in *californicus;* nasals moderate, naso-frontal suture emarginate; occiput not projecting posteriorly; interparietal wide, anterior angle evident, others very much rounded; interorbital space moderate, about as in *californicus;* lower premolar larger than last molar.

Measurements.—*Type* (from dry skin): Total length, 180; tail vertebræ, 102; hind foot, 22.5. *Skull:* (See table, p. 63.)

Remarks.—So far as known, this species has no near relative on the mainland adjacent to its habitat. In cranial characters it seems to be

somewhat similar to *californicus*, while externally it is a combination of *fallax* and *spinatus*.

Specimen examined.—The type.

Cranial measurements of Perognathus.

[All measurements are in millimeters.]

Species.	Locality.	Basilar length of Hensel.[1]	Occipito-nasal length.	Greatest mastoid breadth.	Length of interparietal.	Greatest width of interparietal.	Interorbital width at narrowest point.	Length of nasals.	Number of specimens averaged.
Perognathus fasciatus	Tilyou ranch, Mont	16.5	23	11.8	.....	4.3	.....	.....	3
P. f. infraluteus	Loveland, Colo	15.4	21.8	11.7	.....	4.8	.....	.....	3
P. flavescens	Kennedy, Nebr	15.1	22.1	11.6	.....	4.8	.....	.....	3
P. merriami	Brownsville, Tex	14.8	20.4	11.2	2.3	3.6	.....	.....	4
P. m. gilvus	Eddy, N. Mex	15	20.7	11.7	2.2	3.3	4.7	7.5	2
P. flavus	El Paso, Tex	14.6	21	12	2.6	2.9	.....	.....	1
P. flavus	Fort Huachuca, Ariz	14.5	20.3	11.7	2.4	2.8	.....	.....	4
P. f. bimaculatus	Fort Whipple, Ariz	15.9	21.6	13	2.5	3.1	4.5	7.6	3
P. apache	Keams Canyon, Ariz	16.3	23	13	2.9	4	5	8.6	4
P. apache melanotis[2]	Casas Grandes, Chihuahua, Mexico.	15.3	21.5	11.8	2.8	4.3	5	8	1
P. callistus	Kinney ranch, Wyo	16	22.9	13	2.8	4.6	4.8	8.2	1
P. panamintinus	Panamint Mountains, California.	14.9	21.4	11.9	2.5	3.5	5.2	8.3	3
P. p. brevinasus	San Bernardino, Cal	14.2	20.1	11.8	3	3.8	5	7.1	3
P. nevadensis	Halleck, Nev	14.8	20.6	12	2.2	3.7	5.2	8.2	2
P. pacificus[2]	Edge of Pacific Ocean, Mexican boundary.	13	19	11	2.2	3.4	4.9	7	1
P. longimembris	Fresno, Cal	17.5	23.6	13	3	3.8	4.8	9.2	3
P. amplus[2]	Fort Verde, Ariz	16.8	23.6	13.9	3	3.3	5	9.2	1
P. parvus	Mabton, Wash	17.6	25.1	13	3.1	5.4	.....	.....	5
P. p. olivaceus	Salt Lake City, Utah	17.6	.....	12.6	3.7	4.9	.....	.....	4
P. p. magruderensis	Mount Magruder, Nev	19.1	27	13.6	3.1	4.8	.....	.....	4
P. p. mollipilosus	Fort Crook, Cal	17.8	25.3	12.8	3.1	5.1	.....	.....	3
P. alticola	San Bernardino Mts., Cal	18	25.4	12.6	3.2	4.6	.....	.....	2
P. lordi	Oroville, Wash	18.7	26.7	13.6	3.3	4.7	.....	.....	5
P. l. columbianus	Pasco, Wash	18.6	25.9	14.1	3.1	4.1	.....	.....	4
P. formosus	St. George, Utah	18.6	26.7	14	3.7	5.8	6.6	10.4	3
P. baileyi	Magdalena, Mexico	21.5	30	15.6	4.2	6.8	6.8	12.2	3
P. hispidus	Mier, Mexico	20.2	28	13.8	4.1	7.2	7	10.6	3
P. h. paradoxus	Kansas and Nebraska	24	32	15	4.7	8	7.5	13.2	3
P. h. zacatecæ[2]	Valparaiso Mountains, Mexico.	22.5	30.2	15	4	8	7	12	1
P. penicillatus[2]	Little Colorado Desert, Arizona.	20	28.3	14.5	3.5	6.9	6.8	10	1
P. penicillatus	Colorado River, near Callville, Nev.	19.5	27.8	13.4	3.2	7.6	6.6	10.8	3
P. p. angustirostris	Carriso Creek, California	18	26	13	3.1	7	6.4	10.3	3
P. p. pricei	Oposura, Sonora, Mexico	18.4	26	13	3.4	6.7	6.2	9.4	3
P. p. eremicus[2]	Fort Hancock, Tex	17.5	.....	12.6	3	7	6.4	9.8	1
P. stephensi[2]	Mesquite Valley, California	16	22.7	12	3	6.7	6	9	1
P. arenarius[2]	San Jorge, Lower California	15.3	23	12	3.5	6.4	6.2	8.8	1
P. intermedius[2]	Mud Spring, Ariz	17	24.5	13.5	3	8	6.3	9.4	1
P. nelsoni	La Parada, Mexico	18	26	13.8	3.5	7.6	6.7	10	3

[1] See note, p. 14.

[2] Type.

Cranial measurements of Perognathus—Continued.

[All measurements are in millimeters.]

Species.	Locality.	Basilar length of Hensel.	Occipito-nasal length.	Greatest mastoid breadth.	Length of interparietal.	Greatest width of interparietal.	Interorbital width at narrowest point.	Length of nasals.	Number of specimens averaged.
P. n. canescens[1]	Jaral, Coahuila, Mexico	17.5	25	13.5	3.7	7.2	6.1	9.3	1
P. goldmani	Sinaloa, Sinaloa, Mexico	20.6	27.7	14.3	3.8	7.4	6.5	11.1	3
P. artus	Batopilas, Chihuahua, Mexico.	18.8	25.4	12.4	3.3	7.1	6.1	9.7	3
P. fallax	Reche Canyon, California	18	26	14	3.8	7.8	6.6	10	3
P. anthonyi[1]	Cerros Island, Lower California.	17.4	25.4	12.9	2.6	5.8	6	10.2	1
P. femoralis	Dulzura, Cal	20.3	29.6	14.3	4	8.1	7.1	11.4	3
P. californicus	Berkeley, Cal	18.9	27.4	13	4.4	8.1	6.4	10.2	3
P. c. dispar	Carpenteria, Cal	19.8	28	13.1	4	8.3	6.5	11.2	3
P. spinatus	Palm Springs, Cal	17	24.3	12.3	3.4	7.7	6.2	9.4	4
P. s. peninsulæ	San Jose del Cabo, Lower California.	18	26.5	13	3.7	7.6	6.6	9.8	4
P. bryanti	San Jose Island, Lower California.	18.9	27.3	13.1	3.5	8.1	6.8	10.3	3
P. margaritæ[1]	Margarita Island, Lower California.	18	25.9	12	3.7	8	6.5	10.3	1
P. pernix	Rosario, Sinaloa, Mexico	17.4	24.4	12.2	3.3	7.2	5.4	9.2	3
P. p. rostratus	Camoa, Sonora, Mexico	16.5	22.7	11.7	3.4	7	5.5	8.6	3

[1] Type.

INDEX.

[Names of new species in **black-face** type, synonyms in *italics*.]

PLATE I.

[One and one-half times natural size.]

FIG. 1. *Perognathus flavus* Baird. Topotype. El Paso, Tex. (No. 25029, U. S. Nat. Mus.)

2. *Perognathus amplus* Osgood. Type. Fort Verde, Ariz. (Type No. 46711, U. S. Nat. Mus.)

3. *Perognathus merriami* Allen. Topotype. Brownsville, Tex. (No. 41764, U. S. Nat. Mus.)

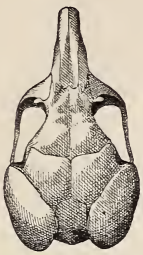
4. *Perognathus flavus bimaculatus* (Merriam). Topotype. Fort Whipple, Ariz. (No. 46478, U. S. Nat. Mus.)

5. *Perognathus* (*Chætodipus*) *californicus* Merriam. Topotype. Berkeley, Cal. (No. 55560, U. S. Nat. Mus.)

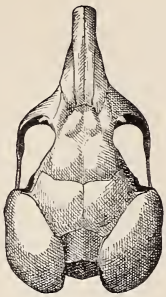
6. *Perognathus* (*Chætodipus*) *pernix* Allen. Topotype. Rosario, Sinaloa, Mexico. (No. 91324, U. S. Nat. Mus.)

7. *Perognathus* (*Chætodipus*) *penicillatus* Woodhouse. Type. Near San Francisco Mountain, Ariz. (Type No. 2676, U. S. Nat. Mus.)

8. *Perognathus* (*Chætodipus*) *pernix rostratus* Osgood. Type. Camoa, Sonora, Mexico. (Type No. 95818, U. S. Nat. Mus.)

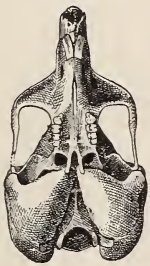


1

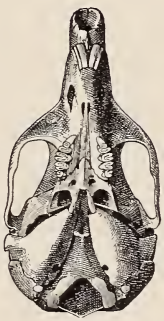


2

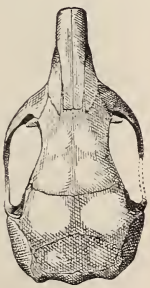
3



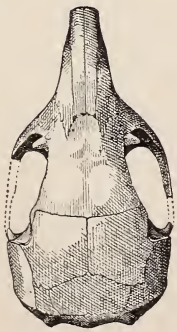
4



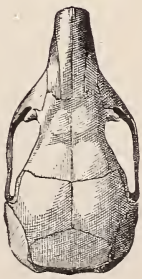
5



6



7



8

SKULLS OF PEROGNATHUS.

1. *Perognathus flavus.*
2. *P. amplus.*
3. *P. merriami.*
4. *P. flavus bimaculatus.*
5. *P.* (*Chætodipus*) *californicus.*
6. *P.* (*Chætodipus*) *pernix.*
7. *P.* (*Chætodipus*) *penicillatus.*
8. *P.* (*Chætodipus*) *pernix rostratus.*

PLATE II.

[One and one-half times natural size.]

FIG. 1. *Perognathus panamintinus* (Merriam). Type. Panamint Mountains, Cal. (Type No. 39866, U. S. Nat. Mus.)

2. *Perognathus lordi columbianus* (Merriam). Type. Pasco, Wash. (Type No. 39450, U. S. Nat. Mus.)

3. *Perognathus nevadensis* Merriam. Topotype. Halleck, Nev. (No. 54565, U. S. Nat. Mus.)

4. *Perognathus* (*Chætodipus*) *bryanti* Merriam. Type. San Jose Island, Lower California, Mexico. (No. 550, Coll. Calif. Acad. Sci.)

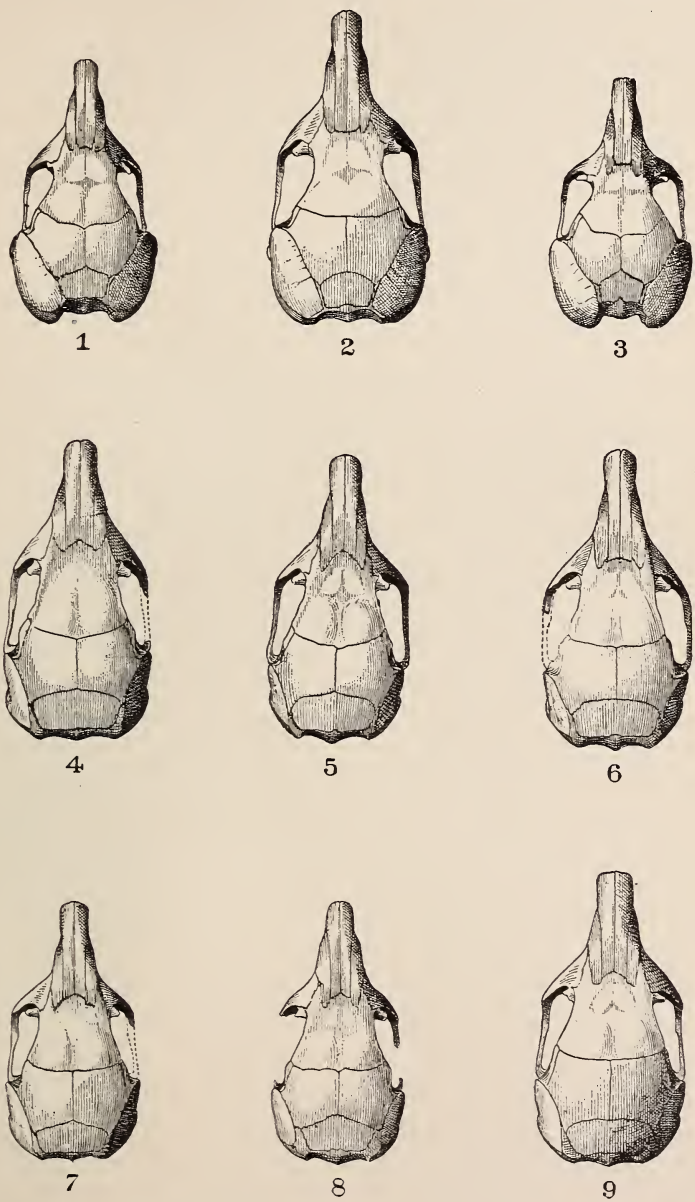
5. *Perognathus* (*Chætodipus*) *margaritæ* Merriam. Type. Santa Margarita Island, Lower California, Mexico. (No. 90, Coll. Calif. Acad. Sci.)

6. *Perognathus* (*Chætodipus*) *spinatus peninsulæ* Merriam. Type. San Jose del Cabo, Lower California, Mexico. (No. 274, Coll. Calif. Acad. Sci.)

7. *Perognathus* (*Chætodipus*) *arenarius* Merriam. Type. San Jorge, near Comondu, Lower California, Mexico. (No. 99, Coll. Calif. Acad. Sci.)

8. *Perognathus* (*Chætodipus*) *stephensi* Merriam. Topotype. Mesquite Valley, Cal. (No. 39874, U. S. Nat. Mus.)

9. *Perognathus* (*Chætodipus*) *nelsoni* Merriam. Type. Hacienda La Parada, San Luis Potosi, Mexico. (Type No. 50214, U. S. Nat. Mus.)

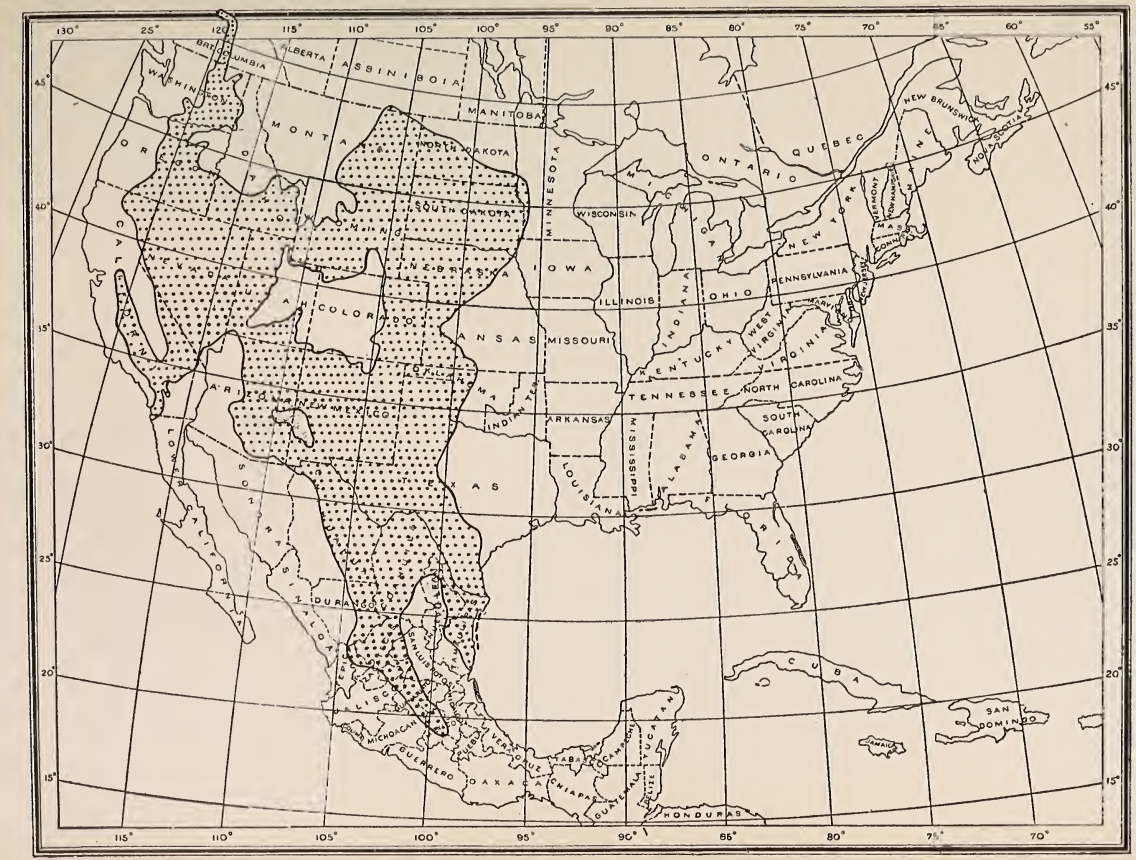


SKULLS OF PEROGNATHUS.

1. *Perognathus panamintinus.*
2. *P. lordi columbianus.*
3. *P. nevadensis.*
4. *P. (Chætodipus) bryanti.*
5. *P. (Chætodipus) margaritæ.*
6. *P. (Chætodipus) spinatus peninsulæ.*
7. *P. (Chætodipus) arenarius.*
8. *P. (Chætodipus) stephensi.*
9. *P. (Chætodipus) nelsoni.*

PLATE III.

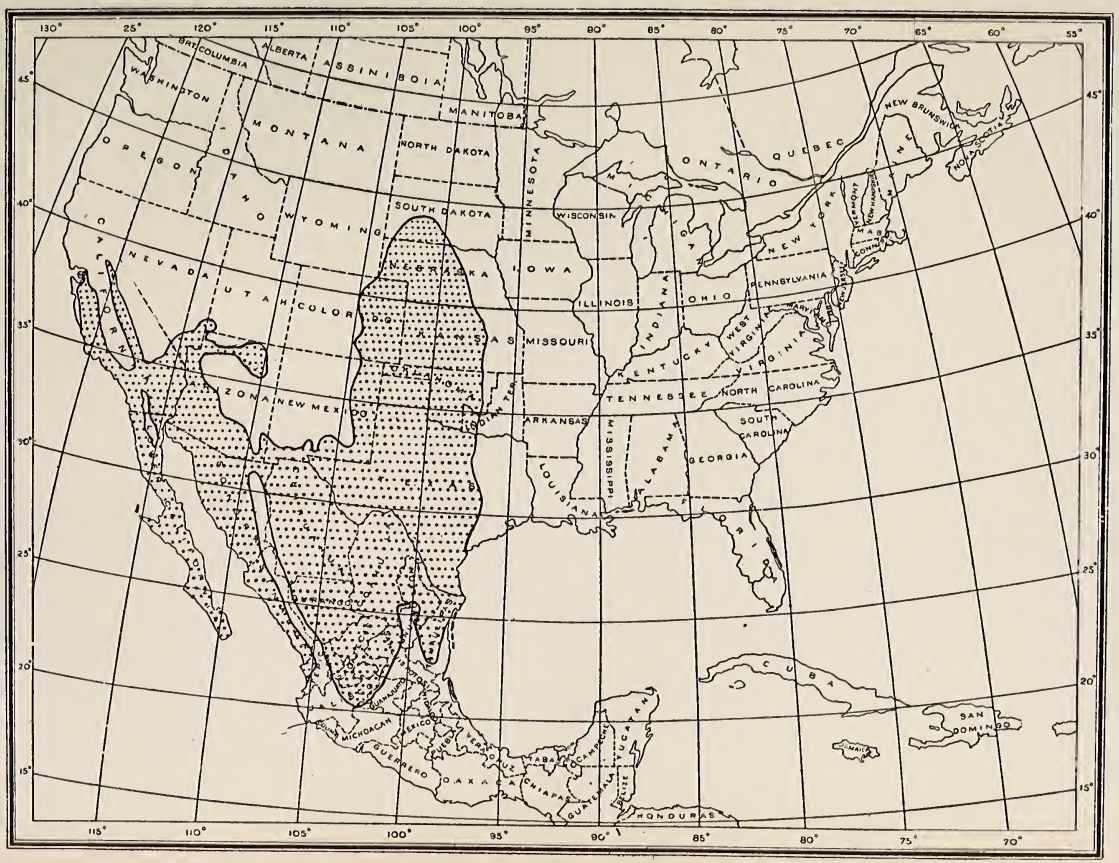
Map showing distribution of the subgenus *Perognathus*.



MAP SHOWING DISTRIBUTION OF THE SUBGENUS PEROGNATHUS.

PLATE IV.

Map showing distribution of the subgenus *Chætodipus*.



MAP SHOWING DISTRIBUTION OF THE SUBGENUS CHÆTODIPUS.

CONTENTS OF NORTH AMERICAN FAUNA.

All applications for Nos. 1-5, 8, and 10-17 should be addressed to the Superintendent of Documents, Union Building, Washington, D. C.

Remittances should be made by postal money order or express money order, *not* by postage stamps or private check.